

# Clinical Trial Results – Acute Management

ESOC-0520

## 01. Clinical Trial Results – Acute Management Calculator for the likelihood of adverse events of patients in stroke trials: An online tool to improve safe recruitment in clinical trials

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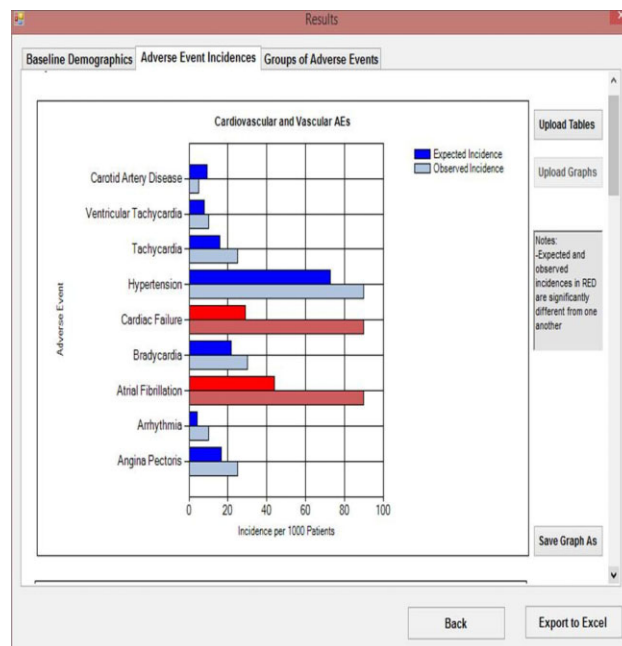
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**Background:** Knowing characteristic adverse events (AEs) and their incidence among patients participating in past acute stroke trials (*Stroke*. 2014;45:2677–2682) may assist recruitment of patients in future studies. We aimed to develop an online tool to inform stroke trial safety.

**Methods:** We identified relevant AEs from patients within the acute trial database, the Virtual International Stroke Trials Archive (VISTA), using receiver operating characteristic principles. We modeled the incidence of these events as a function of patient age, baseline NIHSS score and co-morbidities using binary logistic regression. Models with R-squared value greater than five percent,  $R^2 > 5\%$ , were deemed powerful enough to predict expected AE incidences in future trials and were included. The calculator was developed using both R and Visual Studio development tools.

**Results:** Forty-eight of the most common AEs in acute stroke trials were identified and incorporated into the Adverse Event Stroke Score Calculator. The calculator, which will be available at [www.vistacollaboration.org](http://www.vistacollaboration.org), calculates the expected incidence of AEs or groups of AEs per 1000-patients in a trial cohort and where possible compares these proportions to the observed incidence (Fig. 1).

**Conclusions:** The Adverse Event Stroke Score Calculator is an open access resource to support recruitment and safety interpretation in acute stroke trials. Prediction of AEs with higher likelihood of occurrence may facilitate implementation of preventive clinical measures.



**Fig. 1** Results window, comparing the expected and observed incidences of cardiovascular AEs from a mock dataset. Red bars denote a significant difference ( $p < 0.05$ ).

ESOC-0351

## 01. Clinical Trial Results – Acute Management Thrombus load and bridging intravenous thrombolysis are independent predictors for endovascular recanalization in ischemic stroke with proximal vessel occlusion

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**Background:** Appropriate patient selection for endovascular revascularization treatment (ERT) in acute ischemic stroke is important for a good benefit-risk ratio. Given that recanalization is a major determinant of good functional outcome, we aimed to identify independent predictors for recanalization after ERT.

**Methods:** We did a retrospective analysis of consecutive stroke patients with distal ICA-, proximal MCA- or T-occlusion who were treated with ERT from 2006 to 2012. We assessed admission noncontrast CT and CT angiography for thrombus location, thrombus load (clot burden score, CBS) and collateral status. Clinical data were extracted from medical charts. Univariate and multivariate regression analyses were performed to identify predictors of recanalization ( $TICI \geq 2b$ ) after ERT.

**Results:** 171 patients were identified (70.9 ± 12.3 years, 103 females). 34 (20%) underwent intravenous thrombolysis before ERT. 50 (29%) had intraarterial thrombolysis, 54 (32%) mechanical thrombectomy, and 67 (39%) a combination of both; stent retrievers were used in 64 patients (37.4%). Overall recanalization rate was 66.1% and 9.9% had symptomatic intracranial bleeding. In-hospital mortality was 11.7% and 40% reached good functional outcome at discharge. Univariate analysis revealed thrombus location, bridging intravenous thrombolysis, combined endovascular approaches, good collateral status, continuous CBS and dichotomized CBS ≥ 6 vs <6 as predictors for recanalization. In multivariate regression analysis, bridging intravenous thrombolysis prior to ERT, and dichotomized CBS ≥ 6 vs <6 were identified as independent predictors for recanalization.

**Conclusion:** Bridging intravenous thrombolysis and lower thrombus load increased the rate of recanalization after ERT for ischemic stroke with proximal vessel occlusions.

## ESOC-0352

### 01. Clinical Trial Results – Acute Management Passes of thrombectomy as an independent predictor for functional outcome after endovascular treatment in ischemic stroke with proximal vessel occlusion

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**Background:** Outcome after endovascular revascularization treatment (ERT) in acute ischemic stroke depends on admission NIHSS, age, degree of recanalization, and time to reperfusion. There is still insufficient knowledge about periprocedural parameters predicting clinical outcome, however. We aimed to identify clinical and radiological predictors for favorable outcome after ERT in acute ischemic stroke.

**Methods:** 171 consecutive stroke patients (70.9 ± 12.3 years, 103 female) with distal ICA-, proximal MCA- or T-occlusion were treated with acute ERT within 6 hours after symptom onset from 2006 to 2012. We retrospectively assessed clinical data, admission CT and periprocedural parameters. We performed univariate and multivariate logistic regression analyses to predict favorable outcome (mRS ≤ 2) at discharge from hospital.

**Results:** ERT consisted in intraarterial thrombolysis (29%), mechanical thrombectomy (32%) or a combination of both (39%). 64 patients (37.4%) were treated with stent retrievers and 34 (20%) received intravenous thrombolysis before ERT. Overall recanalization rate (TIMI 2b/3) was 66.1%. 40% reached good functional outcome at discharge. 9.9% had symptomatic intracranial bleeding, 11.7% died. Univariate analysis identified atherosclerotic stroke mechanism, recanalization as positive predictors and more proximal vessel occlusion, increasing passes of thrombectomy, longer time to treatment, longer intervention time and higher admission NIHSS as negative predictors for favorable outcome. In multivariate analysis lower admission NIHSS, shorter onset-to-treatment time, less device passes, recanalization, and atherosclerotic etiology were associated with better outcome.

**Conclusion:** Lower number of passes during thrombectomy is an independent predictor for favorable outcome after ERT. Patients requiring multiple passes and long intervention times may benefit less from this procedure.

## ESOC-0384

### 01. Clinical Trial Results – Acute Management Relationship between nitrate-headache and functional outcome in patients with acute stroke: Results from the efficacy of nitric oxide in stroke trial

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**Introduction:** Nitrate-induced headache is common and may signify vaso-responsive cerebral vasculature. Stroke recurrence was reduced in patients with dipyridamole headache in the PROFESS mega-trial. We assessed the relationship between glyceryl trinitrate (GTN), headache and outcome in acute stroke.

**Methods:** ENOS randomized 4011 patients with acute stroke to receive GTN or control for 7 days. Headache was assessed at day 7, and functional outcome at day 90. Data are number (%); odds ratio (OR), hazard ratio (HR) or mean difference (MD); and 95% confidence intervals.

**Results:** Headache was more common by day 7 in patients randomized to GTN (360/1996, 18.0%) compared to control (170/2004, 8.5%) ( $p < 0.001$ ). Nitrate headache was associated with: younger age, female, higher diastolic blood pressure, non-TACS diagnosis, absence of dysphasia, and less neurological impairment ( $p < 0.05$ ). In adjusted analyses, patients with a GTN headache were less likely to die or deteriorate by day 7 (OR 0.45, 95% CI 0.25–0.82,  $p = 0.009$ ), die in hospital (OR 0.44, 0.22–0.88,  $p = 0.02$ ), or be dead at day 90 (HR 0.64, 0.40–1.02,  $p = 0.062$ ); had better scores on the Barthel Index (MD 14.0, 10.2 to 17.7,  $p = 0.025$ ), mini mental state examination ( $p = 0.002$ ), Telephone Interview of Cognitive Status ( $p = 0.003$ ), and category fluency (animal naming,  $p = 0.007$ ); no differences were seen for the modified Rankin Scale or stroke recurrence.

**Discussion:** Nitrate-induced headache is associated with reduced death or deterioration, disability and cognitive impairment at day 90.

## ESOC-0954

### 01. Clinical Trial Results – Acute Management

#### Effects of blood pressure and blood pressure lowering treatment within 24 hours in the third International Stroke Trial of thrombolytic treatment for acute ischemic stroke

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**Background:** A high blood pressure (BP) is a common reason for withholding thrombolytic treatment. We have studied the impact of BP and BP lowering treatment in patients included in the Third International Stroke Trial (IST-3).

**Methods:** IST-3 randomized 3.035 patients with ischemic stroke to thrombolytic treatment or control. BP was measured at randomization, before start, and at 30 minutes, 1 hour and 24 hours after start of treatment, and use of BP lowering treatment during the first 24 hours was recorded. We characterized BP by mean systolic BP at baseline, systolic BP variability, and change in systolic BP from baseline to 24 hours.

**Results:** Higher baseline BP and higher BP variability were associated with higher numbers of early adverse events, early deaths, and poor functional outcome at 6 months. A larger fall in BP, and use of BP lowering treatment were both associated with lower numbers of early adverse events (except early recurrent ischemic stroke), and with a significantly reduced risk of poor outcome ( $p = 0.002$  and  $0.006$ , respectively), irrespective of whether or not the patient received thrombolytic treatment.

**Conclusions:** Higher baseline BP and higher BP variability seem to be associated with a poorer prognosis, whereas a larger fall in BP and use of BP lowering treatment seem to be associated with a better prognosis. Agents that lower BP or reduce BP variability should be tested further to determine whether current guidelines for treatment of BP in the hyper-acute phase of ischemic stroke are too conservative.

## ESOC-1357

### 01. Clinical Trial Results – Acute Management

#### The effect of intra-arterial treatment in older patients with acute ischemic stroke

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**Introduction:** Outcome after stroke in older patients is often poor. We investigated the effect of intra-arterial treatment (IAT) in older patients in the MR CLEAN study, a randomized controlled trial of IAT versus no IAT in patients with acute ischemic stroke and a confirmed intracranial occlusion who could be treated within 6 hours from onset of symptoms.

**Methods:** We compared the effect of treatment in patients aged 80 years or over versus less than 80 years. We used multivariable ordinal logistic regression to assess treatment effect and the interaction between age and treatment. All estimates were adjusted for prespecified prognostic factors; stroke severity at baseline, time onset symptoms to randomization, diabetes mellitus, previous stroke, atrial fibrillation and ICA-T occlusion.

**Results:** We included 500 patients of which 81 (16%) were 80 years or older. These patients more often suffered from atrial fibrillation, hypertension and myocardial infarction. The overall treatment effect was significant in patients under 80 years (acOR 1.67, 95% CI: 1.78 to 2.36) and in patients 80 years or over (acOR 3.27, 95% CI: 1.24 to 8.67). We found no interaction of age with treatment ( $p = 0.87$ ). The absolute increase in chance of good outcome (mRS 0–2) ranged from 21% at 20 to 7% at 90 years of age.

**Conclusion:** Advanced age is not a contra-indication for intra-arterial treatment, although the absolute treatment effects and chances of good functional outcome decrease with increasing age.

## ESOC-0342

### 01. Clinical Trial Results – Acute Management

#### Thrombolysis for minor ischemic stroke with proven acute symptomatic occlusion using TNK-TPA (TEMPO-1)

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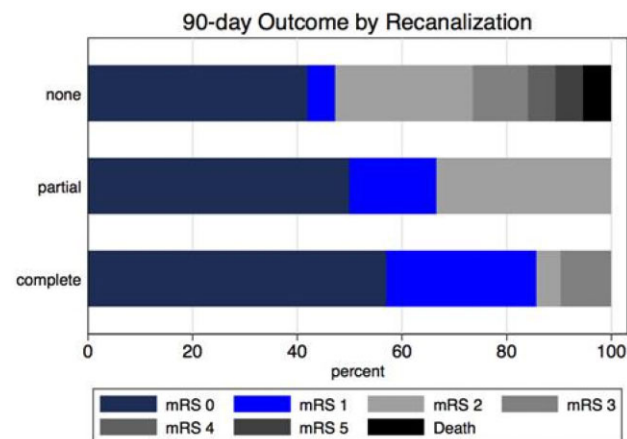
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**Background and Purpose:** Minor stroke and TIA with an intracranial occlusion are associated with neurological deterioration and disability. Tenecteplase (TNK-tPA) compared to alteplase is easier to administer, has

a longer half-life, higher fibrin specificity, possibly a lower rate of intracranial hemorrhage and may be an ideal thrombolytic agent in this population.

**Methods:** TEMPO-1 was a multi-center, prospective, uncontrolled, TNK-tPA dose-escalation, safety and feasibility trial. Patients with an NIHSS  $\leq$  5 within 12h of symptom onset, intracranial arterial occlusion on CTA and absence of well-evolved infarction were eligible. Fifty patients were enrolled; 25 patients at a dose of 0.1 mg/kg, and 25 patients at 0.25 mg/kg. Primary outcome was the rate of drug related serious adverse events. Secondary outcomes included recanalization and 90-day neurological outcome (mRS 0–1).

**Results:** Median baseline NIHSS was 2.5 (IQR 1) and median age was 71 years (IQR: 22). There were no drug related serious adverse events in tier 1. In tier 2 there was 1 symptomatic ICH (4%, 95% CI: 0.01–20.0). Stroke progression occurred in 6% of cases. Overall, 66% had excellent functional outcome (mRS 0–1) at 90-days. Recanalization rates were high; 0.1 mg/Kg (39% complete, 17% partial), 0.25 mg/Kg (52% complete, 9% partial). Complete recanalization was significantly related to excellent functional outcome (mRS 0–1) at 90-days (RR 1.65; CI95 1.09–2.5,  $p = 0.026$ ).



**Conclusion:** Administration of TNK-tPA in minor stroke with intracranial occlusion is both feasible and safe. A larger randomized controlled trial is needed to prove that this treatment is efficacious.

**ESOC-1463**

**01. Clinical Trial Results – Acute Management  
Plaque ulceration is associated with symptomatic carotid artery disease**

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**Introduction:** Prophylactic carotid endarterectomy (CEA) in patients with carotid stenosis can prevent long-term stroke. Indication for operation is currently clinical judgment based on severity of stenosis. The benefit of the operation could be increased if one could identify high-risk plaque prior to surgery. Plaque ulceration might be one feature identified on routine non-invasive imaging. We assessed the association between recent symptoms and features of high-risk plaque by post-operative histology.

**Methods:** This is a prospective observational study over a one-year period in a central London joint neurovascular HASU. Patients with carotid stenosis were reviewed at a neurovascular MDT and where referred for CEA. All plaques underwent routine AHA grading including histological analysis for: calcification, lipid core, thrombus, intra-plaque hemorrhage and thin fibrous cap ulceration.

**Results:** 85 patients had histology available for analysis. Average age was 74 years; 73 had recent symptoms and 12 asymptomatic carotid stenosis. Preoperative imaging included 82 duplex, 64 CTA and 21 MRA. Average stenosis was 71% (s.d. 14.1), 37 patients had moderate stenosis of 50–70%. Only one patient had a moderate risk plaque (AHA grade IV), 26 (30%) had very high-risk plaques (grade VI) the remainder all being high risk (grade V). The distribution was similar in symptomatic severe stenosis, symptomatic moderate stenosis and asymptomatic stenosis. Ulceration was more common in symptomatic patients (43% v 8%  $P = 0.02$ ). **Conclusion:** Patients with symptomatic carotid stenosis are more likely to have plaque ulceration. Current selection criteria for CEA did not identify those patients more likely to have a high-risk plaque.

**ESOC-1335**

**01. Clinical Trial Results – Acute Management  
Does subcutaneous interleukin-1 receptor antagonist reduce inflammation following subarachnoid hemorrhage?**

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**Design:** An open-labeled, single-blinded, randomized controlled study.

**Subjects:** 136 patients with confirmed sSAH.

**Objectives:** Determination of the effects of SC IL-1Ra.

**Methods:** Patients were randomized to IL-1Ra or control. 100 mg SC IL-1Ra in treatment group was first administered within 72 hours of confirmed ictus and then twice daily for up to 21 days (or discharge). Plasma inflammatory markers were measured in both groups at baseline, between day 3–8, 14 and 21 post ictus. Safety was checked at day 30 and Glasgow Outcome score measured at 6 months. Outcomes were area under curve (AuC) for plasma IL-6 (primary) and other inflammatory markers from day 3 to day 8 and clinical outcome.

**Results:** 123 patients (mean age 52 yrs, 27 male) provided sufficient data for primary analysis. Median IL-6 at baseline was 7.6 pg/ml and 10.0 pg/ml in controls and treated respectively. By Day 3 corresponding figures were 8.6 pg/ml and 4.7 pg/ml, dropping to 6.8 pg/ml and 2.8 pg/ml by Day 8. IL-6 AuC was significantly lower in the treated group ( $p < 0.0001$ ). Results for secondary outcomes will also be presented.

**Conclusions:** These are preliminary results. If confirmed, this clinical trial will provide the anticipated proof of efficacy for the use of SC IL-1Ra to dampen IL-1 mediated inflammation following SAH. It will inform a phase III trial of SC IL-1Ra in patients with SAH.

## ESOC-0438

**01. Clinical Trial Results – Acute Management**  
**The effects on cerebral perfusion of induced**  
**hypertension during delayed cerebral ischemia:**  
**A randomized clinical trial**

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*Introduction:* Induced hypertension is often used to treat delayed cerebral ischemia (DCI) after aneurysmal subarachnoid hemorrhage (aSAH), but evidence on effectiveness is lacking.

*Aim:* To investigate the effect of induced hypertension in treatment of DCI on cerebral perfusion as initial stage in a phase III randomized clinical trial.

*Methods:* Patients with an aSAH and occluded aneurysm who developed clinical signs of DCI were randomized to either induced hypertension or no induced hypertension. Hypertension was induced with noradrenaline. Cerebral perfusion was assessed with CT-perfusion as CBF (ml/100 g/s) in predefined regions on two time points: 1) at time of clinical deterioration and 2) 24–36 hours after randomization. Mean arterial blood pressure (MAP) was measured continuously in the hypertension-group and at least every four hours in the no hypertension-group. CBF was assessed by observers who were blinded for treatment allocation. Change in CBF was compared between groups using the Mann-Whitney U test. Informed consent was asked after admission; randomization was done at time of clinical deterioration.

*Results:* The average MAP was 111 (SD 6.73) in the hypertension-group (n = 12) and 100 (SD 6.28) in the no hypertension-group (n = 12, P < 0.001). Delta median CBF was -2.01 ml/100 g/s (IQR -11.40 to 19.55) in the hypertension-group and -4.78 ml/100 g/s (IQR -25.32 to 12.45) in the no hypertension-group, P = 0.67.

*Conclusions:* Induced hypertension does not improve CBF as measured by CT-perfusion. Given the size of change in CBF in both groups, it is unlikely that a larger number of patients will result in clinically relevant differences in CBF.

## ESOC-0910

**01. Clinical Trial Results – Acute Management**  
**Angiographic success and complications within the**  
**endovascular arm of the SWIFT PRIME trial**

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*Background:* The superiority of the newer generation of endovascular devices over previous devices is well established. However it is important to update evaluations of the technical efficacy of these devices including quality of recanalization and the number and nature of complications from the procedure. The current study provides a detailed analysis of the catheter angiographic outcomes using the Solitaire revascularization device within the endovascular arm of a multicenter, international, randomized trial.

*Methods:* The SWIFT PRIME trial is an RCT comparing IVtPA versus IVtPA + endovascular treatment using the Solitaire FR or Solitaire 2 devices. The trial was put on hold after enrollment of 196 patients over 39 sites by the DSMB. Use of suction either through a balloon guide catheter or through a distal access catheter in conjunction with the Solitaire device was recommended. All angiographic images were centrally adjudicated by a core lab regarding quality of reperfusion (TICI scale), quality of recanalization (AOL scale), and presence of angiographic complications. The number and size of device deployments was documented. Presence of intracranial hemorrhage subsequent to the procedure was documented and whether this was likely due to a complication from the angiographic procedure was centrally adjudicated by two experts.

*Results:* Shall be presented at the meeting.

*Conclusion:* The findings will provide insight into the technical success and complication rate of Solitaire FR device for endovascular treatment of stroke in multiple centers in the United States and Europe.

**ESOC-1192**

**01. Clinical Trial Results – Acute Management  
The need for speed: Workflow analysis within the endovascular arm of the ESCAPE trial**

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**Background:** The importance of speed of treatment of ischemic stroke ('time is brain') is well known. Previous data from published RCTs further suggest the importance of time efficiency of recanalization of the occluded vessel. Based on the inclusion criteria of the ESCAPE trial, CT to first reperfusion time has to be possible within 90 minutes. The current study provides a detailed analysis of time/reperfusion outcome relationship and workflow within the endovascular arm of the trial.

**Methods:** The ESCAPE trial is a PROBE design, randomized controlled trial which was stopped at an interim analysis by the DSMB for efficacy. At the time of the trial being stopped a total of 315 patients were enrolled. Patients were randomized 1:1 to standard of care versus standard of care + fast endovascular recanalization using modern devices such as stentriever.

The data will be analyzed for the following work flow time processes: Onset to ESCAPE treating hospital; door to CT; CT to randomization, randomization to groin puncture, groin puncture to first reperfusion and first reperfusion to final reperfusion. 3. Major causes of treatment delay and proportions of endovascular arm subjects meeting the various workflow time processes set out in the trial will be determined.

**Results:** To be presented at the meeting.

**ESOC-1322**

**01. Clinical Trial Results – Acute Management  
Ordinal analysis of vascular events in the Scandinavian Candesartan Acute Stroke Trial (SCAST)**

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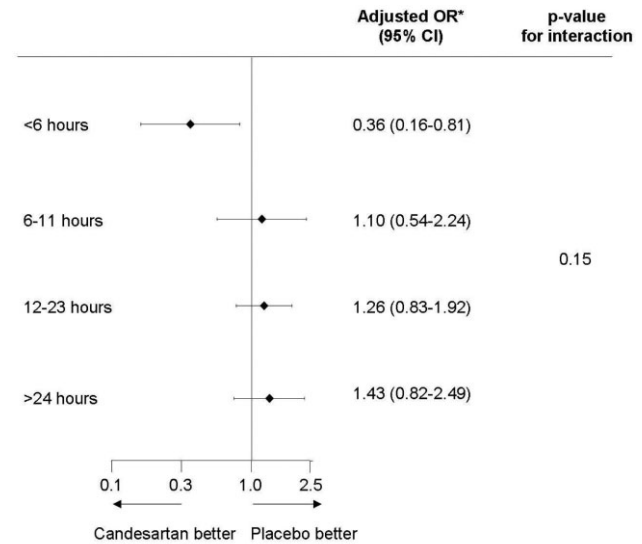
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**Background:** Early blood pressure lowering treatment seems to be beneficial in patients with acute intracerebral hemorrhage, and possibly in ischemic stroke. We used a new method for analysis of vascular events in the Scandinavian Candesartan Acute Stroke Trial (SCAST).

**Methods:** SCAST was a randomized- and placebo-controlled trial of candesartan within 30 hours of ischemic or hemorrhagic stroke. Of 2029 included, 231 patients (11.4%) had a vascular event (stroke, myocardial infarction, or vascular death) during the first 6 months. The modified Rankin Scale (mRS) score at six months was used to categorize vascular events in order of severity: "no event" (n = 1798), "minor" (mRS 0–2, n = 53), "moderate" (mRS 3–4, n = 46) and "major event" (mRS 5–6, n = 132). We used ordinal logistic regression for analysis.

**Results:** Candesartan had no effect on vascular events (adjusted common OR 0.94, 95% CI 0.62–1.43, p = 0.77), which is comparable to the result from the primary analysis using conventional Cox regression (HR 1.09, 0.84–1.41, p = 0.52). The results in subgroups were also comparable to those in the primary analysis, i.e. the effects were the same in ischemic and hemorrhagic stroke, and the effect of treatment within 6 hours was not significantly better than at other time intervals (p-value for interaction 0.15, Fig. 1).

**Conclusion:** The result of ordinal analysis was comparable to that of the conventional analysis, that there was no effect of candesartan on vascular events. Ordinal analysis of vascular events is possible, and can be used in future trials.



\*Adjusted for age, Scandinavian Stroke Scale score and systolic blood pressure.

**ESOC-0897**

**01. Clinical Trial Results – Acute Management  
Improving time to reperfusion within the ESCAPE Endovascular Clinical Trial**

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**Background:** Endovascular treatment of acute ischemic stroke is more effective with faster treatment of acute stroke. The ESCAPE RCT with 22 global sites, aimed to demonstrate the benefit of endovascular treatment compared to the current standard of care. A key differentiating feature of this trial is a focus on fast treatment times for the endovascular arm.

**Methodology:** An *audit and feedback* intervention using teleconference and webinar is used to improve time from CT to reperfusion through the course of the trial. The intervention is studied using a nested prospective cohort study within the ESCAPE RCT. The main measures for the ESCAPE trial are CT to groin puncture (target = 60 min) and CT to first reperfusion (target = 90 min). Using a supportive coaching approach, the audit and feedback comprised of a webinar immediately followed by an emailed letter. Reduction in the measures over time is assessed.

**Results:** There were 165 endovascular cases enrolled. Audit and feedback was performed on 16 of the top recruiting sites, and three sites had a

second cycle performed. Each webinar was 30 minutes in duration. The mean attendance rate by each site at the webinar was 5.3. The CT to puncture and CT to reperfusion time showed a linear and steady decline over the course of the trial. Discussions during the webinar included: pre-notification and preparing team ahead of patient's arrival; standard procedures; and efficient processes for after-hour.

**Conclusion:** By embedding an audit and feedback approach within an RCT, improvements over time can be achieved for treatment times.

## ESOC-0475

### 01. Clinical Trial Results – Acute Management Enrollment yield and reasons for screen failure in a large, phase 3 prehospital trial of paramedic delivery of a potential neuroprotective agent

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**Background:** Enrolling patients in the field is a promising strategy to facilitate entry of subjects in acute stroke trials within the first hours after onset. The enrollment yield and reasons for screen failure in prehospital stroke trials have not been well delineated.

**Method:** The Field Administration of Stroke Therapy – Magnesium (FAST-MAG) trial identified patients for enrollment using a two stage screening process – paramedics in person followed by physician-investigators by cellphone. Outcomes of consecutive screening calls from paramedics to enrolling physician-investigators were prospectively recorded.

**Results:** From 2005 to 2013, 4,458 phone calls were made by paramedics to physician-investigators. A total of 1,700 (38.1%) calls resulted in enrollments. Among the 2,758 patients not enrolled, 3,140 reasons for screen failure were documented. The most common reasons for non-enrollment were: more than 2 hours from last known well (16.6%), having a prestroke condition causing disability (15.9%), and absence of a consent provider (9.5%). Novel barrier to enrollment specific to the prehospital setting were infrequent, but included: cellphone connection difficulties (3.0%), insufficient time to complete consent (1.3%), and competent patient being hard of hearing (1.3%) or severely dysarthric (1.2%). The rate of enrollment of cerebrovascular mimics was low, 3.9%.

**Conclusions:** In this large, multicenter prehospital trial, nearly two of every five calls from the field to physician-investigators resulted in trial enrollments. The most common reasons for non-enrollment were out of

window last known well time, prestroke confounding medical condition, and absence of a consent provider.

## ESOC-1106

### 01. Clinical Trial Results – Acute Management Pseudoaneurysms in cervical artery dissection: Results from a multicenter randomized trial – Cervical Artery Dissection in Stroke Study (CADISS)

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**Introduction:** Cervical artery dissection is a major cause of ischemic stroke in patients aged <50. The sub-intimal or sub-adventitial tear results in intramural hematoma with thrombus and/or pseudo-aneurysm. Pseudoaneurysms are common, but why they occur in some patients is unknown. There are limited data on whether they relate to future risk and whether antiplatelets or anticoagulants are more appropriate treatments for patients with pseudoaneurysms.

**Method:** Cervical Artery Dissection in Stroke Study randomized 250 patients with extracranial internal carotid artery (ICA) and vertebral artery (VA) dissection to antiplatelets or anticoagulants, 97 patients ineligible for randomization were recruited to non-randomized arm. Patients were randomized to anti-platelets or anti-coagulants for 3 months. Neuroimaging was performed using standard clinical dissection protocols at baseline, vascular imaging was performed at 3 months. All neuroimaging was centrally reviewed by an experienced consultant neuroradiologist.

**Results:** Dissection was confirmed radiologically in 267(80%) (198 randomized, 69 non-randomized). 23/267 (8.6%) patients had pseudoaneurysms at baseline. Pseudoaneurysms were present in 13% ICA and 6% VA dissections. 249 patients had adequate 3 month neuroimaging of whom 36 (14.5%) had pseudo-aneurysms at 3 months. At 3 months, pseudoaneurysms seen at baseline had resolved in 12/23 (52%), but in 25 (10%) a new pseudoaneurysm had occurred. Initial results of CADISS are available in Feb 2015, we will present a first analysis determining (1) Factors associated with pseudoaneurysms and their resolution and effect of antiplatelets/anticoagulants,(2) Recurrent stroke risk in patients with pseudoaneurysm and effects of antiplatelets or anticoagulants.

**Conclusion:** Overall 20% of patients developed pseudoaneurysm at baseline or 3 months. CADISS will provide new data on factors involved in their development and how they relate to recurrent stroke.

## ESOC-1052

### 01. Clinical Trial Results – Acute Management Glycerol trinitrate for acute intracerebral hemorrhage: Results from the Efficacy of Nitric Oxide in Stroke (ENOS) trial

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**Background:** High blood pressure is common in acute intracerebral hemorrhage (ICH) and independently associated with a poor functional outcome. We investigated whether glycerol trinitrate (GTN) altered functional outcome in patients with acute ICH, using data from the 'Efficacy of Nitric Oxide in Stroke' (ENOS) trial.

**Methods:** ENOS was a partial-factorial randomized patient-masked blinded end-point trial of transdermal GTN or none given for 7 days in 4011 patients with acute stroke and systolic blood pressure  $\geq 140$  mm Hg. Here we assessed the effect of GTN (n = 310) versus no GTN (n = 319) in patients with ICH on functional outcome at 90 days according to the modified Rankin scale (mRS).

**Results:** Blood pressure at baseline was 172/93 mm Hg and significantly lower on day 1 in patients assigned to GTN (difference  $-7.5/-4.2$  mm Hg; both  $p \leq 0.05$ ). At 90 days, no difference in mRS was observed between those receiving GTN versus no GTN (adjusted odds ratio, OR for worse outcome with GTN 1.04, 95% confidence interval, CI 0.78–1.38;  $p = 0.81$ ). In a subgroup of 61 patients treated within 6 hours, GTN improved functional outcome with a shift in the modified Rankin Scale (OR 0.22, 95% CI 0.07–0.69;  $p = 0.0096$ ). There were no significant difference in the rates of serious adverse events between GTN and no GTN.

**Conclusions:** In patients with acute intracerebral hemorrhage, treatment with GTN lowered blood pressure but did not improve functional outcome. Very early treatment may be beneficial but needs further assessment, as will be done in the forthcoming RIGHT-2 trial.

## ESOC-0330

### 01. Clinical Trial Results – Acute Management ASPIRATION SCREENING IN ACUTE STROKE – IS MEASUREMENT OF OXYGEN SATURATION HELPFUL?

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**Background:** Dysphagia is one of the most dangerous symptoms of acute stroke. Various screening tools have been suggested for the early detection of this condition. In spite of conflicting results, measurement of oxygen

saturation (SpO<sub>2</sub>) during clinical swallowing assessment is still recommended by different national guidelines as screening tool with a decline in SpO<sub>2</sub>  $\geq 2\%$  usually being regarded as marker of aspiration. This paper assesses the sensitivity of SpO<sub>2</sub> measurement to evaluate the aspiration risk in acute stroke patients.

**Methods:** 50 acute stroke patients with moderate to severe dysphagia were included in this study. In all patients, FEES was performed according to a standardized protocol. Blinded to the results of FEES SpO<sub>2</sub> was monitored simultaneously. The amount of desaturation during/after swallows with aspiration was compared to the amount of desaturation during/after swallows without aspiration in each patient. The extent of aspiration and cough strength were assessed qualitatively.

**Results:** In each subject one swallow with and one swallow without aspiration was analyzed. Overall, aspiration seen in FEES was related to a minor decline in SpO<sub>2</sub> (mean SpO<sub>2</sub> without aspiration = 95.54 ( $\pm 2.7$ ) % vs. mean SpO<sub>2</sub> with aspiration = 95.28 ( $\pm 2.7$ ) %). However, a relevant desaturation  $\geq 2\%$  occurred only in 5 patients during/after aspiration. There was no correlation between the extent of aspiration or cough strength and SpO<sub>2</sub>-levels.

**Conclusions:** According to this study SpO<sub>2</sub>-measurement is not a suitable screening tool to detect aspiration in stroke patients.

## ESOC-0738

### 01. Clinical Trial Results – Acute Management Repeated measures analysis of modified Rankin Scale scores in acute stroke trials

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A common method for analysis of modified Rankin Scale (mRS) score at 90 days is to dichotomize it to good vs bad outcome that yields clinically meaningful summary statistics, relative risks or odds ratios (ORs), but dichotomization can be inefficient. Other approaches use the full ordinal scale, such as the shift analysis or proportional odds model (POM). Generally, these approaches have more power to detect treatment differences, if they exist. The POM yields a common OR, provided the proportionality in the odds assumption is met. Also, in addition to 90 days, most trials assess mRS at discharge and/or 30 days, and in some trials, at periodic intervals through 12 months. This makes mRS amenable to repeated measures analysis which may yield even more power to test the treatment effect. To illustrate, we re-analyzed the ordinal mRS data from NINDS rt-PA Stroke Study and the NIHSS $\geq 20$  subgroup of Interventional Management of Stroke III Trial. Results from repeated measures analyses and, as a comparison, single measure analyses, all adjusted for baseline NIHSS and symptom onset to randomization time, are provided below. Appropriate assumptions for the repeated measures analysis will be detailed.

	Repeated measures analysis		Single measure analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
NINDS t-PA (3 months)	1.53 (1.18, 1.98)	0.0013	1.43 (1.09, 1.91)	0.0130
NINDS t-PA (12 months)	1.45 (1.26, 1.88)	0.0041	1.42 (1.06, 1.90)	0.0194
IMS-III (3 months)	1.57 (0.95, 2.60)	0.0775	1.64 (0.97, 2.77)	0.0661
IMS-III (12 months)	1.65 (1.00, 2.74)	0.0522	1.67 (0.97, 2.86)	0.0649



## ESOC-1019

### 01. Clinical Trial Results – Acute Management

#### Effect of glyceryl trinitrate on neuroimaging parameters in patients with acute ischemic stroke: Results from the Efficiency of Nitric Oxide in Stroke (ENOS) trial

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**Background:** High blood pressure is common in acute ischemic stroke and associated with a poor outcome. Transdermal glyceryl trinitrate (GTN), a nitric oxide donor, is a candidate treatment for acute stroke, especially if given within 6 hours.

**Methods:** Patients randomized into the large Efficacy of Nitric Oxide in Stroke (ENOS) trial were included in this subgroup analysis if they had an ischemic stroke and neuroimaging at both baseline and day 7. Analysis assessed the effect of GTN on day 7 imaging parameters and on the modified Rankin Scale (mRS) in subgroups defined by baseline imaging criteria.

**Results:** Of 4,011 patients recruited into ENOS, 3,342 had an acute ischemic stroke and 837 (GTN 412, no GTN 425) of these had both a baseline and day 7 scan performed. GTN did not alter outcome and did not affect neuroimaging parameters at day 7 when adjusted for baseline results. In pre-specified subgroups, interactions were present between markers of early ischemic change on baseline scan (hyperdense artery, loss of gray-white matter, mass effect) and treatment group, suggesting improved functional outcome with GTN in these patients. In patients randomized within 6 hours of stroke onset, GTN was associated with less loss of gray/white matter differentiation (36.7% vs 55.6%, odds ratio 0.20, 95% confidence intervals 0.04, 0.89) and less periventricular lucencies at 7 days.

**Conclusions:** Although GTN did not alter imaging outcomes in ENOS, treatment was associated with less loss of gray/white matter differentiation in patients randomized within 6 hours. This result needs further prospective assessment.

## ESOC-1096

### 01. Clinical Trial Results – Acute Management

#### Relation between change in systolic blood pressure and short and long term outcome in acute stroke

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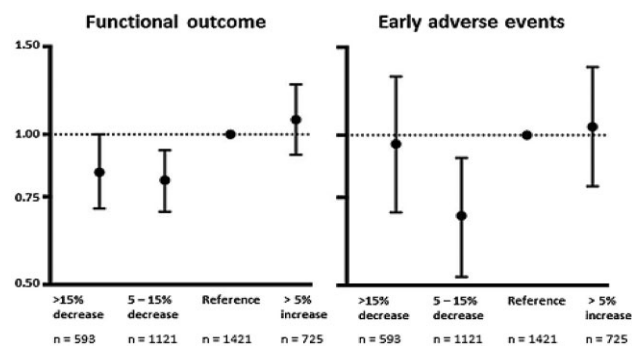
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**Background:** The Efficacy of Nitric Oxide in Stroke (ENOS) trial found no beneficial effect of blood pressure (BP) lowering with transdermal glyceryl trinitrate (GTN). We aimed to investigate whether early change in BP after stroke is associated with fewer early adverse events (neurological deterioration or recurrent stroke) within 7 days and improved functional outcome at three months.

**Methods:** ENOS was a multicenter randomized single-blind and outcome-blinded trial of GTN vs. no GTN in 4,011 patients recruited within 48 hours of an ischemic or hemorrhagic stroke and with raised systolic BP (SBP 140–220 mmHg). We categorized patients, independent of treatment, by change in SBP from baseline to day 1: >15% decrease, 15–5% decrease, 5% decrease to 5% increase (reference), and >5% increase, and assessed the effect on functional outcome (ordinal regression) and early adverse events (logistic regression) adjusting for known baseline predictors.

**Results:** Across all patients, both moderate (5–15%) and large (>15%) decreases in SBP were associated with beneficial shifts in the mRS: OR 0.81 (95% CI 0.70–0.90) and OR 0.84 (95% CI 0.71–1.00) respectively. A moderate decrease in SBP was also associated with a lower risk of early adverse, OR 0.69 (95% CI 0.52–0.90) (Fig. 1).



**Conclusion:** A moderate reduction in SBP of 5–15% within the first 3 days of stroke seems to be associated with fewer early adverse events and better long-term functional outcome.

**ESOC-1413****01. Clinical Trial Results – Acute Management  
Diagnostic accuracy of telestroke in patients with sudden onset of dizziness**

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**Background:** Dizziness is frequent in emergency care. In acute ongoing dizziness fast differentiation between central vestibular (such as stroke) and peripheral vestibular disease is essential for correct management. Telemedicine has become an increasing means to bring special expertise to rural areas. However, subtle oculomotor disturbances are difficult to capture with existing videoconference systems but are important for this patient group.

**Aim:** To assess correctness of initial telediagnosis compared to final diagnosis at discharge.

**Methods:** The Telemedical Project for integrative Stroke Care (TEMPiS) is a TeleStroke Unit network with 2 hub and 18 spoke hospitals. Patients are remotely examined via videoconference. On admission we prospectively documented all consecutive patients suffering from acute ongoing dizziness from Sept–Dec 2013. Initially suspected and final etiology, initial recommendations and retrospective correct workup were analyzed.

**Results:** 123 patients were included. Out of 55 with initial telemedical classification of central etiology, 43 (78%) patients finally had a central vestibular cause. Out of 68 with initial non-central or uncertain etiology, 17 (25%) finally had central vestibular cause. Sensitivity and specificity for central cause were 72% (43/60) and 81% (51/63) respectively. Stroke Unit treatment was recommended in 52 of 58 (90%) patients with stroke as final diagnosis.

**Conclusion:** In patients with acute ongoing dizziness, accuracy of admission diagnosis via conventional videoconference based telemedicine consultation is limited.

Development of new devices is needed to reliably identify stroke patients.

**ESOC-0138****01. Clinical Trial Results – Acute Management  
Electrical pharyngeal stimulation for dysphagia treatment in tracheotomized stroke patients**

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**Background:** Treatment of post-stroke dysphagia is notoriously difficult with different neurostimulation strategies having been employed with a variable degree of success during the last years. Recently, electrical pharyngeal stimulation (EPS) has been shown to improve swallowing function and in particular decrease airway aspiration in acute stroke patients. In the present study we used EPS for the treatment of severely dysphagic tracheotomized stroke patients.

**Methods:** 30 consecutive stroke patients successfully weaned from the respirator were included in this study. All patients had severe dysphagia making decannulation impossible. Patients were randomized (verum : placebo = 2:1) to receive either EPS or placebo stimulation on three consecutive

days. Primary endpoint was improvement of swallowing function enabling decannulation which was assessed by a previously established fiberoptic endoscopic evaluation of swallowing (FEES)-based algorithm. Patients having received sham stimulation were offered EPS during unblinded follow-up if required.

**Results:** Both groups were well matched for age, stroke severity and stroke location. Decannulation after study intervention was possible in 75% of patients of the treatment group and in 20% of patients of the sham group ( $p < 0.01$ ). During follow-up 7 still dysphagic patients of the sham group received unblinded EPS, whereupon in 5 of them (71%) the tracheal tube could be removed. No adverse events occurred.

**Conclusion:** EPS can safely be applied to tracheotomized stroke patients. EPS enhances remission of dysphagia thereby enabling decannulation in the majority of patients.

**ESOC-1200****01. Clinical Trial Results – Acute Management  
Malignant middle cerebral artery infarctions in patients included in the MR CLEAN trial**

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**Introduction:** Little is known about malignant middle cerebral artery infarctions (MMI) after intra-arterial treatment (IAT) for ischemic stroke. A possible explanation for the development of MMI could be the development of hyperperfusion syndrome after recanalization following IAT. We aimed to determine the relation between clinical and radiological predictors and occurrence of MMI among patients included in the MR CLEAN study, a randomized controlled trial of IAT versus no IAT in patients with ischemic stroke.

**Methods:** All 500 trial patients were included in the analysis. In this sub-study, primary outcome was occurrence of MMI. Clinical and radiological variables with a possible association with MMI in univariable analyses ( $p < 0.1$ ) were included in multivariable logistic regression analyses to assess a possible independent association with MMI.

**Results:** Of 500 patients included in the trial, 65 (13%) had MMI. 51% (33/65) of the MMI group was allocated to IAT versus 46.0% (200/435) in the non-MMI group ( $p = 0.47$ ). In our model, independent predictors of MMI were age (OR 0.97, 95% CI 0.95–0.99), baseline NIHSS (OR 1.07, 95% CI 1.02–1.13) and ASPECT score 5–10 (0.24, 95% CI 0.10–0.56). IAT was not associated with a higher risk of MMI (OR 1.37, 95% CI 0.79–2.40).

**Conclusion:** In the MR CLEAN population independent risk factors for the occurrence of MMI are severe neurological deficit, low ASPECT score (0–4) and younger age. Despite our results, IAT should not be withheld in patients with these risk factors. We will further study these findings and their implications.

## ESOC-0814

### 01. Clinical Trial Results – Acute Management COOLIST: Cooling for Ischaemic Stroke Trial. A multicenter, open, randomized, phase ii clinical trial

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**Background:** Animal studies suggest that cooling to temperatures of 35°C or below improves outcome after ischemic stroke. We assessed the feasibility and safety of surface cooling for 24 hours in awake patients with acute ischemic stroke.

**Methods:** This is an international, randomized, open, multi-center, phase II clinical trial, comparing standard treatment with surface cooling to 35.0, 34.5, or 34.0°C in patients with acute ischemic stroke and a score on the NIHSS  $\geq 6$ , admitted to a stroke unit. Cooling was started within 4.5 hours after symptom onset and maintained for 24 hours. The primary outcome was feasibility, defined as successfully having completed the assigned treatment strategy. Secondary outcomes included safety and functional outcome (as measured with the modified Rankin scale) at three months.

**Results:** 22 patients were included (mean age 63 years; 19 men; median NIHSS, 13 (IQR, 9)). Three of 5 patients randomized to cooling to 35.0°C; 3 of 6 patients randomized to 34.5°C; and none of 5 patients randomized to 34.0°C successfully completed the assigned treatment ( $p = 0.11$ ). Pneumonia occurred in 8 of 16 cooled patients and in none of 6 controls (absolute risk increase, 50%; 95% CI, 5–72%). There was no difference in functional outcome between treatment groups.

**Conclusion:** In awake patients with acute ischemic stroke, surface cooling to 35.0°C appears feasible in the majority patients, and cooling to 34.0°C not. Cooling is associated with an increased risk of pneumonia.

Registered as NTR2616 and supported by the Netherlands Heart Foundation (2010B239)

prior medication beta-blocker (OR1.60, 1.08–2.37) and dysphagia (OR4.10, 2.55–6.58) were associated with clinical diagnosis of pneumonia; age and dysphagia with expert panel diagnosis (OR1.04, 1.00–1.08 and 4.54, 1.99–10.37 respectively). Advanced age (OR1.03, 1.01–1.05), male sex (OR0.38, 0.27–0.55), hypercholesterolemia (OR0.18, 95%CI 0.05–0.69), stroke severity (OR1.04; 1.02–1.07), bladder catheter (OR3.49, 95%CI 2.38–5.13) and IVT (OR0.54, 0.35–0.82) were associated with clinical diagnosis of UTI; bladder catheter (OR6.56, 3.80–11.31) with expert panel diagnosis. Both pneumonia and UTI were independently associated with unfavorable outcome (OR9.62, 5.08–18.52 and 1.87, 1.24–2.79, for physician diagnosis; OR6.17, 2.27–16.67, and 3.56, 1.81–6.99 for expert panel diagnosis).

**Conclusions:** Definitions of post-stroke infections by physicians and CDC-criteria differ substantially. Both pneumonia and UTI are strongly associated with unfavorable outcome.

## ESOC-1373

### 01. Clinical Trial Results – Acute Management Post-stroke infections: Sub-study of the Preventive Antibiotics in Stroke Study (PASS)

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**Background:** In a recent large RCT (PASS), preventive ceftriaxone reduced infection rate but did not improve functional outcome in 2550 acute stroke patients. In this sub-study, we investigate differences between physician vs. expert panel diagnosis, risk factors, and associations with outcome of post-stroke infections.

**Methods:** In PASS, post-stroke infection was diagnosed by treating physician or expert panel, strictly adhering to CDC-criteria. We use multivariate analysis to investigate associations of baseline characteristics with infections and regression analysis to evaluate the effect on outcome.

**Results:** Infections were diagnosed in 348 of 2538 patients (14%) by physicians and 129 (5%) by the panel; urinary tract infection (UTI) (7% physician, 3% panel) and pneumonia (6% physician, 2% panel) were most common. Advanced age (odds ratio (OR)1.03, 1.01–1.06), severe stroke (OR1.08, 1.04–1.16) obstructive-pulmonary-disease (OR2.21, 1.26–3.91),

## Clinical Trial Results – Rehabilitation and Recovery

### ESOC-1420

#### 02. Clinical Trial Results – Rehabilitation and Recovery Asymptomatic hemorrhagic transformation after thrombolysis in stroke: Not so benign?

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**Introduction:** Hemorrhagic transformation (HT) is usually taken into account when symptomatic. The aim of our study was to evaluate the link between all-type hemorrhagic transformation after thrombolysis for ischemic stroke and functional outcome at 3 months.

**Methods:** Our study was performed prospectively between June 2012 and June 2013 in our stroke unit of Tours. All patients treated with intravenous thrombolysis were consecutively included. HT were classified according to ECASS on susceptibility weighted imaging (SWI) on a 3 tesla MRI at 7 ± 3 days after thrombolysis. We evaluated functional outcome at three months using the modified Rankin scale (mRS). Dependency was defined by mRS < or = 3.

**Results:** Over one year 127 patients have received thrombolysis therapy for ischemic stroke. Among them 91 had a 3T MRI with SWI at 7 days. Fifty of them had HT (of which 8 were symptomatic). At 3 months, 68% of those patients were dependant versus 31% of patient without HT (p = 0.001), OR = 4.6 (1.9–11.4)).

**Discussion:** All-type HT is significantly associated with dependency at 3 months. The impact of symptomatic HT is well known, but the literature is very poor on all-type HT. Its innocuity is not so sure and rare studies have already enlightened the increase risk of dependency. Using 3T MRI with SWI allow us to increase detection of small hemorrhage, still the results are significant.

**Conclusion:** The presence of HT after thrombolysis should be considered, even when it is not associated with significant neurological deterioration. It could have an impact on long-term functional outcome.

### ESOC-1354

#### 02. Clinical Trial Results – Rehabilitation and Recovery Safety of stereotactic intracranial injection of modified bone marrow-derived mesenchymal stem cells (SB623) in chronic stroke patients: A Phase 1/2A study

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**Background:** Currently, there are no clinically effective therapies for chronic stroke, which is a significant cause of disability.

**Methods:** We evaluated safety after 12 months of modified bone marrow-derived mesenchymal stem cells (SB623) transplanted via stereotactic intracranial injection into patients with stable chronic stroke (6–60 months post-stroke) during a two-year, phase 1/2A, open label, study (NCT01287936) (N = 18). The study was approved by an institutional review board, and patients provided written informed consent.

**Results:** Treatment emergent adverse events (TEAEs) were experienced by all 17 patients in the safety population. There were no dose-limiting toxicities or deaths, and no patients withdrew from the study due to adverse events. The most frequent TEAEs were procedural headache (88.2%), constipation (23.5%), depression (23.5%), nausea (23.5%), vomiting (17.6%), and fatigue (17.6%). The intensity of most TEAEs was mild (17.6%) or moderate (47.1%). No TEAEs were probably or definitely related to the study treatment. TEAEs definitely related to surgical procedure and possibly related to study treatment were experienced by 42.2% and 17.6% of patients, respectively. After 12 months there were no significant changes or trends in patients' biochemistry or hematology parameters, vital signs, lipids, or cytokines (TNF- $\alpha$ , IL-6, and INF- $\gamma$ ). At screening, serum antibodies to HLA antigen on donor SB623 cells were detected in a single patient, however this was not associated with TEAEs. In addition, SB623 specific antibodies did not develop in patients after transplantation.

**Conclusions:** The intracranial injection of SB623 cells in chronic stroke patients was generally safe and well tolerated after 12 months.

### ESOC-0099

#### 02. Clinical Trial Results – Rehabilitation and Recovery Time spent in physiotherapy sessions during sub-acute rehabilitation does not predict recovery of walking ability

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The Phase 3, randomized controlled CIRCIT trial (n = 283) was predicated on the belief that more therapy time would lead to improved functional recovery and investigated the effectiveness of two alternative models of augmented physiotherapy (7-day week therapy and group circuit class therapy) compared to usual care for stroke survivors in hospital-based rehabilitation. Participants receiving 7-day week and circuit class therapy received an additional 3 hours, and 22 hours of physiotherapy time, respectively, compared with usual care. Here we investigate the contribution of therapy time to improvements on the primary outcome measure (6 minute walk test [6mWT]). Using linear regression we found that therapy time alone did not influence 6mWT change scores ( $\beta = 0.059$ ,  $p = 0.351$ ). Adding the covariates of age, admission functional independence measure (FIM) score, Charlson co-morbidity index and time since stroke increased the predictive value of the model, but still explained only 12% of the variance in 6mWT change. Age, FIM score and time since stroke (but not co-morbidities) were all significant factors within the model, but therapy time remained non-significant. These results are surprising given the evidence that more therapy is better. Our previous work suggests that time in physiotherapy sessions is a poor proxy measure of therapy 'dose' as stroke survivors are

inactive for large proportions of therapy sessions. Alternative metrics for therapy are required and should include measures of factors known to promote motor learning, including level of effort, grading of task complexity and amount of practice

## ESOC-0877

### 02. Clinical Trial Results – Rehabilitation and Recovery Motorized multidirectional protuberance device for sitting balance of stroke patients

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**Background and Purpose:** Trunk control is essential for the efficient and effective performance of all goal-directed activities while sitting. We tested the effect of the use of a Multidirectional protuberance chair in addition to physical therapy in training stroke patients with impaired sitting balance compared with effect in patients receiving conventional physical therapy only.

**Methods:** The study was conducted in King Khalid Hospital from October 2012 to June 2013. The protuberance group consisted of 24 patients who received protuberance training in addition to conventional physical therapy. During the 3 weeks training program, the chair generated protuberance in random directions, intensity of protuberance was adjusted as per severity of impairment and improvement was documented on various balance scales and ability to retain balance against time.

**Results:**

**Table 1** Demographic results of protuberance and control groups

Characteristic	Protuberance group	Control group	P
Mean ± SE age, y	58.17 ± 1.80	62.31 ± 3.09	.506
Mean ± SE duration of disease, wk	11.37 ± 2.06	12.85 ± 3.51	.753
Sex, women/men	10/14	9/4	.884
Side of involvement	11 L, 9 R, 1 bilateral	5 L, 7 R, 1 bilateral	.832
Type of stroke	17 thromb, 9 hemorrhagic	6 thromb, 7 hemorrhagic	.745

**Results:**

**Table 1** Quality of movement/week

	QOM 1	QOM 2	QOM 3	QOM 4	QOM 1'	QOM 2'	QOM 3'	QOM 4'
p-value	.091	.047	.021	.013	.111	.023	.011	.005

**Table 2** Amount of use/week

	AOU 1	AOU 2	AOU 3	AOU 4	AOU 1'	AOU 2'	AOU 3'	AOU 4'
p-value	.399	.042	.015	.002	.259	.015	.002	.002

**Table 2** Mean ± SE length of time patients could retain sitting balance

	Time, s		
	Initial	After 3 weeks	Discharge
Protuberance group	65.67 ± 10.46	265.04 ± 9.32	293.71 ± 5.12
Control group	68.69 ± 16.83	187.08 ± 15.99	272 ± 17.40
P*	.909	<.001	.201

\*Differences between protuberance and control groups.

**Conclusions:** Protuberance-based balance training provides earlier postural trunk control, is a useful addition to conventional physical therapy in the rehabilitation of stroke patients with impaired sitting balance.

## ESOC-0896

### 02. Clinical Trial Results – Rehabilitation and Recovery Comparing the immediate effect of auditory and visual mental imagery on reaching and grasping task among sub-acute stroke patients

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**Introduction:** Upper-limb hemiparesis is one of the most debilitating effects of stroke. We are comparing the effects of both type of mental imagery i.e. visual and auditory on upper limb impairment among stroke. Study intends to determine the efficacy of auditory and visual mental imagery to increase upper limb function among sub-acute stroke patients. **Method:** The study was done in Yasuda Hospital in India during 2010–2011. A randomized, controlled, multiple baseline, pre and post test case series design was applied. The Action Research Arm test and Motor Activity Log was administered every time before and after the procedure i.e. 2 days a week for 4 weeks.

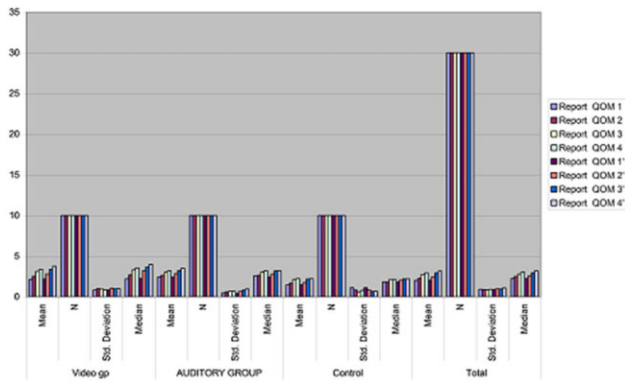


Fig. 1 Quality of movement score in 4 weeks

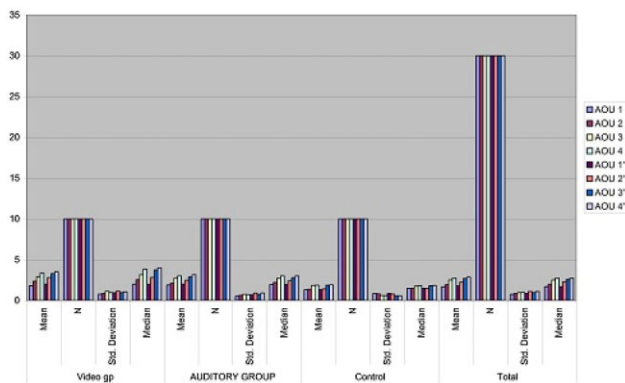


Fig. 2 Amount of use score in 4 weeks

**Discussion:** The increased use and motor function changes exhibited more by Mental practice group confirmed our hypothesis that there may be change in task performance after visual mental imagery and auditory mental imagery among sub-acute stroke patients, though the changes were more in visual mental imagery group as compared to auditory mental imagery.

**Conclusion:** Our study concludes that visual mental imagery appears to be a promising rehabilitation protocol for improving affected upper limb motor function in stroke patients as compared to auditory mental imagery.

**ESOC-0162**

**02. Clinical Trial Results – Rehabilitation and Recovery Dual-mode-noninvasive brain stimulation over the primary motor cortices in stroke patients**

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Noninvasive brain stimulation (NBS) using the repetitive transcranial magnetic stimulation (rTMS) or the transcranial direct current stimulation (tDCS) were recently adopted for modulating motor function of stroke patients. We investigated the effect of simultaneous dual-mode stimulation using rTMS and tDCS over bilateral primary motor cortices (M1) whether it is more effective than single stimulation using rTMS for recovery of motor function in subacute stroke patients. Thirty-one subacute stroke patients were recruited in this open-label study. In dual-mode stimulation group, the 10 Hz rTMS (90% of resting motor threshold,

1,000 pulses) were applied over the ipsilesional M1 for 20 minutes with simultaneous application of the cathodal tDCS (2 mA) on the contralateral M1 for 20 minutes. Single stimulation group underwent 10 Hz rTMS without tDCS. Ten daily sessions were conducted for 2 weeks. The total, upper, and lower scores of FMA were measured before, after, and 2 months after the intervention. The scores of total and upper FMA were significantly improved over time in both dual and single stimulation group ( $p < 0.05$ ). However, there were group and time interaction effects in total FMA ( $p < 0.05$ ) and upper FMA ( $p = 0.056$ ). Post-hoc study showed that the mean changes in total and upper FMA ( $p < 0.05$ ) scores were better in the dual stimulation group than the single group after 10 sessions of stimulation. The dual-mode NBS with simultaneous application of 10 Hz rTMS and the cathodal tDCS over the bilateral M1s was safe and superior to 10 Hz rTMS alone for improving motor function in subacute stroke patients.

**ESOC-0164**

**02. Clinical Trial Results – Rehabilitation and Recovery Effects of cerebrolysin on motor recovery in patients with severe motor impairment after stroke**

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The aims of this study was to evaluate whether Cerebrolysin provide additional motor recovery of rehabilitation therapy during the subacute phase of stroke in patients. This study was a phase IV clinical trial designed as a multicenter, randomized, double-blind, placebo-controlled, parallel-group study. Seventy stroke patients with the moderate to severe motor function involvement (Fugl-Meyer assessment (FMA)  $\leq 84$ ) were included at 7 days after stroke onset. Participants were randomly assigned to one of two groups to receive a 21-day course of either Cerebrolysin or placebo in addition to the regular rehabilitation therapy. Assessments for motor function were performed at baseline, immediately after treatment, 2 and 3 months after stroke onset. The plasticity of motor system was assessed with diffusion tensor imaging (DTI) for white matter integrity, and with resting state functional magnetic resonance imaging (rsfMRI) for cortical functional connectivity. None of participants showed severe adverse effect in each group. Sixty-one patients (Cerebrolysin group: 32) completed the follow-up process included in the analysis. Both group demonstrated significant time effect on motor function, however, only the patients with severe motor impairment (FMA  $< 50$ ) showed a significant interaction between time and type of intervention ( $p < 0.05$ ). Effects of the Cerebrolysin on white and gray matters were demonstrated in terms of restricted increments of corticospinal diffusivity by DTI and recovery of the sensorimotor connectivity by rsfMRI, respectively. Cerebrolysin treatment demonstrated additional benefit on motor recovery and plastic changes of CST in patients with severe motor impairment while administered with conventional rehabilitation therapy during the subacute phase of stroke.

## ESOC-0920

## 02. Clinical Trial Results – Rehabilitation and Recovery Predictors of functional outcomes and quality of life at 12 months after first-ever stroke in Korea: The KOSCO study

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This study aimed to analyze the factors influencing the functional status and quality of life (QOL) of stroke survivors at 12 months after onset to provide useful information for establishing comprehensive and systematic care for stroke. This is the interim results of the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) designed as 10 years long-term follow-up study of stroke patients. The face-to-face assessments were completed from 1,803 patients (mean age  $63.8 \pm 13.0$ , 79.2% ischemic stroke) at discharge and at 12 months after their stroke onset. Assessments included Korean Mini-Mental State Examination, Fugl-Meyer Assessment (FMA), Functional Ambulatory Category (FAC), the American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale, Korean Version of Frenchay Aphasia Screening Test, and Geriatric depression scale-short form (GDS-SF). Functional independence and quality of life were assessed by Korean modified Barthel index (K-MBI) and Euro Quality of Life (EQ)-5D. Multiple regression analysis revealed that age at onset, FMA score, and FAC at discharge were the significant influencing factors on functional independence measured by K-MBI score at 12 months. FMA score and GDS-SF at discharge were also the significant influencing factors on QOL (EQ-5D) at 12 months. Intensive rehabilitation to increase motor function at discharge seemed to be a good strategy for improving independence and QOL of stroke patients (Supported by Korea Centers for Disease Control and Prevention (2013E-11001-01)).

## ESOC-1119

## 02. Clinical Trial Results – Rehabilitation and Recovery A feasibility study of an integrated stroke self-management program: A cluster randomized controlled trial

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*Background:* This study tested the feasibility of conducting a cluster randomized controlled trial (RCT) into the effectiveness of a stroke self-management program (SMP) integrated into post hospital rehabilitation. The program consisted of a workbook combined with defined strategies used by clinicians to facilitate self-management.

*Methods:* Ethics approval (11LO1450). A cluster RCT was utilized with community stroke rehabilitation teams (CSR) as units of randomization; both intervention and control sites comprised multiprofessional teams delivering post hospital rehabilitation. Stroke therapists in the intervention teams only were trained to use the program; impact was tested on quality of life, mood, self-efficacy, functional capacity and economic outcome at six weeks and three months and compared to control teams.

*Results:* Four CSR teams were recruited who received 317 stroke referrals over 10 months: 138 met trial eligibility criteria and 78 participants were recruited (24.6%). Demographic and baseline outcome measures were similar between intervention and control arms. The SMP was feasible; results favored the intervention clusters, with the exception of SF-12, none were significantly different between arms. Functional capacity (NEADL) and self-efficacy (SSEQ) showed most responsiveness to the intervention.

*Conclusion:* It was feasible to integrate a stroke self-management program into post hospital community rehabilitation and train therapists to deliver the program according to pre-determined criteria. The study was completed with minimal data lost to follow up and the design could be replicated in a definitive trial to test the effectiveness and cost effectiveness of integrated self-management support post stroke.

Funded by RfPT (NIHR). Registration: ISRCTN – 42534180.

## ESOC-0333

**02. Clinical Trial Results – Rehabilitation and Recovery Pharyngeal hypesthesia in MCA-infarction is related to overall dysphagia severity**

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**Background:** Impairment of the conventional processing of laryngopharyngeal sensory information entails neurogenic dysphagia. Recently, several studies indicated a bilateral processing in the primary somatosensory cortex while swallowing execution. In the present study correlations between anatomical conditions and amount of laryngopharyngeal sensory impairment, severity of general medical condition and severity of dysphagia in acute stroke patients have been under examination.

**Methods:** In this study, we included 45 acute stroke patients with infarction of the middle cerebral artery and with moderate to severe dysphagia. In all patients, FEES was performed according to a standardized protocol within 96 hours after stroke onsets. The laryngopharyngeal sensitivity was evaluated by touching the tip of the endoscope to the arytenoids, the posterior pharynx wall and the lateral pharynx walls.

**Results:** The amount of laryngopharyngeal hypoesthesia is not correlated with the severity of stroke. Though, the severity of dysphagia is closely correlated with the amount of the laryngopharyngeal hypoesthesia. There is no strong lateralization of the sensory laryngopharyngeal deficit. Right hemispheric strokes determine severe laryngopharyngeal sensory deficits compared to left hemispheric strokes, pronouncing the left side, specifically the left arytenoids.

**Conclusions:** Overall, this study has demonstrated that the amount of laryngopharyngeal sensory impairment depend on the severity of dysphagia and is independent of the severity of stroke. In addition, our results maintain a bilateral processing in the primary somatosensory cortex while swallowing execution with a right hemispheric focus.

## ESOC-1155

**02. Clinical Trial Results – Rehabilitation and Recovery Cerebrolysin and Recovery after Stroke (CARS): A randomized, placebo-controlled, double-blind, multicenter, phase ii clinical study**

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**Background and Purpose:** The aim of this early neurorehabilitation trial was to investigate whether patients randomized to Cerebrolysin showed improved motor function of the upper extremities over 90 days in comparison with patients randomized to placebo.

**Methods:** This study was designed as a prospective, randomized, double-blind, placebo-controlled, multicenter and parallel-group study. Patients were treated with Cerebrolysin (30 ml/day) or placebo (saline) once daily over 21 days starting the treatment 24–72 hours after stroke onset. In addition, patients participated in a standardized rehabilitation program

over 21 days starting within 72 hours after stroke onset. Primary endpoint was the action research arm test (ARAT) score on day 90. Safety assessment was based on adverse events, vital signs and laboratory parameters. **Results:** The nonparametric effect size on the ARAT score on Day 90 indicated a large superiority of Cerebrolysin as compared to placebo (MW = 0.71, 95%CI 0.63–0.79). The multivariate effect size on the global status, as assessed by twelve different outcome scales, showed a small superiority (MW 0.60,  $P < 0.0001$ ). The rate of premature discontinuations was below 5% (3.8%). Cerebrolysin was safe and well tolerated.

**Conclusions:** Cerebrolysin had a beneficial effect on function and global outcome in early rehabilitation patients after stroke. The safety aspects of Cerebrolysin were comparable to placebo, thus suggesting a favorable benefit-risk ratio. Due to the size of the study the results should be confirmed by a high precision, large-scale randomized clinical trial.

## ESOC-1407

**02. Clinical Trial Results – Rehabilitation and Recovery Feasibility of treatment with modafinil to reduce fatigue after stroke**

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**Introduction:** Poststroke fatigue is common and assumed to negatively affect rehabilitation and quality of life. The aim of this study was to investigate the feasibility of a trial when treating stroke patients with the wakefulness promoting modafinil or placebo and to examine if modafinil can improve rehabilitation.

**Method:** This trial was double-blind, randomized and placebo-controlled. Inclusions ran from October 1 2012 to November 1 2014. The intervention group was treated with up to 400 mg modafinil and the control group with placebo for three months. Assessments were done after 1, 3 and 6 months. The primary endpoint was a reduction in the General Fatigue Score on the questionnaire "Multidimensional Fatigue Inventory-20" after three months. Inclusion criteria were stroke, written informed consent and a General Fatigue score of 12 or more. Exclusion criteria were drug abuse, psychiatric instability or cognitive disabilities. The study was approved by the Ethic Committee.

**Results:** We screened 1121 patients. Forty-one fulfilled the in- and exclusion criteria and were included: 7 had an intracerebral hemorrhage and 34 ischemic stroke. Six patients left the study before the three month follow up. The primary endpoint was achieved in 35 patients. Four patients stopped medication and three had reduced dosages due to adverse events. Results from the primary endpoint and the Modified Ranking Scale will be presented.

**Discussion:** This study is the first randomized and placebo-controlled trial of modafinil treatment after stroke. Modafinil has proven effective in multiple sclerosis and we hope to demonstrate a beneficial effect after stroke.



## ESOC-0917

## 02. Clinical Trial Results – Rehabilitation and Recovery

### Multiple organ dysfunction syndrome in critically ill stroke patients and early robot-assisted therapy

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**Introduction:** Multiple organ dysfunction syndrome (MODS) increases risk of unfavorable outcome and mortality in severe stroke.

**Methods:** This case-control study included 66 consecutive critically ill patients (49 males, 17 females, median age 59.3), admitted to the Intensive Care Unit within 7 days from onset of ischemic or hemorrhagic stroke. We assessed mortality, MODS and specifically rate of pulmonary embolism (PE) and acute respiratory disease (ARD) up to Day 21 and used NIHSS and MODS II scales.

**Results:** Patients were equally distributed into two groups – Intervention and Control and received standard stroke therapy vs. standard stroke therapy plus daily robot-assisted arm and leg therapy (MOTomed letto 2) in Intervention group. Groups had similar stroke and MODS severity on admission (NIHSS: Me = 20[LQ-16,UQ-29] vs. Me = 18[LQ-15,UQ-27],  $p > 0.5$ ; MODS II: Me = 2[LQ-1,UQ-4] vs. Me = 2[LQ-1,UQ-4],  $p > 0.5$  in Intervention and Control group, respectively).

There was no significant difference in rate of MODS and its severity (67 vs. 60%, Me = 1[LQ-1,UQ-2] vs. Me = 0[LQ-0,UQ-1]  $p > 0.05$  in Control and Intervention group, respectively) on Day 21. The rate of MODS affecting three and more organ systems was 41% vs. 14% ( $p = 0.013$ ) in Control and Intervention group, respectively. Rates of PE, ARD and mortality on Day 21 were significantly higher in the Control vs. Intervention group (39% vs. 12%,  $p = 0.014$ , 88% vs. 64%  $p = 0.026$ , and 39% vs. 12%,  $p = 0.014$ , respectively).

**Conclusion:** Early robot-assisted therapy in severe stroke patients was associated with significant reduction of serious pulmonary complications and MODS affecting three and more organ systems and mortality on Day 21.

## ESOC-0050

## 02. Clinical Trial Results – Rehabilitation and Recovery

### Neurophysiological and clinical effects of one session radial shockwave therapy on post-stroke plantar flexor spasticity: A single blind clinical study

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**Background:** Spasticity is a common phenomenon after upper motor neuron syndrome such as stroke, multiple sclerosis, spinal cord injury, and cerebral palsy. There are different physiotherapy strategies for controlling spasticity. This study aimed to investigate the effectiveness of radial shockwave therapy (RSWT) on plantarflexor spasticity post stroke.

**Methods:** The study was a single blind clinical study with three measurements: pre, immediately post and 1 hour after treatment. Twelve patients with stroke (5 male, 7 female; mean age of 59 years) were included in the study. All patients received one session of RSWT (2000 shots, frequency 5 Hz, and energy 60 mj). Primary outcome measures were the Hmax/Mmax ratio and the Modified Modified Ashworth Scale (MMAS). Secondary outcome measures were the H reflex latency, active range of motion (AROM), passive range of motion (PROM), passive plantar flexor torque (PPFT), and the timed up and go test (TUG).

**Results:** Main effect of Time on Hmax/Mmax ratio was not statistically significant. The spasticity as evaluated by the MMAS decreased 1 score posttreatment which persisted for 1 hour after the end of treatment. The H-reflex latency was significantly improved post treatment ( $p < 0.05$ ). A

significant main effect of Time was found for the AROM, the PROM, and the PPFT. The TUG test was improved post treatment ( $p = 0.02$ ).

**Conclusion:** One session RSWT may be effective in improving plantar flexor spasticity in patients with stroke. Further rigorous investigations are needed.

## ESOC-1209

## 02. Clinical Trial Results – Rehabilitation and Recovery

### The effect of early versus late constraint-induced movement therapy on motor function: Results from a randomized controlled trial with 12-month follow-up

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**Objective:** To compare the effect of constraint-induced movement therapy (CIMT) applied early after stroke with delayed intervention and to evaluate the long-term effect.

**Methods:** Forty-seven informed subjects with mild to moderate stroke gave their consent to participate in this single-blinded randomized multi-site trial. The participants were randomized to an early (7–28 days post stroke) or delayed (6 months) intervention group. Both groups received 3 h/d CIMT intervention over 10 consecutive working days. The participants were tested at 5 occasions: before and after early as well as delayed intervention and after 12 months. The primary outcome measure was Wolf Motor Function Test (WMFT), secondary outcome measures were Nine Hole Peg test (NHPT) and the Fugl-Meyer assessment score (FMA). **Results:** Thirty-one subjects completed all five assessments. Compared to pre-treatment, both groups improved significantly at 12 months follow-up on WMFT. There were no significant differences between pre 6 months testing and 12 months follow-up in the early intervention group, while the delayed intervention group reached a plateau at post 6 months test. No significant differences were found between the groups at any time point. FMA and NHPT showed corresponding results.

**Conclusion:** Despite no significant differences between the groups, the early intervention group showed a faster recovery curve compared to CIMT applied 6 months later. The small sample size is a limitation of this study. More research is necessary to determine when it is best to start the intervention.

ESOC-1406

**02. Clinical Trial Results – Rehabilitation and Recovery**  
**Home-based reach-to-grasp training for people after stroke: A feasibility randomized controlled trial**

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*Background:* Arm rehabilitation after stroke is a top research priority. Specifically, there is an urgent need for trials on task-specific training to improve arm function for people discharged home post stroke.

*Aim:* To determine the feasibility of a Phase III randomized controlled trial of home-based reach-to-grasp (RtG) training after stroke.

*Methods:* Design: multicenter, assessor-blinded feasibility RCT.

- Intervention group (RtG): task-specific reach-to-grasp training. Dose 56 hours: 14 therapist visits over 6-weeks plus 1 hour self-practice per day.

- Control group (CG): usual care.

- Participants: less than 12 months post-stroke, discharged home.

- Data collection: recruitment, adherence, treatment fidelity, acceptability, adverse events. Outcomes: Action Research Arm Test (ARAT, primary outcome), Wolf Motor Function Test (WMFT), Motor Activity Log, Stroke Impact Scale. Time points: pre-randomization and 7, 12 and 24 weeks post-randomization.

*Results:* 47 participants (RtG = 24, UC = 23) were recruited over 17 months, two withdrew.

94% of scheduled treatment visits were completed. RtG participants performed a median of 157 repetitions per visit plus 52 repetitions of self-practice per day. 96% participants rated training acceptable, 71% rated 1 hour of independent practice/day acceptable and 83% reported it improved arm function. There were no serious adverse events.

The ARAT score in the RtG group improved beyond the MCID, whilst it did not change in the CG (Table 1).

**Table 1**

ARAT score(0–57)	RtG	CG
Baseline median (IQR)	8.5 (3.0–24.0)	4 (3.0–14.0)
24 weeks median (IQR)	14.5 (3.5–26.0)	4 (3.0–30.0)

*Conclusions:* Findings indicate that a Phase III RCT of home-based RtG training after stroke is warranted and feasible.

## Clinical Trial Results – Prevention

### ESOC-0013

#### 03. Clinical Trial Results – Prevention

##### Risk and risk factors of perioperative myocardial infarction after carotid endarterectomy and carotid angioplasty and stenting: Systematic review and meta-analysis

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**Background:** Carotid Angioplasty-Stenting(CAS) is associated with higher risk of periprocedural stroke and death compared with Endarterectomy(CEA). By contrast, the risk of myocardial infarction(MI) was higher after CEA than after CAS in randomized trials. However, numbers were small and risk factors are unknown. We aimed to estimate the 30-day risk of MI after CAS and CEA and to determine subgroups at higher risks. **Methods:** We performed a systematic review and a meta-analysis of studies published from 01/1980 to 06/2014 and collected unpublished data. We extracted data on 9 predefined risk factors (age, contralateral carotid occlusion, CAD, diabetes, sex, hypertension, PVD, type stenosis and clinical presentation). We selected studies with data in at least one subgroup. We calculated absolute and relative risks and identified differential effects on risks of MI.

**Results:** The risk of MI after CEA was 0.87% (95%CI,0.69–1.07) and 0.70%(95%CI,0.54–0.88) after CAS(Pint = 0.07). Risk of MI has not changed over time in CEA and CAS studies. After CAS, patients with symptomatic stenosis, restenosis were at higher risk of MI whereas males were at lower risk. After CEA, age, coronary artery disease, peripheral artery disease, and restenosis increased the risk of MI. Only the effect of gender differed between CAS and CEA with males being at lower risk of MI than females after CAS whereas there was no difference between after CEA(Pint = 0.01).

**Conclusions:** The risk of MI is slightly higher after CEA than after CAS. Risk factors for MI are overall similar in both techniques except that males are at lower risk of MI after CAS but not after CEA.

### ESOC-0967

#### 03. Clinical Trial Results – Prevention

##### Cilostazol prevents progression of atherosclerosis in ischemic stroke patients with peripheral arterial disease: A randomized, double-blind, placebo-controlled trial

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**Background:** Patients with polyvascular atherosclerotic diseases carry a high risk of vascular events and death. Dual antiplatelet therapy could benefit these patients by inhibiting atherosclerotic progression. We aimed to investigate the effect of combination therapy of cilostazol and aspirin on subclinical atherosclerosis progression in patients with ischemic stroke or transient ischemic attack (TIA) who had peripheral arterial disease.

**Methods:** We conducted an investigator-initiated, randomized, double-blind, placebo-controlled trial at 16 centers in Taiwan. Participants aged 50 years or older who were taking aspirin (100 mg per day) after a previous ischemic stroke or TIA, and an ankle-brachial index (ABI) <1.0 were randomly assigned to receive cilostazol 200 mg per day (n = 403) or placebo (n = 397) for 1 year. The primary end point was changes in ABI, and the secondary end point was changes in common carotid artery intima-media thickness. This trial is registered with ClinicalTrials.gov (NCT01188824).

**Findings:** Ankle blood pressure significantly increased in the cilostazol group compared with the placebo group (p < 0.001), but there was no significant difference in the increase in ABI between the two groups. The regression in mean left, mean right, and maximum left common carotid artery intima-media thickness was significantly greater in the cilostazol group than in the placebo group. There were no significant differences in vascular events, death, or major hemorrhagic events between the two groups.

**Interpretation:** Compared with aspirin alone, aspirin plus cilostazol was more effective in slowing down atherosclerotic progression, and did not increase the incidence of hemorrhagic events in this patient population

## ESOC-0934

### 03. Clinical Trial Results – Prevention Acupuncture for cerebral vasospasm after subarachnoid hemorrhage

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Subarachnoid hemorrhage (SAH) is a neurological disease with a high mortality rate. Cerebral vasospasm, one of serious complications, frequently occurs after successful surgery. Nimodipine, a calcium channel blocker, and hypovolemic-hemodilution-hypertensive (HHH) therapy are used to prevent delayed cerebral vasospasm after SAH, but these treatments are by no means completely effective.

Acupuncture is known to increase the production and activity of vascular endothelial cell-derived NO and improve endothelium-dependent vasodilation. Therefore, we conducted a preliminary case study to investigate the ability of acupuncture to prevent the occurrence of cerebral vasospasm. We treated 20 patients with SAH after their ruptured aneurysms had been secured by endovascular coiling or surgical clipping. Prophylactic HHH therapy and nimodipine were initiated immediately after surgery. Acupuncture treatment started within 3 days after aneurysm rupture and was performed once a day for 2 weeks. The outcomes were compared with those of an age and severity matched control group without acupuncture.

As a result, delayed ischemic neurological deficit (DIND) occurred in 2 patients (10%), angiographic vasospasm in 5 (25.0%) and none of the patients died in acupuncture group. In the control group, DIND occurred in 7 patients (38.9%), angiographic vasospasm in 10 (55.6%) and one patient died.

The results indicate the possibility of acupuncture treatment in preventing the occurrence of cerebral vasospasm after SAH. But, this is a preliminary retrospective case study and rigorous clinical trials such as randomized, double-blind trials are required. To determine the efficacy and safety of acupuncture, a randomized, controlled clinical trial is in progress.

## ESOC-1177

### 03. Clinical Trial Results – Prevention Changes in determinants of health-related behavior improvement after TIA or ischemic stroke

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**Background:** Health-related behavior improvement after TIA or minor stroke may reduce stroke recurrence. We showed that self-efficacy, ie confidence to carry out a certain life style behavior, and fear are important determinants of intention to change health-related behavior after TIA or ischemic stroke. In this study, we assessed whether these determinants vary over time. This may provide insight into the window of opportunity for managing health related behavior change after TIA or ischemic stroke.

**Methods:** We prospectively studied 100 patients with TIA or minor ischemic stroke. Patients were assessed at baseline, and at 3 months after their visit to the TIA clinic or admission to the stroke unit. Fear was measured with an 8-item scale with scores that range from 0 to 32 and higher values indicating higher levels of fear. Self-efficacy was assessed with a 9-item scale with scores that range from 1 to 5, with higher values indicating more confidence to carry out the desired behavior. Changes in fear and self-efficacy from baseline and corresponding 95% confidence intervals (CI) were calculated.

**Results:** At baseline, median self-efficacy was 4 (IQR 3–4), and median fear 16 (IQR 7–21). Fear was significantly higher at baseline than at 3 months (mean difference 2.0; 95% CI 0.08–3.9). No change in self-efficacy was found.

**Conclusion:** Fear significantly decreased over time after TIA or ischemic stroke. Patients with TIA or ischemic stroke have high self-efficacy scores for health-related behavior change and these do not vary over time

## ESOC-0037

### 03. Clinical Trial Results – Prevention Relationship between the plasma level of homocysteine and intra-/ extracranial artery stenosis in the patients with ischemic stroke

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**Objective:** To study the relationship between the plasma level of homocysteine and Intra-/Extracranial Artery stenosis in patients with ischemic stroke.

**Methods:** The correlation between plasma homocysteine levels and cerebral artery stenosis in patients with ischemic stroke were analyzed by case-control study. The laboratory results including medical history, baseline clinical information, imaging examination and homocysteine levels of the patients were collected. The patients were divided into either artery stenosis group or no-stenosis group according to MRA examination.

**Results:** A total of 147 patients with ischemic cerebrovascular disease were enrolled during the study. They were divided into the artery stenosis group (115 cases) and the non-stenosis group (32 cases) according to MRA examination results. The proportion of age ( $65.7 \pm 10.59$  years vs.  $56.33 \pm 14.138$  years,  $t = 4.577$ ,  $p < 0.01$ ), homocysteine levels ( $16.56 \pm 7.5$  mmol/L vs.  $11.25 \pm 6.3$  mmol/L;  $t = 3.65$ ,  $p < 0.01$ ), C-reactive protein ( $4.24 \pm 4.13$  mmol/L vs.  $3.26 \pm 1.6$  mmol/L;  $t = 2.06$ ,  $p = 0.041$ ), low density lipoprotein cholesterol ( $2.87 \pm 0.75$  mmol/L vs.  $2.5 \pm 0.76$  mmol/L;  $t = 1.896$ ,  $p = 0.046$ ), baseline history of diabetes (38.26% vs. 15.62%;  $\chi^2 = 5.772$ ,  $p = 0.016$ ), hypertension (57.4% vs. 25%;  $\chi^2 = 10.507$ ,  $p = 0.01$ ) in the artery stenosis group were significantly higher than those in the non-stenosis group. But high-density lipoprotein cholesterol ( $1.01 \pm 0.23$  vs.  $1.25 \pm 0.43$ ;  $t = -4.26$ ,  $p = 0.000$ ) is lower than nonstenosis group. Multivariate logistic regression analysis showed that age  $\geq 60$  years (OR 3.374, 95% CI 1.351–8.426;  $p = 0.009$ ), HDLC  $> 1.0$  (OR 0.166, 95% CI 0.054–0.511;  $p = 0.002$ ), homocysteine  $> 15$  mmol/L (OR 2.274, 95% CI 1.147–8.173;  $p = 0.025$ ), hypertension (OR 5.782, 95% CI 2.045–16.345;  $p = 0.001$ ), history of smoking (OR 3.514, 95% CI 1.200–10.293;  $p = 0.022$ ) were the independent risk factors for the artery stenosis group. The stenosis group were divided into simple extracranial stenosis group (24 cases), simple intracranial stenosis group (61 cases) and both stenosis group (30 cases) according to stenosis location. The comparison of the clinical data and risk factors among the three groups showed that hypertension ( $\chi^2 = 7.024$ ,  $p = 0.003$ ), LDLC ( $F = 3.276$ ,  $p = 0.042$ ), C-reactive protein ( $F = 3.645$ ,  $0.029$ ) have significant differences. Multivariate logistic regression analysis showed that age (OR 6.351, 95% CI 2.277–17.717;  $p < 0.001$ ), hypertension (OR 3.795, 95% CI 1.261–11.424;  $p = 0.018$ ), HDL-C (OR 0.150, 95% CI 0.043–0.523;  $p = 0.003$ ) were the independent risk factors for intracranial artery stenosis; hypertension (OR 18.490, 95% CI 3.117–10.966;  $p = 0.0010$ ), HDLC (OR 0.078, 95% CI 0.12–0.488;  $p = 0.006$ ), LDLC (OR 6.021, 95% CI 1.212–29.917;  $p = 0.028$ ), homocysteine (OR 4.376, 95% CI 1.026–18.671;  $p = 0.046$ ) were the independent risk factors for extracranial artery stenosis; hypertension (OR 9.178, 95% CI 2.211–38.094;  $p = 0.002$ ), HDLC (OR 0.089, 95% CI 0.021–0.385;  $p = 0.001$ ) homocysteine (4.951, 95% CI 1.378–17.783;  $p = 0.014$ ) were the independent risk factors for co-existing of artery stenosis.

**Conclusions:** The increased plasma homocysteine levels is only related to the extracranial artery stenosis in the patients with ischemic stroke.

## ESOC-1040

### 03. Clinical Trial Results – Prevention

#### Early outcome data from the Cardiac Rehabilitation Adapted for TIA and Stroke (CRAFTS) randomized-controlled trial

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**Background:** The impact of comprehensive, lifestyle-modification programs on adherence to secondary prevention guidelines following TIA/stroke is uncertain.

**Methods:** This single-blinded, multi-center, randomized-controlled trial (ISRCTN90272638) recruited patients ≥3 months after TIA or ≥1 year after ischemic stroke from a Rapid Access Stroke Prevention Clinic and Community Stroke Rehabilitation Service. Patients were randomized to (i) 2-hour didactic risk-factor reduction education class; brief lifestyle intervention counselling on exercise participation, dietary intake and smoking cessation; and 16 aerobic-exercise training classes over 8 weeks (**intervention group**) or (ii) 2-hour didactic risk-factor reduction class alone (**control group**). Primary outcomes included adherence with moderate aerobic exercise (>20 minutes 3 times/week), consumption of 5 portions of fruit and vegetables/day, and smoking cessation. Secondary outcomes included Cardiovascular Risk Scores (CRS), and cardiovascular fitness (VO<sub>2</sub>peak on submaximal testing). An independent, blinded assessor performed baseline (**week 1**) and follow-up (**week 10**) objective measurements. Chi-squared tests compared proportional improvement between groups. Adjusted mean changes in continuous variables were analyzed by ANCOVA. Analyses were by intention-to-treat.

**Results:** Seventy-two patients were assigned to 'intervention' and 70 to 'control' groups. A higher proportion in the intervention group improved compliance with moderate exercise (P = 0.04), fruit and vegetable consumption (P = 0.026), smoking cessation (P = 0.045), and all three measures compared with controls (P = 0.005). Cardiovascular fitness (VO<sub>2</sub>peak) was more improved in the intervention group than in controls (P = 0.042), no difference in CRS was noted (P = 0.144).

**Discussion:** A modified-cardiac rehabilitation program improves initial adherence to lifestyle guidelines, and may improve cardiovascular fitness after TIA/ischemic stroke. One-year follow-up data are being analyzed.

## ESOC-0922

### 03. Clinical Trial Results – Prevention

#### Contributing factors for the baseline intima-media thickness of the carotid artery in Japanese stroke patients: J-STARS Echo Study

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**Background and Purpose:** J-STARS is a multicenter, randomized, open-label, parallel group trial on the secondary stroke prevention, using pravastatin (10 mg/day) in Japanese patients with noncardioembolic ischemic stroke and hypercholesterolemia (Nagai Y, et al: Int J Stroke 2014). As one of the sub-studies, this study (ClinicalTrials.gov NCT00361530) aimed to explore pleiotropic effects of statin on the changes of carotid atherosclerosis, as assessed by ultrasound.

**Methods:** Of 1589 patients recruited for J-STARS, 804 patients (266 women, 66.4 ± 8.3 years old) underwent ultrasound evaluation. Mean and maximum intima-media thickness (IMT) of the bilateral common carotid arteries was automatically measured by the Intimascope® (Softmedical).

**Results:** Baseline characteristics of patients were similar between 393 patients in pravastatin group and 411 patients in control group. Mean IMT was 0.84 ± 0.22 mm in pravastatin group and 0.84 ± 0.20 mm in control group (p=0.57). Max IMT was 1.24 ± 0.45 mm and 1.23 ± 0.38 mm, respectively (p = 0.62). By multiple regression analysis, factors associated with mean IMT were men (β 0.050, p = 0.002), age (/10 years) (0.038, p < 0.001), categories of blood pressure (0.026, p = 0.020), and mRS at entry (0.020, p = 0.016). Also, factors associated with max IMT were men (0.075, p = 0.019), age (0.065, p < 0.001), diabetes mellitus (0.070, p = 0.042), categories of blood pressure (0.045, p = 0.038), and mRS (0.035, p = 0.045).

**Conclusion:** In the Japanese stroke patients recruited for J-STARS, baseline IMT values and their associations with atherosclerotic risk factors were similar to those reported in prior studies from Western countries, supporting the rationale of international comparison despite difference in race and ethnicity.

## ESOC-0091

### 03. Clinical Trial Results – Prevention

#### Feasibility of multidomain preventive lifestyle intervention in stroke patients. twelve-month findings from a randomized, multi-center, multi-intervention study to prevent cognitive decline after ischemic stroke (ASPIS)

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**Background:** Cognitive impairment after stroke is a considerable burden to stroke survivors. Using the data of the 1-year interim analysis of the ASPIS trial designed to examine whether intensive multi-intervention lifestyle modifications can prevent cognitive decline at 24 months we evaluated the effectiveness of such intervention on lifestyle parameters.

**Methods:** A randomized, multicenter, observer-blind, two-arm parallel group clinical trial in 202 acute stroke patients. Lifestyle interventions in the intervention group were individually designed with the target of increasing regular physical activity, improving healthy diet and adequate blood pressure control. The control group obtained standard stroke care.

**Results:** After 12 months the use of reduced-fat milk ( $p = 0.031$ ), reduced-fat spreads ( $p = 0.007$ ) and the consumption of fish ( $p = 0.021$ ) significantly increased in the intervention group compared to baseline, but no changes were observed in the control group. Furthermore, we created a low-risk lifestyle summary score including lifestyle indicators (nutrition, physical exercise, body mass index, non-smoking) and a low-risk lifestyle and laboratory summary score including additionally fasting glucose, blood pressure and non-high-density lipoprotein cholesterol. Those scores indicated a significant improvement in the number of healthy lifestyle indicators and adequately controlled laboratory parameters ( $p < 0.001$ ) in the intervention group compared with the control group.

**Conclusions:** These interim results of the ASPIS-trial demonstrate the feasibility of intensified individualized lifestyle interventions in stroke patients and confirm that multidomain interventions might be more effective in changing lifestyle habits than standard stroke care.

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**Results:** We prospectively enrolled 87 patients (age  $62.2 \pm 9.7$  yrs, male 66.7%). Plaques were of moderate (stenosis 50–70%;  $n = 11$ ) to severe (stenosis  $>70\%$ ;  $n = 87$ ) stenosis (mean stenosis:  $76 \pm 10\%$ ). We observed irregular or ulcerated surfaces in 53 plaques (54.1%), and all ulcers ( $n = 7$ ) were located at the upstream border. Maximal stenosis was predominantly at the proximal (20.4%) or distal (48%) region of the plaque. The majority of plaques were eccentric (87.8%). Surfaces of moderate stenoses were mostly smooth, significantly higher than that in severe stenoses (81.8% vs. 41.4%) ( $p = 0.015$ , Fisher's Exact Test).

**Conclusion:** High-grade symptomatic intracranial plaques were frequently eccentric, associated with an irregular or ulcerative surface at the upstream border. These morphological characteristics may predict plaque vulnerability.

## ESOC-0345

### 03. Clinical Trial Results – Prevention

#### MORPHOLOGICAL CHARACTERISTICS OF INTRACRANIAL ATHEROSCLEROTIC PLAQUES

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**Background:** Intracranial atherosclerosis is a common stroke etiology with a high risk of recurrence. Studies on morphology of intracranial plaques may improve our understanding of underlying stroke mechanism.

**Method:** We prospectively recruited patients with symptomatic intracranial atherosclerotic stenosis for 3D-rotational angiography within one month from the index stroke. Morphological parameters included plaque surface (smooth/irregular/ulcerated), ulcer location (upstream/downstream), plaque thickness, length, thickness-to-length ratio, upstream angulation, maximal stenosis distribution (proximal/middle/distal) and eccentricity.

## Prevention (Other Than Clinical Trials)

### ESOC-1562

#### 04. Prevention (Other than Clinical Trials)

##### Better stroke preventive effect of calcium channel blockers is not explained by its effect in macro and microvascular disease markers

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**Background:** Recent data challenged the cornerstone statement that only blood pressure (BP) values are important to stroke prevention, regardless of drug class, showing that calcium channel blockers (CCB) seem to be more effective in reducing cerebrovascular events, although the mechanisms remains elusive.

**Aim:** To find whether CCB use is associated with lower retinal damage, coronary atherosclerosis, aortic stiffness and carotid artery intima-media thickness (IMT).

**Methods:** Two groups, with CCB (n = 77) and without CCB (n = 78), were selected from a cohort patients at a Hypertension Clinic. Groups were compared regarding gender, age, BMI, past medical history, HgA1c, lipids, uric acid, 24-hours MAPA BP, left ventricle dysfunction, retinopathy lesions by fundus photograph, aortic stiffness by pulse wave velocity (PWV), coronary calcium score (CAC), carotid plaques and IMT by duplex ultrasound.

**Results:** CCB patients used more statin (p = 0.004), antiplatelet (p = 0.011) and combined hypertensive (p < 0.001) drugs and had higher HgA1c (p = 0.040) and lower BP (systolic p = 0.003; diastolic p = 0.002). CAC (89.7 vs 88.5 AU, p = 0.566) and PWV (10.9 ± 1.8 vs 11.0 ± 1.8 m/s, p = 0.815) did not differ between groups. Mean IMT was higher (0.76 ± 0.13 vs 0.72 ± 0.13 mm, p = 0.048) and retinopathy (61% vs 42%, p = 0.024) more frequently present with CCB but not after multivariate adjustment.

**Conclusions:** In a hypertensive population, retinal disease, carotid, coronary and aortic atherosclerotic pre-clinical biomarkers, were not significantly different in CCB users, as compared to non-CCB users. CCB higher efficacy in stroke prevention may be explained by other factors unrelated to direct cerebral micro and macrovascular damage.

### ESOC-1397

#### 04. Prevention (Other than Clinical Trials)

##### Antiplatelet agents use before ischemic stroke is associated with reduced severity of stroke

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**Introduction:**

- Antiplatelet agents use in acute stroke reduce the risk of recurrent ischemic stroke
- It is less well known whether antiplatelet agents use before stroke onset reduces the severity of ischemic stroke

- We used a phase 3 database of Citicoline where sufficient numbers of patients were on antiplatelet agents and measures of stroke severity were available (NIHSS at stroke onset)

**Methods:**

- Outcomes were dichotomized to:
  - \* Severe stroke (NIHSS > 14)
  - \* Mild to moderate stroke (NIHSS ≤ 14)
- Patients were divided into 2 populations:
  - \* On antiplatelet agents before stroke onset
  - \* Not on antiplatelet agents before stroke onset

**Analysis:**

- Outcomes: NIHSS score at admission
- NIHSS ≤ 14 is a positive outcome
- NIHSS > 14 is a negative outcome
- Univariate analysis was performed using demographic, vascular risk factors and medications before stroke onset. Univariate predictors with P < 0.1 were included in the multivariate model
- Multivariate regression analysis was done to determine independent factors predictive of NIHSS ≤ 14 (Milder stroke)

**Conclusions:**

- Patients with a history of cardiac disease were 1.516 time more likely to have a severe stroke (NIHSS > 14) than patients who did not have a history of cardiac disease (P < 0.05)
- Patients on antiplatelet therapy were 1.466 time more likely to have a mild to moderate (NIHSS ≤ 14) stroke compared to patients not on antiplatelet therapy (P < 0.05)

### ESOC-0745

#### 04. Prevention (Other than Clinical Trials)

##### TIA Pathway implementation to improve clinical management in a second-level hospital: The experience of Modena in Management of TIA Patient

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**Background:** Transient ischemic attack (TIA) is considered a medical emergency and is associated with high risk of stroke in short time. In our local experience, a protocol for management of TIA was created and applied until 2008, and results of first two years application were encouraging. We evaluated results of last four year-application of protocol, in a prospective observational cohort study.

**Protocol:** Patients with suspected TIA is evaluated by Neurologist and undergone to CT scan. If CT has resulted negative for brain lesions patient is admitted to Emergency Department (ED) for 24 hours observation and ABCD2 score is calculated. Blood sample, carotid and transcranial ultrasound, ECG and blood pressure monitoring are performed. At the end of the observation we could have different settings on the basis of presence of ABCD2 score, cerebrovascular risk factors, and results of investigations. On the basis of these factors patient could be discharged or hospitalized.

**Methods:** We prospectively analyzed patients admitted at ED with suspected TIA in the period January 2011-June 2014 and compared to data of patient with suspected TIA for the year 2007, in particular diagnosis accuracy, recurrence stroke-TIA, risk factor analysis.

**Results:** In the period January 2011 to June 2014 we documented an increased diagnostic accuracy (65–75% vs 43%), a reduction in number

and percentage of recurrent stroke-TIA (13% vs 29%,  $p < 0.001$ ) and a confirmed reduction in hospitalization for patient with TIA (19–31% vs 41%).

**Conclusion:** These results, after application of multidisciplinary protocol, may suggest a strategy for improving management of TIA patients.

## ESOC-1382

### 04. Prevention (Other than Clinical Trials) Medication adherence at six months post-ischemic stroke – The ASPIRE-S Study

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**Background:** Survivors of ischemic stroke (IS) are at high-risk of future vascular events. Secondary prevention improves long-term outcomes however medication adherence is essential for therapeutic benefits. ASPIRE-S (Action on Secondary Prevention Interventions and Rehabilitation in Stroke) was a prospective multi-center study that comprehensively assessed patients six months following IS. This included a measure of self-reported medication adherence.

**Methods:** Consenting patients admitted with IS to three Dublin hospitals were recruited over one year, from October 2011. At six months post IS, assessments were completed. The Medication Adherence Rating Scale captured self-reported medication adherence.

**Results:** 302 patients (58% male; mean age 69 years, range 22–95) were recruited, of whom 256 (85%) were followed-up at six months. Overall, self-reported adherence was excellent (mean score 24.2/25, range 12 to 25). However, 43% of patients admitted to (sometimes) unintentionally missing medication dosages. These patients (compared with fully adherent patients) were younger (54% of those vs 23% of those >80 y), on less medications (57% of those on vs 22% of those on  $\geq 10$  medications) and had better function (51% of those with mRS  $\leq 2$  vs 23% of those with mRS >3);  $p$

**Conclusion:** Overall self-reported medication adherence was excellent. Older age and polypharmacy may necessitate medication supervision, resulting in improved adherence. Patients with milder strokes may have been less concerned about secondary prevention and therefore medication adherence. Focus must be placed on all patients to explain the purpose of medications and the importance of adherence to ensure effective secondary prevention post-stroke.

## ESOC-0540

### 04. Prevention (Other than Clinical Trials) Self-efficacy and determinants of self-efficacy for health-related behavior change in patients with TIA or minor ischemic stroke

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**Background:** Health-related behavior change after TIA or minor stroke may reduce stroke recurrence. Self-efficacy, i.e. confidence to carry out behavior necessary to reach a desired goal, is important for achieving health-related change. Little is known about the role of self-efficacy in health-related behavior change in patients with ischemic stroke or TIA. We aimed to assess self-efficacy for health-related behavior change in patients with TIA or ischemic stroke.

**Methods:** We prospectively studied 100 patients with TIA or minor ischemic stroke. Patients filled in questionnaires on self-efficacy for health-related behavior change, and sociocognitive determinants including severity, susceptibility, fear, social support. Self-efficacy was measured with a 9-item scale with scores that range from 1 to 5. Higher values indicate more confidence to carry out the behavior necessary to reach the desired goal. Demographic data, vascular history and risk factors, event type, cognitive impairment and depression were also collected. We studied relations between sociocognitive determinants, depression, cognitive impairment, vascular risk factors and history, and demographic data and self-efficacy with univariable linear regression.

**Results:** Median self-efficacy at baseline was 4 (IQR 3.8–4.7). Age (OR 1.04, 95% CI 1.01–1.09), depression (OR 1.09, 95% CI 1.03–1.16), presence of vascular history (OR 2.42, 95% CI 0.98–6.03), BMI (OR 1.15, 95% CI 1.01–1.30), and fear (OR 1.06, 95% CI 1.01–1.12) were associated with low self-efficacy.

**Conclusion:** Patients with TIA of minor ischemic stroke on average have high self-efficacy scores for health-related behavior change. Low self-efficacy scores are associated with higher age, known vascular disease, depression, higher BMI and increased fear.

## ESOC-1566

### 04. Prevention (Other than Clinical Trials) Carotid intima-medial thickness, aortic stiffness and retinal microvascular signs provide evidence for optimal blood pressure target in hypertensive patients

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**Background:** Hypertension is a major modifiable risk factor for ischemic and hemorrhagic stroke, particularly in the elderly. In this aged group, recent guidelines changed the systolic blood pressure (BP) control cut-off from 140 mmHg to 150 mmHg, which could raise concern about stroke prevention.



**Aim:** We aim to find differences in biological markers of heart damage, aortic stiffness, carotid and retinal microvascular disease that could support or refute this view.

**Methods:** Three groups, A, B and C, with Systolic BP < 140 (n = 39), 140–149 (n = 27) and ≥150 (n = 89), respectively, were selected from a cohort at an Hypertension Clinic. Groups were compared regarding gender, age, past medical history, BMI, HgA1c, lipid, uric acid, 24-hours MAPA BP, left ventricle hypertrophy (LVH), aortic stiffness by pulse wave velocity (PWV), carotid intima-medial thickness (IMT) by duplex ultrasound and retinopathy microvascular signals (RMS) by fundus photograph.

**Results:** Groups did not differ in baseline characteristics except for higher diastolic BP in C (p < 0.001) and lower HgA1c levels in A (p < 0.001). PWV (11.6 ± 1.8, 10.1 ± 1.5 and 10.1 ± 1.5, p < 0.001), IMT (0.77 ± 0.13, 0.69 ± 0.11 and 0.70 ± 0.13, p < 0.001), RMS score (2.4 ± 2.7, 1.3 ± 2.3 and 0.9 ± 1.4, p = 0.004), presence of any retinopathy (61, 39 and 39%, p = 0.024) and of LVH (30, 11 and 11%, p = 0.013) was only higher in >150 mm Hg group. Groups A and B were similar.

**Conclusions:** Retinal microvascular signals, left ventricular hypertrophy, aortic stiffness and carotid intima-medial thickness significantly increased only at systolic BP levels above 150 mmHg. This provides evidence of biological plausibility for this BP target for older patients.

## ESOC-1148

### 04. Prevention (Other than Clinical Trials)

#### Level of heterogeneity between neuroradiologists, neurosurgeons, neurologists and epidemiologist in the Unruptured Intracranial Aneurysm Treatment Score (UIATS)

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**Objective:** Unruptured intracranial aneurysms (UIAs) are being identified with increasing frequency. Recently, a group of experts developed an UIA treatment score (UIATS) that guides decision making for management of UIAs. We assessed heterogeneity between different specialties regarding their agreement with treatment recommendations based on the UIATS during its development.

**Methods:** A multidisciplinary (neurosurgery, NSX; neuroradiology, INR and neurology/clinical epidemiology, NEU/EPI) group of 69 experts on

UIA management and research was convened to develop and validate the UIATS model using a Delphi consensus. Thirty selected UIA cases were used to analyze agreement with UIATS management recommendations based on a 5-point Likert scale (5 indicating strong agreement) for experts who were and were not involved in the development of the UIATS. Inter-rater agreement (IRA) between experts and specialties was assessed with standardized coefficients of dispersion (vr\*) (vr\* = 0 indicating excellent and vr\* = 1 poor agreement).

**Results:** Overall agreement with UIATS treatment recommendations (mean Likert scores) per reviewer was 4.2 (95%CI: 4.1–4.3) for all experts, 4.3 (95%CI: 4.2–4.4) for NSX, 4.1 (95%CI: 3.9–4.3) for INR and 4.1 (95%CI: 3.9–4.4) for NEU/EPI (p = 0.234). Overall IRA (vr\*) for all specialties was 0.026 (95%CI: 0.019–0.033), without any evidence for heterogeneity between the different specialties (p = 0.846).

**Conclusions:** The UIATS captures an excellent consensus among highly informed individuals on UIA management, irrespective of their underlying specialty. Clinicians can use the UIATS as a comprehensive mechanism for indicating how a large group of specialists might manage an individual UIA patient.

## ESOC-0252

### 04. Prevention (Other than Clinical Trials)

#### Stroke Riskometer app: A new promising approach for primary stroke prevention and epidemiological research on stroke and other major non-communicable disorders (NCD) across the globe

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There is little awareness in the population about stroke and other major NCD that share common risk factors (eg, heart attack, dementia, diabetes mellitus), and their risk factors. This, coupled with underutilization of strategies for primary prevention of NCD on an individual level and the lack of accurate data on the frequency and significance of risk factors in different populations have been implicated in the ever-increasing worldwide burden of these NCD. Recent advances in mobile (smartphone) technologies and their worldwide use (about 1.75 billion users) offers a unique opportunity to utilize these technologies for improving health and research capabilities. In recognition of the importance of e-research NCD initiatives, the United Nations (UN) Economic and Social Council, the International Telecommunication Union (ITU) and the World Health Organization (WHO) have recently (June 2013) launched a new mHealth initiative for improving NCD prevention, treatment and policy enforcement.

To inform and support these UN/ITU/WHO efforts, AUT University in collaboration with New Zealand Stroke Education (charitable) Trust recently developed a new, validated version of the Stroke Riskometer™ app translated into 12 world's most spoken languages. Endorsed by the World Stroke Organization, World Federation of Neurology and

the International Association on Neurology and Epidemiology the app allows calculation of not only risk of stroke occurrence and risk profile-tailored recommendations on stroke prevention but also a participation in the unprecedented, global smartphone-based research on frequency, distribution and determinants of major NCD – RIBURST study (Reducing the International Burden of Stroke Using Mobile Technology).

#### ESOC-1162

##### 04. Prevention (Other than Clinical Trials) Awareness of stroke risk factors in the general population and changes of risk factor knowledge by an educational lecture

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**Introduction:** Previous studies showed poor knowledge of stroke risk factors in the general population. We investigated awareness of stroke risk factors in the lay public and changes of its short-term knowledge by an educational lecture.

**Method:** Hospitals providing Stroke Unit care in Germany were invited to organize educational lectures for the lay public during the World Stroke Day 2014. Risk factor awareness among participants was measured before and after the lecture. Two different lecture formats were used, one with regular information material and one with material specifically adapted for lay public needs. Hospitals were randomly assigned to one of these presentation groups. The study was organized by the German Stroke Society, the German Stroke Foundation, the Center for Stroke Research Berlin and the Institute of Clinical Epidemiology Würzburg.

**Results:** Overall, 2124 persons in 51 regions across Germany participated in the study. Diabetes and atrial fibrillation were less known as risk factors for stroke before the lecture (65.0% and 64.9%, respectively), whereas hypertension and obesity were correctly identified from 95.1% and 88.4% of the participants. After the lecture the correct short-term knowledge increased significantly to 84.0% or more for all risk factors. Hierarchical linear regression showed improvement of risk factor knowledge being associated with personal experience of vascular diseases and participation in a lecture specifically adapted for lay public needs.

**Conclusion:** Educational lectures seem to be beneficial to improve short-term knowledge of risk factors for stroke, especially if the information material is specifically adapted to lay public needs.

#### ESOC-0434

##### 04. Prevention (Other than Clinical Trials) Neurophysiological monitoring during trans-catheter, endovascular closure of adults' patent foramen ovale (PFO)

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**Introduction:** Trans-catheter endovascular is a non-surgical, minimally invasive technique to treat PFOs. However, cardio-cerebral embolisms can occur. Our aims are to describe and assess an intra-procedural neurophysiological monitoring (IPNM) protocol to prevent stroke clinically significant during these procedures.

**Materials and Methods:** Twenty-one (N = 21) successive patients have been studied between January of 2010 and July of 2014. Somatosensory evoked potentials from upper and lower extremities, and bi-hemispheric electroencephalogram were monitored.

**Results:** Mean age was 53.9 years (SD: ±16.7), and two thirds of the patients were females. Average duration of the procedure was 79.9 mins. All subjects received heparin according to ACT, general anesthesia, and muscular relaxation. A device was successfully deployed in 90.5% of subjects, and two cases were aborted. Four cases (19.05%) had abnormal baseline signals, and none presented significant (amplitude reduction <sup>3</sup> 50%, latency increase <sup>3</sup> 10% of baselines) changes. Although no post-procedure brain MRI has been done, no subject has shown abnormal mental status or neurologic deficit.

**Conclusions:** Preliminary data shows IPNM has a 100% specificity, with no false positives to detect clinically significant cardio-cerebral embolisms during the endovascular closure of PFOs. No patient showed neurological changes, therefore, a false negative rate could not be determined.

#### ESOC-1409

##### 04. Prevention (Other than Clinical Trials) Neuroprotection induced by physical activity level prior to ischemic stroke

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Regular physical activity (PhA) is associated with improved functional outcome following stroke. We aim to investigate the possible neuroprotective effect of prestroke PhA, on final infarct size using 24 hour MRI-DWI and functional outcome determined on modified Rankin Scale (mRS) after three months.

Physical Activity Scale for Elderly (PASE) was used to determine PhA. PASE is a questionnaire which quantifies physical activity over a 7-day period (range 0 to >400).

102 patients, mean age 64.3 years, 39.2% women with rtPA treated acute ischemic stroke were included. 24-Hour MRI-DWI (n = 80) and 3-month mRS (n = 102) were adjusted for baseline acute-DWI lesion and National Institute of Health Stroke Score (NIHSS), respectively.

Increase of one point in PASE score was associated with decreased final infarct volume (-0.4% (-0.7%;-0.3%) (SE = 0.002) (p = 0.031), suggesting a dose response relationship. The linear regression analysis included age, hypertension, atrial fibrillation and type 2 diabetes mellitus and baseline acute DWI lesion volume. Infarct growth defined as DWI (24 h-baseline), were significantly reduced in patients with the highest PhA (linear regression, p = 0.036)

PhA was associated with decreased odds for a long-term unfavorable outcome (mRS 2 to 6), when corrected for baseline NIHSS. -1.1% (SE

0.0039) ( $p = 0.005$ ). The association remained significant also after multiple logistic regression analysis included relevant baseline characteristics ( $p = 0.039$ ).

**Conclusion:** Level of physical activity prior to ischemic stroke may induce neuroprotection and reduced infarct growth and final infarct in the hyper acute phase of ischemic stroke (<24 hours) which may contribute to an improved functional outcome at 3 months.

#### ESOC-0378

##### 04. Prevention (Other than Clinical Trials) Statin pretreatment is associated with initial stroke severity in non-cardioembolic ischemic stroke patients with dyslipidemia: The Fukuoka Stroke Registry

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**Background:** Statin pretreatment improves neurological outcomes after ischemic stroke. However, the effect of statin pretreatment on initial stroke severity, especially in patients with dyslipidemia, has been remained controversial. We aimed to evaluate the association between statin pretreatment and initial stroke severity in ischemic stroke patients with dyslipidemia.

**Methods:** Patients with first-ever ischemic stroke (within 24-hours of onset) with dyslipidemia who had been functionally independent (modified Rankin Scales  $\leq 1$ ) before the onset were enrolled in this study ( $n = 1,323$ ). Mild stroke severity was defined as NIHSS  $\leq 4$  on admission. Multivariable logistic regression models and propensity score (PS)-matched analysis were used to quantify the association between statin pretreatment and mild stroke severity.

**Results:** Of overall patients, 299 (22.6%) were taking statins prior to the stroke. Mild stroke severity on admission tended to be more frequent in patients with statin pretreatment than in those without the treatment (65% vs 60%,  $p = 0.09$ ). Multivariable analysis showed that statin pretreatment was significantly associated with higher probability of mild stroke severity on admission (odds ratio [OR], 1.75; 95% confidence interval [CI], 1.26–2.46). In the stroke subtype-stratified analysis, the association was similar in patients with non-cardioembolic ischemic stroke in multivariable-adjusted model (OR, 2.00; 95% CI, 1.33–3.05) as well as in the PS-matched analysis (OR, 2.24; 95% CI, 1.01–4.97). A similar but non-significant association was observed in patients with cardioembolic stroke (multivariable OR, 1.73; 95% CI, 0.90–3.37).

**Conclusions:** Statin pretreatment was significantly associated with mild stroke severity on admission within 24-hours of onset in non-cardioembolic ischemic stroke patients with dyslipidemia.

#### ESOC-0443

##### 04. Prevention (Other than Clinical Trials) Modeling likely risk and benefit of long-term aspirin-based secondary prevention after TIA and ischemic stroke at older ages: Population-based study

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**Background:** Randomized trials (RCT) of long-term aspirin after TIA and ischemic stroke were done 20–40 years ago in patients with a mean age of 63 years. Half of patients are now aged  $\geq 75$  (20% aged  $\geq 85$ ), when risk of bleeding is considerably increased. Modeling studies show that benefit from antiplatelet drugs is unlikely once the ratio of major bleeds:ischemic events reaches 0.5.

**Methods:** We studied all bleeding events requiring medical attention (identified from 10-year face-to-face follow-up and multiple other sources) and all recurrent ischemic vascular events (stroke, acute coronary events or sudden cardiac death) in all patients with a first TIA or ischemic stroke who were treated with antiplatelet drugs in a defined population (Oxford Vascular Study) from 2002–2012. The ratio of major bleeds (CURE Trial definition) to ischemic events was stratified by age.

**Results:** Of 2072 patients on antiplatelet treatment (1961/94.6% aspirin-based), 1088 (52.5%) were aged  $\geq 75$  y. During 8,585 patient-years of follow-up, there were 117 major bleeds and 392 ischemic events. At age  $< 75$  the bleed: ischemic ratio (0.16, 95% CI 0.10–0.25) was comparable to that in previous RCTs (0.20, 0.19–0.22). However, the ratio was much higher (0.42, 0.31–0.57) at age  $\geq 75$  (difference –  $p = 0.0003$ ), particularly after the acute phase (post-90 days: 0.54, 0.37–0.78) and at age  $\geq 85$  (0.64, 0.41–1.00).

**Conclusions:** The ratio of major bleeds:ischemic events on long-term follow-up in patients treated with aspirin after TIA and ischemic stroke at age  $> 75$  may not be consistent with overall benefit of long-term treatment. Trials of gradual withdrawal treatment in older age groups are justified.

#### ESOC-1426

##### 04. Prevention (Other than Clinical Trials) Management of carotid stenosis in the real evolving world: Single-center experience with a multidisciplinary team including stroke neurologists

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**Background:** Carotid stenosis management has evolved in the last decade and includes endarterectomy (CEA), stenting (CAS) and/or medical treatment (MT). Guidelines recommend decision making after multidisciplinary discussion including neurologists. We aimed to present a single-center experience over 6 years on carotid stenosis management.

**Methods:** Prospective hospital registry of all patients evaluated in a weekly multidisciplinary session including stroke neurologists, vascular surgeons and interventional radiologists. Treatment decision was achieved following internal protocols which have been progressively updated according to international guidelines and clinical trials. Patients were followed-up by a stroke neurologist.

**Results:** From January 2008 to December 2014, 465 patients with carotid stenosis were evaluated. Final decision treatment was 138 CEA, 133 CAS

and 194 MT. MT alone was more frequently decided in asymptomatic stenosis, older patients and in those with co-morbidities. Revascularization of asymptomatic stenosis decreased over time from 60% in 2008 to 18% in 2014. Time from multidisciplinary session to revascularization decreased progressively from 30 days in 2008 to 7 days in 2014. Combined peri-procedural (30 days) stroke/death was 2.3% in CAS and 0% in CEA in asymptomatic stenosis, and 4.6% in CAS and 5.2% in CEA in symptomatic. Stroke recurrence at 1 year was recorded in 3.2% (2/63) of patients under MT (both with symptomatic stenosis not suitable for revascularization), in 2.8% (2/72) in CAS and in 1.5% (1/68) in CEA.

**Conclusions:** Multidisciplinary decision including stroke neurologists and continuous evaluation of quality standards lead to an optimal management of carotid stenosis. Asymptomatic carotid stenosis has a benign natural course under optimal MT

#### ESOC-1006

##### 04. Prevention (Other than Clinical Trials) Centrally Observed Home Telemetric Monitoring of Blood Pressure to Manage Intensive Treatment (COMMIT) Study: Medication changes and control of BP

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**Background:** Hypertension is a major modifiable risk factor for recurrent stroke, but rates of control in practice are low. We determined the feasibility of using telemetric home BP-monitoring to improve control after TIA and stroke.

**Methods:** We studied consecutive patients with TIA and non-disabling stroke in a population-based study (Oxford Vascular Study). After prescription of initial antihypertensive medication, patients measured their BP with a Bluetooth-equipped monitor (t+ Medical, Abingdon, UK) for 1–3 months, depending on control. Measurements transmitted automatically in real time and were checked daily on a secure webpage. If BP was consistently above (>130/80) or below (<100/60) medication was adjusted. BP was measured in clinic at 1 and 3 months follow-up.

**Results:** Among 1000 participants, mean/SD age was 69/13 years (range = 21–98), with 23% aged ≥80 years. BP-lowering medication was initiated or increased at the pre-monitoring baseline assessment in 555 patients. Medication was further initiated or adjusted at least once within the first month of home-monitoring in 558 patients and from 1–3 months in 393 patients. Mean BP measured on clinic follow-up fell from 141/83 at entry to 130/74 at 1-month ( $p < 0.001$ ) and to 127/72 mmHg at 3-months ( $p < 0.001$ ).

**Conclusion:** Telemetric home BP monitoring was feasible in patients with TIA and non-disabling stroke irrespective of age. Monitoring informed titration of medication in the majority of patients, and was associated with good BP control.

#### ESOC-0392

##### 04. Prevention (Other than Clinical Trials) Stroke prevention in atrial fibrillation population: Predictors of anticoagulation control in new warfarin users

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The safety and effectiveness of warfarin therapy depends critically on the quality of anticoagulation control, often assessed using the percentage time in therapeutic International Normalized Ratio (INR) range (TTR). We aim to identify patient characteristics associated with quality of anticoagulation control on warfarin, as measured by TTR.

We carried out a population-based retrospective study using data from the Clinical Practice Research Datalink. This study included one cohort of patients starting warfarin treatment after a first diagnosis of atrial fibrillation (AF) between January 2000 and December 2013. We used multivariate mixed regression and logistic regression models to predict the fully-adjusted effect of each predictor variable upon TTR.

The study population comprised 29,717 incident AF patients who initiated warfarin. Patient characteristics all together explained only 2% of the variation in individual's TTR. Poor anticoagulation control (TTR<70%) driven by subtherapeutic INRs occurred in younger patients (<45 years) and in AF patients with repeated hospitalizations. Poor anticoagulation control driven by sub and/or supratherapeutic INRs was seen in AF patients who were current smokers and in patients using medications for pain.

In a real world clinical practice setting there is a high amount of unpredictable inter-individual TTR variability and in some patients good anticoagulation control is more challenging to achieve and maintain than in others. These findings draw attention to the difficulty of achieving high-quality anticoagulation control with warfarin clinical practice and may help to identify patients who will require closer monitoring or innovative management strategies to optimize the outcomes of oral anticoagulant therapy.

#### ESOC-1470

##### 04. Prevention (Other than Clinical Trials) Sonodynamic therapy of neointimal hyperplasia stenosis in the rabbit carotid artery with repeated extracorporeal shock waves accompanied by PESDA microbubbles and protoporphyrin IX administration

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**Introduction:** In-stent restenosis is related to neointimal hyperplasia. Severe carotid restenosis after stenting is a risk factor for ischemic stroke and its related deaths.

**Aims:** We developed an experimental electrohydraulic shock wave generator (0–20 kv), and investigated its effectiveness on neointimal hyperplasia reduction in the rabbit carotid artery.

**Methods:** Briefly, New Zealand white rabbits underwent perivascular severe cold injury using liquid nitrogen at the right common carotid artery. After eight weeks, the histopathology results showed progressive smooth muscle cells proliferation in neointimal layer, resulting in vessel wall thickening. Then treatment group underwent sonodynamic therapy with repeated electrohydraulic shock waves accompanied by protoporphyrin IX (50 mg/kg) and PESDA microbubbles (100 µl/kg, 2–5 ×10<sup>5</sup> bubbles/ml) administration. Blood volume flow and blood mean velocity were measured by color Doppler ultrasonography at the stenotic region. Moreover, wall mean thickness and percentage of luminal cross-sectional area of stenosis were measured by B-mode ultrasound and histology.

**Results:** Results showed a significant reduction in the mean value for blood mean velocity, wall mean thickness and the percentage of luminal cross-sectional area of stenosis and a significant increase in the mean value for blood volume flow in the treatment group compared with the other groups ( $P < 0.05$ ).

**Conclusion:** Cytotoxic effect of protoporphyrin IX and inertial cavitation effect of PESDA microbubbles, induced by repeated shock waves, can cause to reduce the smooth muscle cells in neointimal layer and significantly dilate the luminal cross-sectional area of stenosis.

### ESOC-1473

#### 04. Prevention (Other than Clinical Trials) Non- invasive treatment of advanced carotid atherosclerosis using repeated extracorporeal shock waves accompanied by PESDA microbubbles and high-dose atorvastatin administration

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**Introduction:** The management of advanced carotid atherosclerosis with severe stenosis (>70%) reduces the risk of stroke and its related deaths. Management options are invasive and include carotid endarterectomy and carotid artery stenting.

**Aims:** We developed an experimental electrohydraulic shock wave generator (0–20 kv), and investigated its effectiveness on stenosis reduction in the rabbit carotid artery.

**Methods:** Carotid fibro-lipid plaque with severe stenosis (>70%) and neovascularization was induced at the right common carotid artery of New Zealand white rabbits. The animals treated by repeated electrohydraulic shock waves accompanied by PESDA microbubbles (100 µl/kg, 2–5×10<sup>5</sup> bubbles/ml) and high- dose atorvastatin (5 mg/kg/day) administration. Blood volume flow and blood mean velocity were measured by color Doppler ultrasonography at the stenotic region. Moreover, wall mean thickness and percentage of luminal cross-sectional area of stenosis were measured by B-mode ultrasound and histology.

**Results:** Results showed a significant reduction in the mean value for serum lipid parameters, blood mean velocity, wall mean thickness and the percentage of luminal cross-sectional area of stenosis and a significant increase in the mean value for blood volume flow in the treatment group compared with the other groups ( $P < 0.05$ ).

**Conclusion:** Inertial cavitation effect of microbubbles, induced by repeated shock waves, and lipophilic and pleiotropic effects of high-dose atorvastatin can cause to destroy the plaque microvessels, reduce the lesion lipid content and significantly dilate the luminal cross-sectional area of stenosis.

### ESOC-0435

#### 04. Prevention (Other than Clinical Trials) Should we be screening the Asian population at a younger age? A review of the University Hospitals of Leicester NHS Trust Stroke Database

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Leicestershire is renowned for being a multicultural area, with an Asian population of 35.8% (1). There is currently limited research exploring the differences in stroke between the Asian and White population. Banerjee et al demonstrated that, compared to the White population, the London south Asian stroke population was younger with a larger proportion of hemorrhages (2). This review was undertaken to determine whether the Leicestershire population demonstrates the same pattern.

Data from the University Hospitals of Leicester NHS Trust's stroke database from February 2013 to July 2014 was analyzed. It confirms that in the Asian population strokes occur at a younger age (graph 1), and there is higher incidence of vascular risk factors (Table 1), but a difference in stroke type was not found.

This raises the question of whether these groups are being screened appropriately. Should risk factors, such as hypertension, be actively looked for at an earlier age? Further research is planned, and may prove vital to the future health care planning of the local stroke service.

Table 1

	White	Asian
% population of Leicester and Leicestershire	50.5	35.8
Total number of strokes	940	121
% with hypertension	59.36	69.4
% with diabetes	19.89	43.8

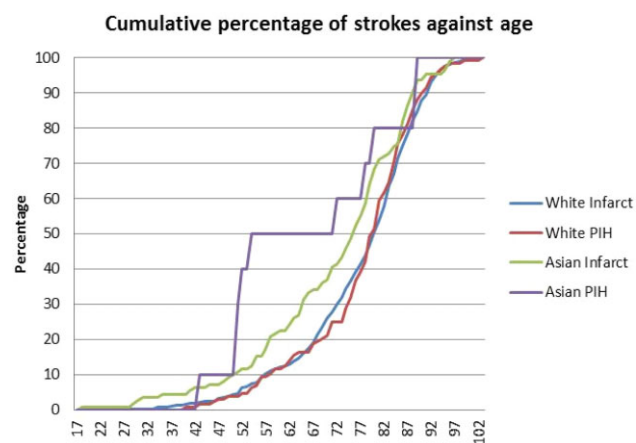


Fig. 1

## Pooled Analysis and Metanalysis

### ESOC-1384

#### 05. Pooled Analysis and Metanalysis Therapeutic targeting of secondary brain injury – A systematic review and meta-analysis of previous clinical trials

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**Objective:** The effect of experimental treatments targeting secondary brain injury following acute cerebral insults, such as ischemic stroke, aneurysmal subarachnoid (SAH) or intracerebral hemorrhage (ICH), traumatic brain injury (TBI) and intracranial infections remains unclear. To address this, we performed a systematic review and meta-analysis of all clinical trials on sole reduction of secondary brain injury across all entities noted.

**Methods:** A systematic review for all randomized, controlled, blinded clinical trials solely targeting secondary brain injury after aforementioned entities and with 'death' or 'poor neurological outcome' as outcome measures was performed. Effect sizes were analyzed using Cochrane Collaboration Review Manager and expressed as pooled risk ratio (RR) estimates with 95% confidence intervals (CI).

**Results:** Out of 3817 studies, ultimately data from 130 studies on 53,393 patients were included. In the pooled analysis, there was no significant effect of experimental treatment on the incidence of 'death' for ischemic stroke [RR 1.01 (95% CI: 0.93–1.09)], aSAH [RR 0.91 (95% CI:0.83–1.00)], ICH [RR 0.93 (95% CI:0.82–1.04)], TBI [1.01 (95% CI:0.92–1.11)] and intracranial infection [RR 0.93 (95% CI:0.84–1.04)]. For those studies, which allowed pooled analysis for 'poor outcome' as an endpoint due to common definitions, similar results were seen.

**Conclusion:** The poor effect of experimental treatments in previous clinical trials targeting secondary brain injury on neurological outcome is likely originated in the strong association of primary brain injury and functional outcome but also insensitive therapeutic targets or endpoints. Future treatments may become more efficacious when pathomechanisms for primary and secondary brain injury are concomitantly targeted.

### ESOC-0616

#### 05. Pooled Analysis and Metanalysis G-CSF for treating stroke: An independent patient data meta-analysis

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**Background:** Granulocyte colony stimulating factor (G-CSF) may enhance recovery from stroke through various mechanisms including reducing apoptosis in the ischemic penumbra if administered early, or through neurorepair if given later. Several small trials suggest administration is safe but effects on efficacy are unclear.

**Methods:** We searched for randomized controlled trials (RCT) assessing G-CSF for treating hyperacute, subacute or chronic stroke and asked Chief Investigators to share individual patient data on baseline characteristics, stroke severity and type, end-of-trial modified Rankin Scale (mRS),

Barthel Index (BI), severity (National Institutes of Health Stroke Scale NIHSS), serious adverse events and death. Multivariate analyses were adjusted for age, sex, baseline severity and time-to-treatment. Significance was taken at  $p < 0.05$ .

**Results:** Individual patient data were obtained from 6 of 10 RCTs comprising 196 stroke patients (116 G-CSF, 80 placebo), mean age 67.1 (SD 12.9), 92% ischemic, median NIHSS 10 (IQR 5–15), randomized 11 days (interquartile range IQR 4–238) post ictus. In adjusted and unadjusted analyses, G-CSF did not alter the odds of a poor outcome: mRS $>3$ , odds ratio OR 0.83 (95% confidence interval [0.4, 2.1],  $p = 0.8$ ); BI  $< 60$ , OR 0.85 (95% CI [0.4, 1.8],  $p = 0.7$ ). Time-to-treatment did not influence effect on outcome. There were more patients with a serious adverse event in the G-CSF group (29.6% versus 7.5%,  $p = 0.051$ ) with no significant difference in all-cause end-of-trial mortality (G-CSF 11.2%, placebo 7.6%,  $p = 0.4$ ).

**Conclusion:** G-CSF did not significantly improve stroke outcome in this individual patient data meta-analysis, and may have increased serious adverse events.

### ESOC-0019

#### 05. Pooled Analysis and Metanalysis Outcome of stent-retriever thrombectomy in acute basilar artery occlusion: A clinical registry and meta-analysis

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**Background and Purpose:** Basilar artery occlusion (BAO) remains one of the most devastating subtypes of stroke with dismal natural course, carrying 90% mortality if not recanalized, even with fibrinolytic therapy. Recanalization is the most powerful predictor of favorable outcome in patients with stroke, and may be improved with mechanical thrombectomy (MT) using stent retriever device. However, the benefit in functional outcome and safety of MT has not been fully examined. The aim of this study was to determine efficacy and safety profiles of stent retriever MT in BAO stroke patients.

**Methods:** We analyzed data retrospectively from our consecutive clinical series and conducted a systematic review of all previous studies of stent retrievers MT in BAO stroke patients between November 2010 and April 2014.

**Results:** From March 2010 to March 2013, 22 patients with acute BAO were treated with Solitaire stent retriever device in our series. The literature search identified 15 previous studies involving a total of 312 subjects. In the meta-analysis, including our series data, the recanalization rate (TICI score  $\geq 2b$ ) reached 81% (95% CI, 73–87). The rate of symptomatic intracranial hemorrhage was 4% (95% CI, 2–8), favorable outcome (mRS  $\leq 2$  at 3 months) was found in 42% (95% CI, 36–48) and mortality rate was 30% (95% CI, 25–36).

**Conclusions:** MT with stent retriever is a safe treatment modality for patients presenting with acute BAO, and might represent a relevant strategy for recanalization therapy, mainly in the presence of contraindications or resistance to intravenous thrombolysis.

## ESOC-1013

### 05. Pooled Analysis and Metanalysis

#### The importance of a multidisciplinary approach to dysphagia in acute stroke

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**Objectives:** Acute stroke is the most common cause of oropharyngeal dysphagia. It affects 37–78% of stroke patients and increases the risk of aspiration pneumonia (APn). We aim to compare the incidence of APn before and after the implementation of a protocol for dysphagia screening (DS).

**Material and Methods:** The study period extended from September 2013 to June 2014. The protocol was implemented in February 2014. Different clinical parameters were compared retrospectively between groups (preDS: up to February 2014; postDS: after February 2014). Patients were divided in those with little or nule presumptive risk of APn, screened through the modified water swallowing test; and those with medium or high presumptive risk of APn, screened by a pre-trained nurse through the volume-viscosity swallow test (V-VST). This nurse also established the need for further invasive screening tools (videoendoscopy and/or video-fluoroscopy) and adapted diet consistencies individually.

**Results:** 178 patients were included: 78 preDS/100 postDS. Groups were comparable in age, sex, stroke severity and affected hemisphere. Dysphagia was present in 37.7% preDS and 36% postDS. Prevalence for pneumonia was of 32% preDS and 10% postDS (OR = 4.2;  $p = 0.0002$ ). The mortality rate was 16.6% preDS and 10% postDS ( $p = 0.09$ ). No difference in hospital stay was found. The V-VST showed a reliability 94.4%.

**Conclusions:** In our series, implementing a dysphagia screening protocol including a pre-trained nurse for the correct identification and management of dysphagia was associated with lower rates of pneumonia after stroke.

## ESOC-0618

### 05. Pooled Analysis and Metanalysis

#### Patient reported outcome measures for visual impairment after stroke: A systematic review

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Patient reported outcome measures (PROMs) are important tools in identifying and highlighting the impact of clinical conditions on individuals daily lives. We sought to identify PROMs for use in research and clinical practice involving individuals with visual impairment following stroke, to evaluate their content validity against quality assessment criteria and to collate key items across vision- and health-related categories to form the basis for a single stroke/vision PROM.

In order to identify existing PROMs we searched scholarly online resources and hand searched articles. Data was extracted relating to the

development and validation of the included instruments. The quality of the development process was assessed using a modified PROM quality assessment tool. Through clinician and stroke survivor surveys, data was extracted for key items across a range of vision- and health-related categories.

Thirty-four vision-specific PROMs were relevant and available to be analyzed in this review. Quality appraisal identified four highly rated instruments: NEI-VFQ, AI, DLTV and VA-LV-VFQ. All instruments have only been used with either a limited number of stroke survivors or a sub-population. Over 600 items were identified across 20 categories, these were reduced to 100 items following a rating process with clinicians and stroke survivors input.

No instruments were identified which specifically targeted visual impairment following stroke. Further research is required to refine the 100 items which a population of stroke survivors with visual impairment considered to be of most importance. The validation of a combination of instruments or a new instrument for use with this population is required.

## ESOC-0108

### 05. Pooled Analysis and Metanalysis

#### Prognostic value of 24-h ABPM in acute ischemic stroke: A systematic review and meta-analysis

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**Background and Purpose:** The association of blood pressure (BP) levels during the acute phase of ischemic stroke with outcome remains controversial. The objective of this systematic review is to assess the predictive value of systolic (SBP) and diastolic BP (DBP), measured by ambulatory blood pressure monitoring (ABPM) methods during the acute phase of ischemic stroke, compared to the value of casually derived BP measurement.

**Methods:** We searched for studies with patients admitted within 24 hours of stroke onset, and who had ABPM during the first 24 hours of admission. We identified studies that reported BP in those with good outcome and in those with poor outcome at end of follow-up, and performed a meta-analysis of the association between mean BP and BP variability on outcome.

**Results:** High SBP and DBP levels derived with ABPM during the first 24 hours were associated with poor short-, medium- and long-term outcome, but the same was not found for casual BP measurements. An increase in SBP of 9.1 mmHg (95%CI: 6.6–11.6,  $p < 0.001$ ;  $I^2 = 9\%$ ) and an increase in DBP of 2.3 mmHg (95%CI: 0.8–3.7,  $p = 0.002$ ;  $I^2 = 0\%$ ) was associated with poor outcome. A decrease of BP during night was associated with good outcome. BP variability in the acute phase was not significantly associated with outcome after stroke.

**Conclusions:** Higher SBP and DBP levels derived with ABPM in the acute phase of stroke were associated with poor outcome. The same was not found for higher casual BP measurements on admission, and it is possible that ABPM conveys better prognostic information.

## ESOC-0067

### 05. Pooled Analysis and Metanalysis Young-aged stroke in Korea: Changing patterns of risk factors and etiologies

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Although the etiologies of young-age stroke may change over time, the changing patterns of etiologies have been rarely investigated. Acute ischemic stroke patients aged between 15 to 44 years were enrolled from 2009 to 2013 in Asan Medical Center. The results were compared with similarly designed study results from 1994 to 1997.

In results, the proportion of young age stroke (252 of 4581 (5.5%, vs. 9.7%) and that of male patient (64.7%, vs. 75.2%) decreased. While smoking (57.7% vs. 67.0%) and drinking (32.5% vs. 41.1%) rates were reduced in male patients, they increased in female patients. The prevalence of diabetes and dyslipidemia increased in both genders. The proportion of large artery atherosclerosis declined (1.7%, vs. 25.9%) in men, while increased in women (13.5%, vs. 5.4%). Other determined etiology proportion increased (39.3%, vs. 26.8%) and among that, dissection rates increased (23%, vs. 10.7%). 3-teslor high resolution vessel-wall MRI has been used since January, 2010.

Compared to the previous study, the proportion of male to female ratio decreased. While smoking and drinking rates decreased in male, metabolic risk factors such as diabetes and dyslipidemia increased in both genders, which explain the increasing proportion of large artery atherosclerotic disease in female patients. The proportion of strokes associated with artery dissection increased, which may be due to the use of advanced diagnostic tools. Our data show that etiologies in young age strokes change depending on the changing risk factor profiles and extensiveness of advanced diagnostic work up.

## ESOC-0493

### 05. Pooled Analysis and Metanalysis Test properties of informant (proxy)-based cognitive screening tools when used in stroke settings

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**Background:** Assessing cognition through structured interview with family or caregiver is frequently employed in stroke. We sought to collate the evidence on test properties of these informant based assessments.

**Method:** We performed systematic review of the literature, following best practice as outlined in Cochrane Diagnostic Test Accuracy guidance. We created sensitive search terms based on concepts of "stroke"; "informant assessment" and "dementia/cognition" and searched multiple cross-disciplinary, international electronic databases. We included studies where an informant assessment was compared against a reference standard of dementia/multi-domain cognitive impairment. We assessed potential bias using QUADAS2 and reporting quality using STARDem. A priori we described three potential uses of informant assessments: diagnosis of pre-stroke dementia; contemporaneous diagnosis of dementia or as prognostic tool assessed against prospective dementia.

**Results:** From 1830 titles, we assessed 189 abstracts and included 10 studies. All papers used the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). There was substantial heterogeneity and we did not attempt to pool results (Table 1). No papers scored "low risk of bias" on all QUADAS-2 items, areas of concern were around patient

flow/loss to follow up and the application of the IQCODE. Reporting quality was variable, no paper reported all items recommended in STARDem.

**Conclusions:** There is a limited literature on informant cognitive assessments in stroke. We found no papers describing test accuracy of IQCODE for diagnosis of pre-stroke cognitive decline, albeit the scale is commonly used for this purpose in trials and clinical practice.

Study	Setting (recruitment)	"n" included	"n" with dementia	Diagnostic test	Index test (threshold)	Summary results
<b>Informant scale for contemporaneous diagnosis of dementia</b>						
Lee 2015	Community	353	45	VCI-HS	IQCODE ≥ 8.6 (at 3/12 post-stroke)	Sens: 45%; Spec: 96%
Tang 2003	ASU	189	24	DSM-IV	IQCODE ≥ 3.40 (at 3/12 post-stroke)	Sens: 33%; Spec: 98%
Slane 2000	Community	49	N/A	Neuropsych battery	N/A (4 years post-stroke)	Correlation with cognitive factor (r = -0.42, p = 0.016)
Srikanth 2006	Community	79	8	DSM-IV	IQCODE ≥ 3.30 (at 3/12 post-stroke)	Sens: 88%; Spec: 63%
Narasimhan 2008	?	576	169	DSM-IV	IQCODE > 3.38	Sens: 86%; Spec: 78%
<b>Informant scale for prospective (delayed verification) diagnosis of dementia</b>						
Henson 2001	ASU	104 at 36/12	39 at 36/12	ICD-10	IQCODE ≥ 7.8 (6/12-36/12)	Sens: 30%; Spec: 100% (6/12)
Mlinkovic 2005	ASU	142	26	DSM-IV	IQCODE ≥ 1.04 (at 3/12 post-stroke)	Sens: 66%; Spec: 100%
Serrano 2007	ASU	142 at 24/12	33 at 24/12	DSM-IV	IQCODE ≥ 3.35 (5/12-24/12)	Sens: 37%; Spec: 88% (5/12)
Wagle 2010	Rehabilitation	104	52	RBANS	IQCODE > 3.44 (at 15/12 post-stroke)	Sens: 25%; Spec: 92%
Sellin 2009	ASU	66	28	ICD-10	IQCODE ≥ 7.8 (at 18/12 post-stroke)	Sens: 99%; Spec: 66%

## ESOC-1252

### 05. Pooled Analysis and Metanalysis Quality of life after acute ischemic stroke: Analysis of utility data from the Virtual International Stroke Trials Archive (VISTA)

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**Background:** Health utility (HU) estimates are used in cost-utility analyses to assess the economic value of interventions. For stroke, HU data have been generated using modest sample sizes and homogenous populations, limiting generalizability and clinical application. The ideal would be international HU data that map across all possible functional outcomes.

**Methods:** We estimated mean HU values for modified Rankin Scale (mRS) levels 0–5 at 3 months after stroke, using corresponding EQ-5D data from the Virtual International Stroke Trials Archive (VISTA). HU estimates were generated using the time trade-off method and validated using ordinary least squares regression, adjusting for age and baseline NIHSS. We generated both country-specific and exemplar HU estimates to describe expected variability when applying a single value set to an international trial population.

**Results:** We analyzed data from 3,858 patients with acute ischemic stroke (mean age: 68.8 ± 12.6, baseline NIHSS: 12 ± 9). HU estimates progressively worsened with increasing disability. Application of country-specific value sets revealed little between-country variation in HU values for mRS of 0–2, but increased variation with poorer mRS. Application of country-specific value sets to the whole dataset demonstrated similar HU values and stability for mRS of 0–2, and increased variation at levels 3–5 (Table 1).



**Conclusions:** These data can inform cost-utility studies by providing robust HU estimates for countries typically represented in acute stroke trials for each level of mRS at a common trial end point.

Value set applied in corresponding countries	Modified Rankin Scale score at 3 months					
	0 (n = 529)	1 (n = 866)	2 (n = 633)	3 (n = 669)	4 (n=825)	5 (n = 336)
Australia	0.96 (0.05)/8	0.82 (0.18)/11	0.77 (0.18)/19	0.58 (0.20)/15	0.49 (0.17)/20	0.02 (0.14)/7
China	0.95 (0.08)/9	0.87 (0.14)/22	0.79 (0.15)/19	0.60 (0.16)/31	0.34 (0.19)/37	0.17 (0.21)/20
Denmark	0.90 (0.12)/4	0.82 (0.09)/7	0.92 (0.12)/2	0.60 (0.16)/8	0.37 (0.22)/14	-0.22 (0.28)/5
Germany	0.98 (0.04)/45	0.93 (0.13)/88	0.86 (0.17)/51	0.65 (0.24)/47	0.46 (0.24)/65	0.03 (0.15)/29
Netherlands	0.89 (0.10)/17	0.83 (0.19)/37	0.75 (0.15)/33	0.61 (0.21)/48	0.34 (0.30)/60	0.12 (0.21)/20
Poland	0.96 (0.06)/210	0.90 (0.10)/522	0.83 (0.10)/196	0.73 (0.14)/153	0.39 (0.29)/189	0.01 (0.26)/63
Singapore	0.96 (0.09)/21	0.81 (0.21)/34	0.47 (0.26)/18	0.24 (0.13)/26	-0.21 (0.29)/38	-0.48 (0.17)/23
South Korea	0.93 (0.04)/4	0.86 (0.09)/9	0.80 (0.07)/5	0.66 (0.17)/7	0.41 (0.23)/5	0.27 (0.46)/4
Spain	0.88 (0.17)/53	0.86 (0.16)/60	0.67 (0.27)/25	0.48 (0.30)/71	0.08 (0.40)/101	-0.33 (0.28)/75
UK	0.81 (0.13)/4	0.90 (0.11)/7	0.72 (0.15)/7	0.42 (0.27)/22	0.19 (0.29)/22	-0.20 (0.19)/8
USA	0.89 (0.16)/44	0.83 (0.15)/256	0.75 (0.16)/221	0.65 (0.19)/237	0.44 (0.22)/267	0.15 (0.14)/120
Zimbabwe	0.94 (0.12)/10	0.84 (0.14)/13	0.77 (0.13)/7	0.58 (0.10)/4	0.53 (0.20)/7	0.25 (0.05)/2
<b>Value set applied to whole dataset</b>						
Australia	0.93 (0.13)	0.86 (0.16)	0.76 (0.17)	0.61 (0.21)	0.35 (0.27)	0.02 (0.18)
China	0.92 (0.12)	0.84 (0.15)	0.73 (0.16)	0.58 (0.17)	0.37 (0.20)	0.15 (0.16)
Denmark	0.93 (0.15)	0.83 (0.16)	0.73 (0.16)	0.61 (0.19)	0.37 (0.19)	-0.02 (0.27)
Germany	0.95 (0.12)	0.90 (0.14)	0.83 (0.18)	0.68 (0.23)	0.38 (0.27)	0.09 (0.18)
Netherlands	0.91 (0.16)	0.83 (0.18)	0.73 (0.19)	0.59 (0.23)	0.35 (0.25)	0.12 (0.21)
Poland	0.94 (0.11)	0.89 (0.12)	0.81 (0.14)	0.70 (0.20)	0.41 (0.29)	0.06 (0.27)
Singapore	0.88 (0.21)	0.74 (0.28)	0.51 (0.30)	0.23 (0.32)	-0.16 (0.33)	-0.48 (0.22)
South Korea	0.94 (0.10)	0.88 (0.11)	0.80 (0.12)	0.69 (0.15)	0.42 (0.25)	0.09 (0.18)
Spain	0.93 (0.14)	0.85 (0.18)	0.72 (0.21)	0.51 (0.28)	0.09 (0.36)	-0.34 (0.23)
UK	0.90 (0.17)	0.82 (0.19)	0.70 (0.21)	0.53 (0.26)	0.20 (0.31)	-0.15 (0.23)
USA	0.92 (0.12)	0.85 (0.14)	0.77 (0.14)	0.64 (0.17)	0.41 (0.22)	0.14 (0.15)
Zimbabwe	0.92 (0.12)	0.85 (0.13)	0.75 (0.13)	0.63 (0.15)	0.45 (0.19)	0.22 (0.17)

**Table 1** HU generated using country-specific value sets. Utilities displayed as mean (StdDev)/N.

## ESOC-1003

### 05. Pooled Analysis and Metaanalysis Lipoprotein (A) and ischemic stroke – An updated meta-analysis

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**Background and Purpose:** Ischemic stroke correlates with traditional cardiovascular risk factors, but the etiology frequently remains unknown. Lipoprotein (a) [Lp(a)] presumably has atherogenic and vascular inflammatory potential. However, the literature on Lp(a) as a risk factor for stroke is still controversial.

**Methods:** A systematic literature search was performed for case control studies and prospective cohort studies published after June 2006. Associations between Lp(a) serum levels and ischemic stroke from adjusted odds ratios (OR) were calculated in random effect meta-analyses. Results were merged with a previous meta-analysis which included studies prior to 2006. A mixed effect meta-regression was performed to locate sources of heterogeneity.

**Results:** 34 potentially relevant articles were identified, 12 of which were eventually eligible for analyses. A total of 63423 subjects and 4940 stroke events were included in the meta-analyses. The pooled estimated OR was 1.41 (95% CI, 1.26–1.57,  $p < 0.01$ ) for case control studies and 1.14 (95% CI, 0.97–1.34,  $p = 0.11$ ) for prospective cohort studies, with significant heterogeneity being present. Subgroup analyses demonstrated a sex-specific risk difference with an estimated pooled OR of 2.40 (95% CI, 1.69–3.41,  $p < 0.01$ ) for men and 1.49 (95% CI, 1.09–2.04,  $p = 0.01$ ) in women.

**Conclusions:** This meta-analysis underlines the importance of Lp(a) as a risk factor in ischemic stroke and highlights Lp(a) as a stronger risk factor in men compared to women. Sufficiently powered studies with standardized reporting should target subgroups of stroke patients and confirm the sex-specific risk differences of Lp(a). Future interventional trials are needed to assess causality of Lp(a) in ischemic stroke.

## ESOC-0349

### 05. Pooled Analysis and Metaanalysis Meta-analysis of the efficacy of neuroprotective drugs in experimental stroke studies, early phase and phase iii clinical trials

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**Background:** Many experimental studies have shown beneficial effects of neuroprotective drugs in animal models of stroke, whereas only a few clinical trials have yielded positive results. We aimed to determine the efficacy of neuroprotectants in experimental studies, early phase and phase III clinical trials by means of a meta-analysis. Moreover, we aimed to identify study characteristics of experimental studies associated with correct prediction of subsequent clinical trials.

**Methods:** We identified phase III clinical trials and corresponding experimental studies and early phase clinical trials of neuroprotective drugs for ischemic stroke. Two reviewers independently extracted data on infarct size, neurological outcome and study characteristics (e.g. randomization, blinded outcome assessment, co-administration of rtPA, and the use of animals with comorbidities). We determined the overall efficacy of neuroprotective drugs in experimental studies, early phase and phase III clinical trials. Meta-regression analyses will be performed to identify study characteristics of experimental studies associated with correct prediction of subsequent clinical trials.

**Results:** We identified 47 phase III clinical trials, more than 70 corresponding early phase clinical trials, and more than 180 corresponding experimental studies. Seventy-seven percent of experimental studies reported a significantly reduced infarct volume or significantly improved functional outcome in at least one treatment arm. By contrast, there was only one positive phase III study, which was followed by a larger negative study.

**Conclusion:** Our study illustrates the efficacy decline from experimental studies to phase III clinical trials. Regression analyses shall identify characteristics of experimental studies associated with correct prediction of subsequent clinical trials.

## ESOC-0802

### 05. Pooled Analysis and Metaanalysis Beta-blockers, pneumonia and outcome after ischemic stroke: Evidence from VISTA

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**Background:** Beta-blocker therapy (BB) has been suggested to have neuroprotective properties and to decrease infectious complications after stroke. We aimed to examine the effects of pre- and on-stroke BB exposure on mortality, functional outcome, and pneumonia after ischemic stroke.

**Methods:** Data including standard demographic and clinical variables as well as pre-stroke and on-stroke antihypertensive medication, incidence of pneumonia, functional outcome defined using modified Rankin Scale (mRS) and mortality at 3 months were extracted from the Virtual International Stroke Trials Archive. For statistical analysis multivariable Poisson regression was used.

**Results:** 5212 patients were analyzed. 1155 (22.2%) patients were treated with BB before stroke onset and 244 (4.7%) patients were newly started with BB in the acute phase of stroke. Mortality was 17.5%, favorable outcome (defined as mRS 0–2) occurred in 58.2% and pneumonia in 8.2% of patients. Pre-stroke BB showed no association with mortality. On-stroke BB was associated with reduced mortality (adjusted RR 0.63, CI 0.42–0.96). Neither pre-stroke BB nor on-stroke BB showed an association with functional outcome. Both pre-stroke and on-stroke BB was associated with reduced frequency of pneumonia (adjusted RR 0.77, CI 0.6–0.98 and RR 0.49, CI 0.25–0.95).

**Conclusion:** In this large non-randomized comparison, on-stroke BB was associated with reduced mortality. Pre-stroke and on-stroke BB were inversely associated with incidence of nosocomial pneumonia. Randomized trials investigating the potential of beta-blockade in acute stroke may be warranted.

## ESOC-0241

### 05. Pooled Analysis and Metaanalysis Diagnostic accuracy of transcranial doppler for brain death confirmation: Systematic review and meta-analysis

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**Background:** The latest guidelines from the American Academy of Neurology state that there was insufficient evidence for determining brain death with ancillary tests. Transcranial Doppler (TCD) is a useful ancillary test for brain death confirmation because it is safe, non-invasive, and done at bedside. TCD confirms brain death by evaluating for cerebral circulatory arrest (CCA). Case series studies have generally reported good correlations between TCD confirmation of CCA and clinical confirmation of brain death.

**Methods:** We conducted a systematic review of the literature from 1987 to 2014 and a diagnostic test accuracy meta-analysis according to PRISMA guidelines to compare the sensitivity and specificity of TCD confirmation of CCA, using clinical confirmation of brain death as the gold standard. **Results:** We identified 21 eligible studies for a total of 1596 patients. Pooled sensitivity and specificity estimates from 11 study protocols that reported data for the calculation of both values were 0.89 (95% CI: 0.86–0.91) and 0.98 (95% CI: 0.96–0.99) respectively. Between-study differences in the diagnostic performance of TCD were found for both sensitivity ( $I^2 = 71.2\%$ ;  $p < 0.001$ ) and specificity ( $I^2 = 76.1\%$ ;  $p < 0.001$ ). Threshold effect was not significant (Spearman  $r = -0.173$ ;  $p = 0.612$ ). The Area Under the Curve with the corresponding standard error (SE) was  $0.977 \pm 0.013$ , while the  $Q^* \pm SE$  was estimated at  $0.933 \pm 0.023$ .

**Conclusions:** Our findings indicate that TCD is a highly accurate ancillary test for brain death confirmation. However, TCD evaluates CCA rather than brainstem function and this limitation should be taken into account when interpreting the results of this meta-analysis.

## ESOC-0242

### 05. Pooled Analysis and Metaanalysis The diagnostic yield of transesophageal echocardiography in patients with cryptogenic cerebral ischemia: A systematic review and meta-analysis of prospective observational studies

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**Background:** The diagnostic utility of transesophageal echocardiography (TEE) in patients with cryptogenic ischemic stroke (IS) or transient ischemic attack (TIA) remains controversial.

**Methods:** We performed a systematic review and meta-analysis to estimate the pooled prevalence (with the corresponding 95% confidence intervals) of possible cardioembolic causes detected by TEE in prospective observational studies of patients with cryptogenic IS and/or TIA.

**Results:** We identified 35 eligible studies, comprising 5772 patients (mean age = 53.6 years, 56.9% males). The most common finding was ascending aorta and/or aortic arch atheroma [51.2% (27.4%–74.5%)], followed by patent foramen ovale (PFO) [43.2% (36.3%–50.4%)]. Complex aortic plaques and large PFOs were reported in 14% (10.2%–18.9%) and 19.5% (16.6%–22.8%) of TEE evaluations. Atrial septal aneurysm was discovered in 12.3% (7.9%–18.7%) of the TEE examinations, and was significantly more prevalent in conjunction with PFO presence (Risk Ratio = 2.04, 95% CI: 1.63–2.54,  $p < 0.001$ ). The prevalence of left atrial thrombus [3.0% (1.1%–8.3%)] and spontaneous echo contrast [3.8% (2.3%–6.2%)] during TEE examinations was low. In all analyses, except for large PFO, significant heterogeneity was found ( $I^2 > 60\%$ ). After dichotomizing available studies, using mean age of 50 years as a cut-off point, PFO was found to be significantly ( $p = 0.001$ ) more prevalent in young patients [59.9% (49.4%–69.5%)], when compared with older patients [35.2% (26.1%–45.6%)].

**Conclusion:** Routine TEE in patients with cryptogenic IS/TIA identifies cardiac findings in a large proportion. However, there is marked inter-study variation in the definition and prevalence of common findings due to poor inter-rater reliability.

## ESOC-0329

### 05. Pooled Analysis and Metanalysis Transcranial Doppler versus transthoracic echocardiography for the detection of patent foramen ovale in cryptogenic cerebral ischemia: A systematic review and diagnostic test accuracy meta-analysis

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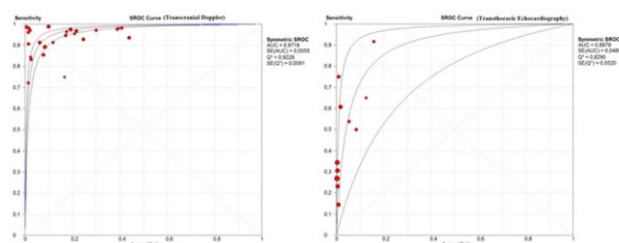
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**Introduction:** The diagnostic value of transthoracic echocardiography (TTE) in the detection of patent foramen ovale (PFO) in patients with cryptogenic ischemic stroke (IS) or transient ischemic attack (TIA) has never been compared with that of transcranial Doppler (TCD) using a comprehensive meta-analytical approach.

**Methods:** We performed a systematic literature review according to PRISMA guidelines to identify all prospective observational studies of patients with cryptogenic IS and/or TIA that provided both sensitivity and specificity measures of TTE, TCD or both compared to the gold standard of transesophageal echocardiography. We presented data in forest plots and summary receiver operator curves (SROCs), using the Moses-Littenberg model.

**Results:** Our literature search identified 34 eligible studies. Pooled sensitivity was found to be greater in TCD (95%; 95%CI: 93–96%) compared to TTE (41%; 95%CI: 35–47%), while TTE appeared to have higher pooled specificity (99%; 95%CI: 98–100%) across studies compared to TCD (87%; 95% CI: 84–89%). No significant heterogeneity across different studies ( $I^2 < 60\%$ ) was found only for TCD sensitivity measurements. In the SROCs plot the overall diagnostic yield – expressed with the area under the curve  $\pm$  standard error – of TCD appeared to outweigh that of TTE ( $0.971 \pm 0.005$  vs  $0.897 \pm 0.048$ ).

**Conclusions:** TCD appears to be more sensitive but less specific compared to TTE for the detection of PFO in patients with cryptogenic IS or TIA.



## ESOC-1583

### 05. Pooled Analysis and Metanalysis Inhibitory non-invasive brain stimulation to homologous language regions may be a useful adjunct to speech and language therapy in post-stroke aphasia. An exploratory meta-analysis

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**Background:** Chronic communication impairment is common after stroke, and conventional speech and language therapy (SLT) strategies have limited effectiveness in post-stroke aphasia. Neurorehabilitation with non-invasive brain stimulation (NIBS) techniques, particularly repetitive transcranial magnetic stimulation (rTMS) or transcranial direct current stimulation (tDCS), may enhance the effects of SLT in selected patients, but there is limited information to guide research and clinical practice.

**Methods:** We systematically searched electronic databases (PubMed, Embase, clinicaltrials.com) to update recent comprehensive systematic reviews which included randomized controlled trials (RCTs) of cathodal tDCS (Elsner et al., 2013) and low-frequency rTMS (Ren et al., 2014) applied over the non-lesioned, non-language dominant hemisphere as an adjunct to SLT in post stroke aphasia. We included search terms “rTMS” OR “tDCS”, “aphasia” AND “stroke”. Studies were assessed for quality by PEDro score and exploratory meta-analysis of the inhibitory NIBS trials considered combinable was undertaken using a random-effects model in RevMan software.

**Results:** Searches identified 9 eligible RCTs (215 participants). All studies had PEDro score  $\geq 6/10$ . For the main outcome “accuracy of naming (%)” in language assessment at the end of intervention, exploratory meta-analysis showed a significant mean effect size of 0.51 (95% CI = 0.24 to 0.79) with NIBS. We found no significant heterogeneity between trials ( $I^2 = 0\%$ ). No adverse events were reported.

**Conclusion:** Results suggest improved accuracy of naming with SLT and NIBS over the unaffected non-language dominant hemisphere in post-stroke aphasia. Larger multicenter RCTs and homogenous intervention protocols are required to ascertain these results and the long-term clinical effects.

## ESOC-0494

### 05. Pooled Analysis and Metanalysis Interventions for post-stroke fatigue: A systematic review and meta-analysis

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**Introduction:** Post-stroke fatigue (PSF) affects more than one third of stroke survivors. Here we systematically reviewed the efficacy of interventions to treat PSF.

**Methods:** We searched nine online databases and five trial registers in May 2014. We included randomized controlled trials which investigated the efficacy of any intervention specifically aimed to treat PSF. The primary

outcome was fatigue severity after treatment. Two authors independently applied inclusion criteria and extracted data. We calculated standardized mean differences (SMDs) and pooled results using a random-effects model.

**Results:** We retrieved 6839 citations, considered 29 full texts and included 8 trials (n = 455). Two trials (n = 211) were not included in meta-analysis as both compared two active interventions without a control. The other six trials (7 comparisons: 5 pharmacological and 2 non-pharmacological interventions) provided data suitable for meta-analysis. There was a statistically significant benefit of interventions treating on PSF (n = 244, SMD = -1.07, 95% confidence interval -1.93 to -0.21), but with substantial heterogeneity (I<sup>2</sup> = 87%). The benefit was not seen in trials with low risk of bias (trials using allocation concealment: SMD = -0.38, 95% CI -0.80 to 0.04 or trials using blinded outcome assessment: SMD = -1.10, 95% CI -2.31 to 0.11). Subgroup analysis found a significant benefit of pharmacological interventions (SMD = -1.23, 95% CI -2.40 to -0.06) and a trend towards benefit of non-pharmacological interventions (SMD = -0.68, 95% CI -1.37 to 0.02).

**Conclusion:** There is no robust evidence to inform the treatment of PSF. Previous trials were small and heterogeneous, and some had a risk of bias. Further high quality trials are needed.

## ESOC-0530

### 05. Pooled Analysis and Metanalysis

#### Safety of intravenous thrombolysis among stroke patients taking new oral anticoagulants – A case series and systematic review of reported cases

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**Background and Purpose:** Current guidelines do not recommend administration of intravenous tissue plasminogen activator (IV-tPA) to patients with acute ischemic stroke (AIS) who take new oral anticoagulants (NOACs). In this study, we present case series of IV-tPA while on NOACs. We also performed a systematic review of similar reported cases in the literature.

**Subjects and Methods:** We reviewed medical records of consecutive patients on NOACs who received IV-tPA for symptoms of AIS at four participating stroke centers in the United States and Europe. We also performed a systematic review of the literature on this topic. Safety endpoints were post thrombolysis symptomatic intracranial hemorrhage (sICH) or serious systemic bleeding.

**Results:** Between October 2010 and October 2014, six patients received IV-tPA for possible AIS while taking dabigatran. None of the patients had sICH or other extracranial hemorrhagic complications. Literature review resulted in a total of 25 cases receiving IV-tPA while on NOACs (dabigatran: 14, rivaroxaban: 10, apixaban: 1). Among them, two patients had sICH and died. Minor and asymptomatic hemorrhagic complications were reported in five patients. Pooled analysis indicates a sICH rate of 6.7% (95% CI:0–22.4%). PT, INR and aPTT were  $14.82 \pm 3.30$  [10.7–22.6],  $1.21 \pm 0.26$  [0.9–20.03], and  $32.55 \pm 6.18$  [20.00–46] seconds (mean  $\pm$  SD [range]). The mean interval between the last dose of NOAC and IV thrombolysis was  $12 \pm 7.8$  [4–28.3] hours.

**Conclusions:** Administration of IV-tPA in stroke patients receiving NOACs that occurred inadvertently in our study might be justified in view of observed safety and considering the severity of stroke and the absence of coagulopathy by conventional tests.

## Hyperacute Management

### ESOC-1548

#### 06. Hyperacute Management Pre-hospital fast positive cases identified by Dublin Fire Brigade ambulance paramedics – Final clinical diagnosis

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**Objectives:** Ischemic stroke clinical outcomes are improved by earlier treatment with intravenous thrombolysis. Using Lean Health Care methodology, an existing clinical pathway for initial assessment of suspected acute stroke was updated aiming to shorten 'door to needle time'. This audit examines the final clinical diagnosis of ambulance paramedic identified FAST positive patients over a 7 month period following implementation of the new stroke assessment pathway.

**Methods:** A retrospective analysis of 177 consecutive pre-notified FAST positive patients presenting between March and November 2014. Patient demographics, time of presentation, symptoms, initial imaging and final diagnosis were recorded.

**Results:** 177 patients (54.8% Male) were included. 95.5% underwent immediate imaging (NCCT Brain and/or CT Angiogram). 67.8% presented outside normal working hours. In total, 57.1% had a final diagnosis of acute stroke. Of 41.2% of patients with non-stroke diagnosis, 28.9% had a neurological diagnosis, which would have warranted acute neuroimaging.

**Conclusion:** Nearly 60% of FAST positive patients identified by Ambulance Paramedics had a final diagnosis of acute stroke. Two thirds present out of hours. A significant proportion of non-stroke patients would still have needed urgent neuroimaging. The current model of ultra-fast assessment of suspected stroke patients in the Emergency Department has significant staff training and resource implications.

### ESOC-0838

#### 06. Hyperacute Management Neurointerventional treatment conducted by interventional radiologists in close cooperation with diagnostic neuroradiologists (The Stavanger procedure)

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**Purpose:** Neurointerventional treatment in acute stroke patients are usually conducted by neurointerventional radiologists. However, there are too few of such sub-specialists to provide a well covering service in Norway. Therefore we have established a neurointerventional treatment where general interventional radiologists perform the intervention in close cooperation with diagnostic neuroradiologists ("The Stavanger procedure"). We present the safety and efficacy of our approach.

**Material and Methods:** A total of 92 acute stroke patients were treated with neurointervention. Revascularization rate was rated with the Thrombolysis in Myocardial Infarction (TIMI) score. Hemorrhage complications assessed according to the ECASS 2 criteria. For clinical outcome the

National Institutes of Health Stroke Scale (NIHSS) was used, long term outcome appraised by the modified Rankin scale at 90 days (mRS). **Results:** Mean patient age was 67.3 years (range 31–92); the average NIHSS at hospital admission was 17 (range 2–36). Successful recanalization was reached in 82.6% of the patients. Procedure-related complications were seen in 14% of the patients, and 10.3% suffered a symptomatic intracerebral hemorrhage. Patients who were successfully recanalized had a significantly better NIHSS postinterventionally (NIHSS 11.4 vs 20.4,  $p < 0.001$ ), and at dismissal (NIHSS 7.1 vs 15.5,  $p = 0.002$ ), a significantly better outcome at 90 days (mRS 2.7 vs 5.1,  $p < 0.001$ ), and a reduced mortality (18.4% vs 50%,  $p = 0.01$ ).

**Conclusion:** Our results show that neurointerventional stroke treatment can be performed by interventional radiologists working in close cooperation with diagnostic neuroradiologists. Patients with successful recanalization profit clinically.

### ESOC-0394

#### 06. Hyperacute Management Obstacles and facilitators in emergency calls about stroke: Nurses' skills enable identification of stroke

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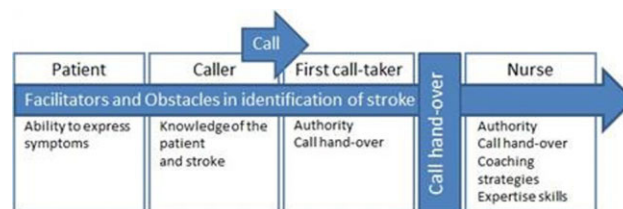
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**Background:** Early identification of stroke in the emergency call can be difficult as the patient may be unable to express their symptoms and the caller generally is a bystander describing the problem by phone. In a previous study we found fall or lying position to be the dominating problem in 2/3 of emergency calls concerning acute stroke but not dispatched as such. The aim of this qualitative study was to explore obstacles and facilitators in the identification of stroke in emergency calls where the patient was reported to have fallen or being in a lying position.

**Methods:** Transcribed emergency calls concerning 29 patients with stroke diagnosis presented with fall or lying position, were analyzed using interpretive phenomenological methodology. The study was approved by the Regional Ethics Board and consent given by the participants.

**Findings:** Patient's ability to express themselves, callers' knowledge of the patient and stroke, first call-takers' and nurses' authority, nurses' coaching strategies and nurses' expertise skills facilitated or hindered the identification of stroke. These aspects/factors were partly adjustable, but some depended on the situation, as well as callers' and patients' abilities. The theme "nurses' expertise skills" was the only found to alone have a decisive effect of the identification of stroke.

**Conclusion:** In emergency calls concerning stroke, The first call-taker's and nurses' action, competence and awareness of obstacles can be improved and strengthened to increase the identification of stroke in emergency calls. In difficult cases, the expertise skills of the nurses' are crucial for identification of the diagnosis.



## ESOC-0901

## 06. Hyperacute Management

## Treatment with exenatide in acute ischemic stroke (TEXAIS)

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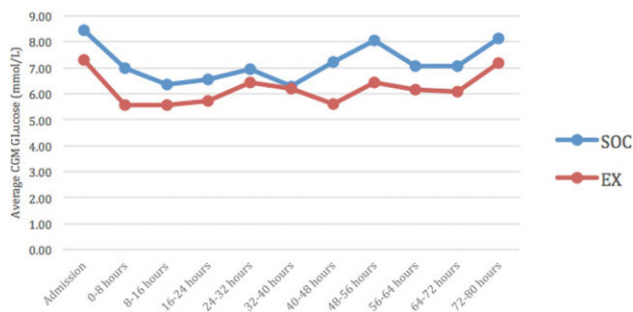
**Background:** Post-stroke hyperglycemia (PSH) occurs in up to 50% of ischemic stroke patients with adverse effects on recanalization, infarct size, long term outcome. Insulin therapies are difficult, cause hypoglycemia, with no long term benefit. The diabetic drug Exenatide (Byetta, Astrazeneca), a glucagon-like peptide-1 (GLP-1) agonist, may be a safer glucose lowering therapy with fewer side effects.

**Methods:** Phase II safety and feasibility open label trial with randomization of acute ischemic stroke patients into treatment (exenatide 5µg subcutaneously twice daily commenced within 9 hours of stroke onset) or control (Standard of Care) groups. Exenatide commenced with inclusion criteria, regardless of admission glucose level, for 5 days. Primary endpoint was the difference between groups in glycemic control measured by continuous glucose monitor and finger prick glucose. Secondary endpoints were adverse events, modified Rankin Day 90.

**Results:** n = 17 pts. No significant differences between treatment and control groups in mean age, sex, risk factors, diabetes (11% vs 14%), admission NIHSS. Hyperglycemia ( $\geq 7$  mmol/L) detected in 44% of all patients. Blood glucose levels consistently lower (with less variable mean SD) in the exenatide group – Fig. 1. [small sample size, (p = 0.550)]. No significant difference in 3 month mRS or adverse events – no symptomatic hypoglycemia, no vomiting in exenatide group.

**Conclusions:** Exenatide appears to be a safe and effective therapy for the minimization of PSH. It potentially can be given safely to most patients presenting with acute ischemic stroke, regardless of admission glucose level. No major episodes of hypoglycemia. A larger Phase 2/3 efficacy trial now planned.

8-hourly CGM mean glucose levels: Control (SoC) vs. Exenatide



## ESOC-0504

## 06. Hyperacute Management

## Carotid artery transluminal angioplasty and stenting in patients with acute ischemic stroke which undergo intraarterial treatment

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**Background:** Recanalization treatment is crucial for good functional outcome of acute ischemic stroke patients with carotid artery occlusion or severe stenosis. Large vessel occlusion show a very limited response to systemic thrombolysis and endovascular treatment is increasingly used.

**Methods:** We prospectively analyzed 11 patients with intracranial vessel occlusion of the anterior circulation simultaneously presenting with high-grade cervical internal carotid artery (ICA) stenosis or occlusion who required ICA stenting during the period 2005–2014 (13,7 % of the patients treated with endovascular treatment for anterior circulation). Reperfusion was assessed according to the Thrombolysis in Cerebral Infarction (TICI) score. Clinical outcome was evaluated at 3 months after treatment by modified Rankin Scale (mRS)

**Results:** 10 patients were male (ages ranged from 65 to 74; mean: 61). Most frequent indications for endovascular treatment were unsuccessful treatment with intravenous alteplase (55%) and wake-up stroke (27%). Median NIHSS score at baseline was 12. Successful revascularization was achieved in 9 patients (81.8%) 1 patient had asymptomatic stent restenosis during follow-up. Only 1 patient had a non fatal symptomatic intracranial hemorrhage. mRS functional score at 90 days of assessment was 0–2 in 7 patients (63.6%) and 3–4 (36.3%). Mortality rate during the procedure or follow up was 0%.

**Conclusion:** Endovascular recanalization of acute cervical carotid artery occlusion was technically feasible and resulted in high extra- and intracranial revascularization rates with and security rates

## ESOC-0163

## 06. Hyperacute Management

## Evaluation of pre-hospital delay and related factors in stroke patients in a second-level hospital in La Mancha (Spain)

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**Background and Purpose:** Stroke is the leading cause of disability and the second most common cause of death in the world. Acute-stroke care is attracting increasing attention, mostly due to the advent of thrombolysis. This study investigated the time elapsed between onset of stroke symptoms and arrival at the hospital ('delay'), and which factors are associated with a shorter delay.

**Methods:** An observational study was conducted on a sample of consecutive stroke patients diagnosed by a neurologist in our Emergency Department between 15th November 2013 and 14th April 2014. Subarachnoidal

hemorrhage and in-hospital stroke patients were excluded. Descriptive, bivariate and multivariate analyses were performed.

**Results:** 138 patients (52.2% male) were included (mean age 73.97 years). Median delay was 165 minutes (52.2% arrived in less than 180 min; 12.3% arrived in the first hour). Quantitative and qualitative results are shown in Figs 1 and 2 respectively. Bivariate analysis is shown in Figs 1–3. Multivariate analysis is shown in Fig 3.

**Conclusions:** The proportion of patients with a delay of up to 180 min (52.2%) was similar to other recent studies performed in our country. However, the fraction of those arriving in the first 60 min was significantly lower. Independent predictors of early arrival (< 180 min) were education level (primary or higher), stroke type (Total Anterior Circulation Infarct patients arriving earlier) and the activation of the so called ‘stroke code’. Risk factors for stroke other than atrial fibrillation or a family history of stroke did not predict a faster response after stroke onset.

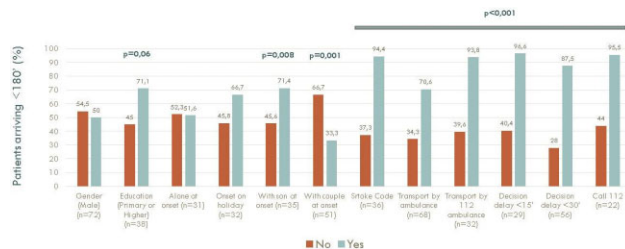


Fig. 1 Bivariate analysis: demographic and circumstantial variables.

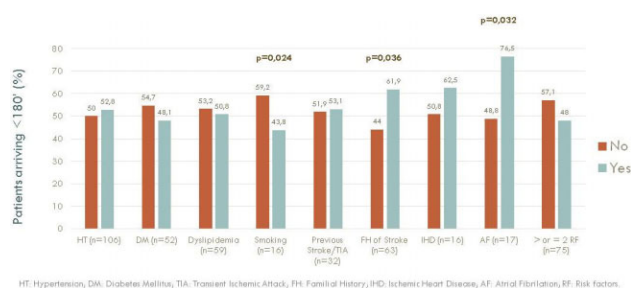


Fig. 2 Bivariate analysis: risk factors

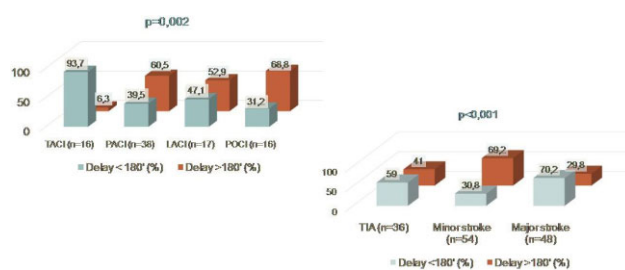


Fig. 3 Bivariate analysis: OSCP subtype and stroke severity

ESOC-0813

06. Hyperacute Management  
Pre-hospital delay and predictors of early arrival in stroke patients

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**Background and Purpose:** Stroke is the leading cause of disability and the second most common cause of death in the world. Acute-stroke care is attracting increasing attention, mostly since the advent of thrombolysis. This study investigated the time elapsed between onset of stroke symptoms and arrival at the hospital (delay), and which factors are associated with a shorter delay.

**Methods:** An observational study was conducted on a sample of consecutive stroke patients diagnosed by a neurologist in our Emergency Department between 15th November 2013 and 14th April 2014. Subarachnoidal hemorrhage and in-hospital stroke patients were excluded. Descriptive, bivariate and multivariate analyses were performed.

**Results:** 138 patients (52.2% male) were included (mean age 73.97 years). Median delay was 165 minutes (52.2% arrived in less than 180 minutes; 12.3% arrived in the first hour). Independent predictors of early arrival (< 180 minutes) were education level -those with at least primary education arrived earlier-, stroke type – Total Anterior Circulation Infarct (TACI) patients arriving earlier – and the activation of the so called ‘stroke code’. **Conclusions:** The proportion of patients with an early arrival (52.2%) was similar to other recent studies performed in our country. However, the fraction of those arriving in the first hour was significantly lower. Risk factors for stroke other than atrial fibrillation or a family history of stroke did not predict a faster response in either bivariate or multivariate analysis. Independent predictors of early arrival were primary education or higher, the activation of the ‘stroke code’, and TACIs.

ESOC-0585

06. Hyperacute Management  
New prehospital stroke scale: The NIHSS-AS

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**Background:** Our aim is to develop and validate an abbreviated and practical prehospital stroke scale to be used by medical emergencies physicians (MEP) and another non- neurologist physicians to predict the presence of large vessel occlusion (LVO) in patients with acute stroke.

**Methods:** The NIHSS-Asturias (NIHSS-AS) was designed based on the National Institutes of Health Stroke Scale (NIHSS) items with strongest correlation between neurologists and MEP administration according to kappa index. Scores on the NIHSS were obtained from a cohort of 235 patients with acute ischemic stroke by neurologists and MEP. The NIHSS-AS scale was validated retrospectively in the same group of patients by other neurologists. LVO was diagnosed by CT in the first 4,5 hours.

**Results:** The model with the highest degree of correlation included the following items: Speech, Orientation, Gaze and Arm weakness (area under the curve 0.73). NIHSS-AS scale  $\geq 4$  has sensitivity 0.775, and specificity 0.642 for detecting LVO.

**Conclusions:** Shortening the NIHSS could facilitate its use during prehospital evaluations. Other short scales have been designed in order to predict the patient outcome but the NIHSS- AS scale is a simple triage tool that can predict LVO in patients with ischemic stroke at prehospital setting by MEP.

## ESOC-1405

### 06. Hyperacute Management

#### Outcomes after early neurological deterioration in patients with acute ischemic stroke

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**Background/Aims:** Early neurological deterioration (END) occurs in 20–40 % of acute ischemic stroke (AIS) patients and has been associated with worse outcome. Recent improvements in treatment may have reduced the prevalence of END and the associated worse outcome. The primary aim of this study was to assess the association between END and outcome after AIS. Secondary aims were to assess the association between early deteriorating episode (EDE) and outcome, and the prevalence of END and EDE.

**Methods:** 368 patients with AIS treated in our stroke unit were included and followed up with assessments including frequently repeated scoring of selected Scandinavian stroke scale- (SSS) items until 72 hours. Primary endpoint was mRS at 12 weeks.

END was defined as 2-point decrease in selected SSS-items between admission and 72 hours. EDE was defined as similar worsening between two consecutive assessments within 72 hours.

**Results:** 14.1% of the patients had END. Adjusted for age and stroke severity, with ORs were 29.7 (7.4–120.6) for death/dependency and 4.6 (1.6–10.6) for death at 12 weeks, compared to patients without END, and length of stay in hospital was increased by 6.5 days ( $p < 0.001$ ). 28.0% of patients had EDE without END, with ORs of 2.2 (1.1–4.7) for death/dependency and 1.5 (0.4–5.7) for death, while hospitalization increased 1.2 days ( $p=0.011$ ), compared to stable patients.

**Conclusion:** Both patients with END and patients with EDE without END have significantly worse prognosis than stable patients, and unstable patients with END and EDE are still a challenge in acute stroke care.

## ESOC-1425

### 06. Hyperacute Management

#### Comparison between two definitions of early neurological deterioration in patients with acute ischemic stroke

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**Background:** Early neurological deterioration (END) after stroke has been found to be associated with worse outcome. Most END definitions are based upon NIHSS. Comparisons between END definitions based upon different stroke scales are scarce. We have performed an END study where

one of the aims was to compare END definitions based upon NIHSS (2 points increase, ENDNIHSS) and 2 points decrease in selected Scandinavian Stroke Scale items (European progressing stroke study (EPSS) definition, ENDEPSS).

**Material and Methods:** 368 acute ischemic stroke patients admitted to our stroke unit were included and followed for 3 months, with NIHSS and SSS every 24 hours from admission until 72 hours, and modified Rankin Scale (mRS) at 12 weeks as the primary endpoint. Logistic regression analyses were performed, adjusted for pre-stroke mRS, initial stroke severity and age.

**Results:** 14.1% and 8.4% of all patients fulfilled the ENDEPSS criteria and the ENDNIHSS ( $p = 0.001$ ), respectively. For ENDEPSS, the adjusted OR was 29.9 (7.4–120.1) for death/dependency (defined as  $mRS \geq 3$ ), and 4.1 (1.6–10.6) for death, and the corresponding estimates using ENDNIHSS were 7.4 (2.2–24.6) and 3.1 (1.1–9.0). When both ENDEPSS and ENDNIHSS were entered into the same model, the corresponding odds ratios were 24.5 (5.2–114.9) and 3.4 (1.2–10.1) for ENDEPSS and 1.6 (0.3–7.9) and 1.5 (0.5–5.2) for ENDNIHSS.

**Conclusion:** A higher proportion of patients were found with END according to the EPSS definition than according to the NIHSS definition. Still, the association between END and poor outcome was stronger for the EPSS definition than the NIHSS definition of END.

## ESOC-0267

### 06. Hyperacute Management

#### Clinical results of reperfusion therapy in patients with acute basilar artery occlusions

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**Objective:** Acute basilar artery occlusion (BAO) is associated with high mortality rate and poor outcome. We investigated outcomes of acute BAO patients treated with reperfusion therapy using a single-center registry (ClinicalTrials.gov: NCT02251665).

**Methods:** Between October 2011 and March 2014, 27 ischemic stroke patients with acute BAO were admitted within 24 hours after onset. Among them, patients treated with reperfusion therapy (intravenous thrombolysis [IVT] and/or endovascular therapy [EVT]) were included. We evaluated patient background, recanalization rate, favorable outcome (modified Rankin Scale  $\leq 2$ ) and mortality at 3 months.

**Results:** Seventeen patients (13 men,  $72 \pm 12$  years old) were included. Median baseline NIHSS score was 24 [IQR 10–29] and median onset-to-treatment time was 92 minutes [IQR 40–200]. IVT was performed in eleven patients (65%) and 5 of whom underwent subsequent EVT, and primary EVT was performed in 6 patients. Successful reperfusion (a modified Mori grade of 3 on MRA within 24 hours) was achieved in 16 patients (94%). Symptomatic intracranial hemorrhage occurred in none. The 3-month outcomes were favorable in 9 patients (53%) and fatal in 3 patients (18%). These results seemed to be better than those of BASICS study; the rate of favorable outcome was 22.2% and the mortality rate was 38.6% in patients treated with IVT and/or intra-arterial therapy.

**Conclusion:** In our stroke center, clinical results of reperfusion therapy in acute BAO patients were better than those in the previous report. This may be due to shorter onset-to-treatment time and novel thrombectomy devices.



## ESOC-0198

## 06. Hyperacute Management

## A novel prehospital stroke scale to predict large vessel occlusion: The Cincinnati Prehospital Stroke Severity Scale (CPSSS)

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**Introduction:** We developed and validated the Cincinnati Prehospital Stroke Severity Scale (CPSSS) to identify patients with severe strokes and large vessel occlusion (LVO).

**Methods:** CPSSS was developed based on regression tree analysis, objectivity, ease in administration by EMS personnel, and cortical signs. We derived and validated the tool using the NINDS t-PA Stroke Trial and IMS III Trial cohorts, respectively, to predict severe stroke [NIH stroke scale (NIHSS)  $\geq 15$ ] and LVO (internal carotid artery, M1, tandem M2, or basilar artery occlusions by angiography prior to IV t-PA therapy). Standard test characteristics were determined, and receiver operator curves were generated and summarized by the area under the curve (AUC).

**Results:** CPSSS items and scoring are shown in the Table 1. In the derivation set, CPSSS had an AUC of 0.89; score  $\geq 2$  was 89% sensitive and 73% specific in identifying NIHSS of  $\geq 15$ . Validation results were similar with an AUC of 0.83; score  $\geq 2$  was 92% sensitive, 51% specific for severe stroke. For 222/303 IMS III subjects with LVO, CPSSS had an AUC of 0.67; a score  $\geq 2$  was 83% sensitive, 40% specific, a positive likelihood ratio of 1.4, and negative likelihood ratio of 0.4 in predicting LVO.

**Conclusion:** CPSSS can help identify stroke patients with NIHSS  $\geq 15$  and LVO.

**Figure: Cincinnati Prehospital Stroke Severity Score****2 points:** Conjugate gaze deviation ( $\geq 1$  on NIHSS item)**1 point:** Incorrectly answers at least one of two level of consciousness questions on NIHSS (age or current month) **and** does not follow at least one of two commands (close eyes, open and close hand)**1 point:** Cannot hold arm (either right, left, or both) up for 10 seconds before arms falls to bed

Table 1 Cincinnati prehospital stroke severity score

	NIHSS 2-4	NIHSS 5-8	NIHSS 9-12	NIHSS 13-16	NIHSS $\geq 17$	TOTAL
<b>GCKNSS Total with NIHSS <math>\geq 2</math> and IV rtPA-Eligible</b>	127 (44%)	56 (20%)	35 (12%)	23 (8%)	45 (16%)	286
<b>Estimated PAO rate by NIHSS from literature</b> (Heldner et al, Stroke, 2013)	18%	39%	66%	85%	87%	-
<b>GCKNSS Subset Expected to Have PAOs</b>	23 (18%)	22 (17%)	23 (18%)	20 (16%)	39 (31%)	127
	<b>GCKNSS: MEDIAN NIHSS 9-12, IQR &lt;8 to &gt;18</b>					
	<b>MR CLEAN: MEDIAN NIHSS 18, IQR 14-22 (FULL RANGE 3-23)</b>					

**Conclusion:** Our findings suggest that MR CLEAN trialists' clinical judgment may have led to the preferential enrollment of patients with higher NIHSS than would be expected based on the NIHSS  $\geq 2$  inclusion alone. Results from upcoming trials and further data from MR CLEAN will likely inform optimal endovascular eligibility.

## ESOC-1501

## 06. Hyperacute Management

## Acute ischemic stroke endovascular therapy eligibility: A population-based projection vs the MR CLEAN cohort

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**Background:** The first positive Phase III trial of acute mechanical thrombectomy, MR CLEAN, was published recently. MR CLEAN had broad eligibility including an NIHSS  $\geq 2$ , but also allowed for patient selection using clinical judgment ("gray area principle"). We explore how the NIHSS distribution would have appeared if the gray principle had not been used, and compare this to the distribution observed in MR CLEAN.

**Methods:** We ascertained all ischemic strokes seen in all emergency departments among the 1.3 million Greater Cincinnati/Northern Kentucky (GCNK) population (known to be representative of the US) in 2005. Relevant data were abstracted from patient charts. We first identified patients with NIHSS  $\geq 2$  and IV rtPA-eligible. We then applied estimated rates of proximal arterial occlusions (PAOs) from the literature.

**Results:** Among 1,843 ischemic strokes, 286 (15.5%) had an NIHSS  $\geq 2$  and were otherwise IV rtPA-eligible. We estimated that 127/1843 (6.8%) would also have PAOs and have a median NIHSS of 9-12 (vs 18 in MR CLEAN) (see Table 1).

## ESOC-0749

## 06. Hyperacute Management

## From clinical trials to bedside: Evaluating the transfer of scientific insights to the "real-world" stroke care in Germany by comparison of nation-wide administrative data

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**Background:** Promising advances in stroke medicine have been reported recently regarding specialized stroke unit (SU) care, expansion of the time window of iv thrombolysis (IVT), mechanical thrombectomy (MT), and decompressive hemicraniectomy (DHC) for malignant brain infarction. It remains unclear to what extent new evidence of therapeutic procedures is transferred to the "real-world" of everyday hospital care.

**Methods:** We analyzed epidemiologic and procedural therapeutic trends of hospitalized acute stroke patients in Germany by the comparison of administrative hospital data of the years 2008 (n = 219,359) and 2012 (n = 239,394).

**Results:** Proportion of specialized SU care rose from 43.4% to 56.9%. Rate of IVT increased from 5.6% to 10.2%. 32% of IVT therapies in 2012 were performed in patients over 80 years. Number of MT increased exponentially from 298 to 3906 procedures. Number of DHC did not increase significantly (2008 = 636; 2011 = 796).

**Conclusions:** A strong momentum in transferring scientific insights to the "real-world" stroke care in Germany was documented. Increase of IVT therapy is largely due to the increase of off-label treatment. Almost every 46 th patient <80 years was treated by MT in 2012. Despite proven benefits in selected patients, utilization of DHC remained almost stable.

## ESOC-1309

## 06. Hyperacute Management

## Association between post-thrombolytic blood pressure and symptomatic intracerebral hemorrhage

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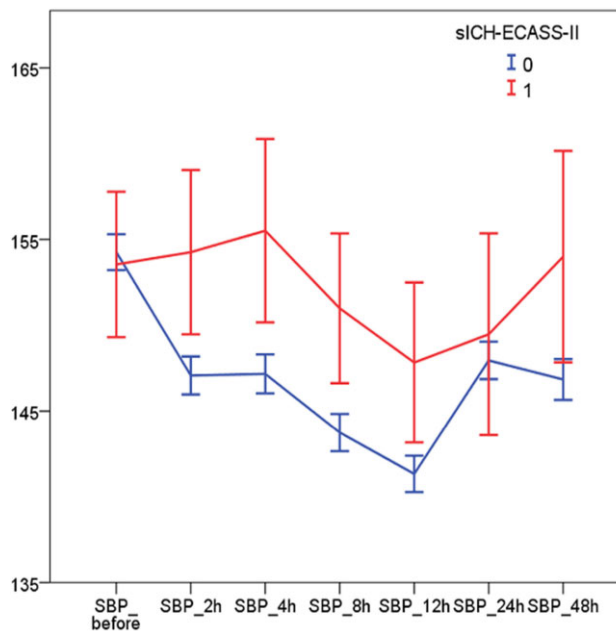
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Most guidelines for administration of IV thrombolysis (IVT) to acute ischemic stroke patients advice to keep systolic blood pressure (BP) below 180/105 mmHg prior the bolus injection. Less is known about optimal management of BP thereafter. We assessed temporal changes in post-thrombolytic systolic BP values and their impact on development of symptomatic intracerebral hemorrhage (sICH).

The study cohort included 1868 consecutive acute ischemic stroke patients treated with IVT at the Helsinki University Central Hospital (1995–2012). sICH was defined according to the ECASS-II, NINDS and SITS criteria. We evaluated BP at baseline, prior IVT, and at 2, 4, 8, 12, 24, and 48 hours after thrombolysis.

Prevalence of sICH in the cohort was 5.8% (ECASS-II), 8.9% (NINDS) and 2.5% (SITS). While systolic BP values at baseline and prior IVT were similar among patients with and without sICH the difference in BP values at all other time points (except for 24 hours) was associated with sICH. The corresponding odds ratios per mmHg increase for development of sICH were ranged from 1.011 (1.001–1.021) to 1.013 (95% CI 1.003–1.023).

Patients with sICH had significantly higher systolic BP values in the hyperacute phase (2–12 h) and at a later phase (48 h) after IVT.



## ESOC-0607

## 06. Hyperacute Management

## Results and acceptability of telestroke in the treatment of acute ischemic stroke with tissue plasminogen activator (t-PA) in Southern Spain

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**Background:** Telestroke has benefited patients with difficult access to thrombolytic therapy for reasons such as geographic distance or limited resources.

**Methods:** Three centers serving a population close to 2 million, a tertiary referral hospital and two community hospitals with a distance between 16 and 110 km from the first one. The video conferencing and data transmission in standard clinical history, analysis and pictures, are performed in certified digital network and it runs after issuing the consultation. CT images were validated in JPEG and DICOM to reduce technical delays. The professionals involved in the project were invited to participate in a satisfaction survey.

**Outcomes:** The CT image showed a Kappa index  $\geq 0.7$  for early signs of ischemic stroke,  $\geq 0.96$  for hemorrhage and  $\leq 0.5$  to define acute/ subacute

hypodensity. Clinical Results: 46 patients were treated between January 2009 and December 2013, age 65.3 ( $\pm 10.2$ ), 26 women (56.5%), median door-needle time 82.5 (71.5–108 minutes), fibrinolysis time 160 (130–191.5), initial NIHSS 14.3 ( $\pm 5.7$ ) and at discharge 10.0 ( $\pm 6.3$ ), 40% of patients with Rankin  $< 3$  at 3 months, 4 total bleeding, 1 symptomatic (intervention with improvement), 17% mortality at 3/6 months and 6.5% in-hospital (total 3 patients). The survey was completed by 34 out of the 60 professionals (56.7%), 11/14 (80%) neurologists from the referral hospital and the means obtained in each dimension exceeded 7.

**Conclusions:** Telestroke is a useful and safe tool that facilitates the access of patients to treatment with intravenous t-PA. The model of assistance is well accepted by the participating professionals.

## ESOC-1249

### 06. Hyperacute Management

#### CT perfusion relative CBF maps best differentiate “true at-risk” ischemic tissue from benign oligemia

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**Background:** The region currently defined as tissue “at-risk” by CT perfusion (CTP) includes areas of benign oligemia. Our aim was to determine CTP parameters and thresholds that would optimally distinguish regions of “true at risk” tissue destined to infarct from “false at risk” tissue, i.e. benign oligemia. This would serve to improve CTP-based decision making in acute stroke management.

**Methods:** Among acute stroke patients evaluated by multimodal CT (NCCT/CTA/CTP) we identified those that had not undergone endovascular/thrombolytic treatment and had follow-up CT. CTP data were post-processed with the Brain Perfusion application in Intellispace Portal (Philips Healthcare). Maps of absolute and relative cerebral blood flow (CBF), cerebral blood volume, mean-transit-time and time-to-peak were generated. Relative values were obtained by normalization to the contralateral hemisphere. Follow-up CT was automatically co-registered to the CTP maps and the final infarct region was manually outlined. For each patient and for each perfusion parameter we chose the threshold that would provide 90% sensitivity in identifying “true at-risk” tissue. At this threshold the specificity, i.e. portion of “false at risk” tissue correctly identified as oligemia was documented.

**Results:** Sixty-six acute stroke patients met selection criteria. Relative CBF was found to identify “true at-risk” tissue more accurately than other studied parameters. A rCBF threshold of 0.7, providing a sensitivity of 90%, recognized 40% of the “false at risk” tissue as oligemia.

**Conclusion:** Appropriately thresholded rCBF maps can differentiate clinically-irrelevant oligemia from tissue destined to infarct.

## ESOC-0214

### 06. Hyperacute Management

#### Effect of stroke code protocol dysfunctions on the rate of intravenous thrombolysis in acute stroke in Catalonia

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**Objectives:** To analyze the Stroke Code (SC) operation in Catalonia and to estimate the number of thrombolytic treatments not given due to SC dysfunctions.

**Methods:** Observational prospective multicenter study based on by region-wide registry data of consecutive stroke admissions from April to June 2013 in all acute-care public hospitals in Catalonia (n = 40). Medical history, stroke characteristics and severity, and times from onset to attention by Emergency Medical Services and hospital admission were registered. Criteria for SC activation were: onset of symptoms within 8 hours or unknown/awaking, previous functional independency and no age limit. Potential candidates to intravenous thrombolysis were patients with ischemic stroke able to be treated within the 4.5 h time window, NIHSS  $> 4$  and no formal contraindications such as current anticoagulant treatment or recent surgery.

**Results:** 2000 stroke patients were admitted. SC criteria were met by 1233/2000 (61.7%) patients and SC protocol was activated in 908 (73.6%) of them. If SC had been activated in all patients with SC criteria the rate of thrombolysis would have increased from the current 15.6% to 16.3% of ischemic stroke patients. Most patients not detected by the SC had minor stroke, posterior territory stroke or wake-up stroke.

**Conclusion:** There is room for improvement for the SC in Catalonia, particularly in the detection of minor, posterior and wake-up strokes. These findings will help to implement training measures for professionals involved in the SC system. Nevertheless, current rate of thrombolytic therapy is close to the theoretical maximum according to our data.

## ESOC-0215

### 06. Hyperacute Management

#### Benefit of a regional educational program for emergency medical services: Increasing stroke code activations and prehospital race scale evaluation

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**Objectives:** To analyze the impact of a regional educational program for Emergency Medical Services (EMS) directed to implement the RACE

scale, previously validated to predict large vessel occlusions on the field (Stroke 2014).

**Methods:** A 5 hour online training course was designed, including: 1) clinical features and treatment options for stroke; 2) Stroke Code (SC) activation criteria; 3) case-based training on the RACE scale. The course was offered to all the ambulance companies of Catalonia (7.5million inhabitants) via the central EMS website (<http://cvsem.il3.ub.edu/course/>), and was fulfilled by 2850 technicians (82% of technicians in our region). A questionnaire about stroke knowledge was answered before and 3 months after the training program. SC activations, EMS response times, and the RACE scale score were continuously registered by the EMS coordination center. We compared 3 months before and after the program.

**Results:** Increasing knowledge of EMS providers (score from 6.6 to 8.3) and number of SC activations (from 9.5 to 12.6 per 100.000 inhabitants) were observed after the program, with no significant variation on the number of reperfusion therapy administered (215 vs. 177 patients). The RACE scale was evaluated in 62% of all the SC activations in the post-training period, concurrently to 2 minutes increase on the time elapsed from EMS alert to hospital arrival (from 49 min to 51 min;  $p = 0.01$ ).

**Conclusion:** An educational program for EMS providers improves their knowledge about stroke and allows the implementation of the RACE scale, a fast and easy-to-administer prehospital scale. In addition, the training program boosted up SC activations.

## ESOC-0727

### 06. Hyperacute Management

#### Differential diagnosis of neurovascular pathologies: The experience of a French stroke care pathway

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**Introduction:** Since the use of tissue plasminogen activator for acute ischemic stroke, stroke care pathways have been developed for patients with a suspicion of acute stroke.

**Methods:** The aim of this prospective study is to analyze the differential diagnosis (DD) of neurovascular diseases in patients included in the stroke care pathway of Strasbourg university hospital (France). All consecutive patients admitted in this pathway within a one-year period were prospectively enrolled in this study. The stroke code was activated by calling the 15 number for patients with an acute neurological deficit within the time window for intravenous thrombolysis. A clinical neurological evaluation and a brain MRI with 3D-TOF-MRA were performed in all patients.

**Results:** There were 1361 consecutive patients admitted for a suspicion of acute stroke. Sixty-two per cent ( $n = 840$ ) had a neurovascular diagnosis including ischemic stroke ( $n = 529$ ), transient ischemic attack ( $n = 236$ ), intracranial hemorrhage ( $n = 68$ ), cerebral venous thrombosis ( $n = 3$ ) and neurovascular medullar pathology ( $n = 4$ ). DD represented 38% of cases

( $n = 521$ ) and the most frequent discharge diagnosis were migraine with aura (17.2%), psychological disorder (16.7%), peripheral vertigo (11.9%) and epilepsy (10.6%).

**Conclusion:** A rate of DD of neurovascular diseases up to 38% confirms the difficulty to distinguish clinically a stroke from another diagnosis. This result highlights that cerebral MRI is expected in all patients with acute neurological symptoms. Stroke care pathway initially developed to select patients with ischemic stroke for a thrombolysis treatment offers the advantage to evaluate DD of stroke.

## ESOC-0119

### 06. Hyperacute Management

#### 12-month data on frequency and pattern of stroke chameleons in Bradford Royal Infirmary, UK

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Sometimes patients with a final stroke diagnosis present with symptoms suggestive of a non-cerebrovascular cause, and have been labeled 'stroke chameleons (SC)' (1,2). Delayed or incorrect stroke diagnoses have implications for therapy and outcome. Since we are not aware of any systematic published data on SC incidence, we aimed to determine incidence and nature of SC in our single center serving a catchment population of 273,327 adult inhabitants.

We prospectively studied consecutive suspected stroke presentations (aged  $\geq 18$  years), from 01/05/2013 to 30/04/2014. A final diagnosis was made by a stroke specialist, taking into account all available clinical information and diagnostic tests.

A total of 916 patients were assessed. 252 (28%) stroke mimics were diagnosed, leaving 664 (72%) confirmed strokes. 19 of 664 (2.8%) confirmed strokes presented initially as SC; a crude incidence rate of 6.95/100,000 person years. Of SC patients, 58% were female; the mean age was 74 years (range 24 to 93). The commonest presenting symptoms were acute confusional state, headache and vertigo, initially diagnosed as delirium, migraine, and acute labyrinthitis respectively. The average delay from admission to final stroke diagnosis was 5.5 days. The arterial territories involved were vertebro-basilar (72%), and MCA (28%). The right cerebral hemisphere was affected in 80%. One ICH also initially presented as SC.

The crude incidence of SC was 6.95/100,000 person year. The delay from admission to diagnosis may have resulted in patients not receiving appropriate care including thrombolysis. Training of health professionals might improve recognition of SC in the A&E, warranting further research.

## ESOC-0120

## 06. Hyperacute Management

## 12-month data on frequency and pattern of stroke mimic diagnosis in a district general hospital in the UK

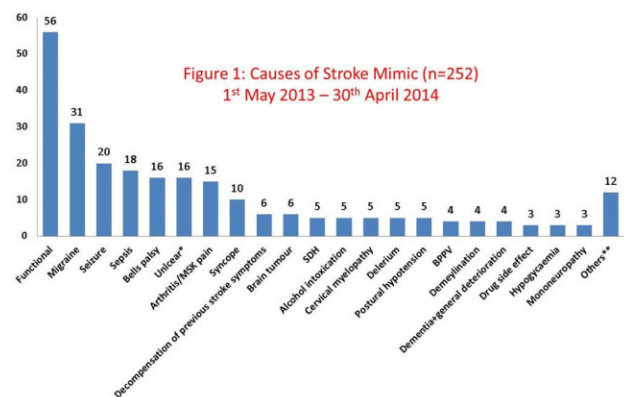
H Ramadan<sup>1</sup>, C Patterson<sup>1</sup>, S Maguire<sup>1</sup>, I Melvin<sup>1</sup>, J Adamson<sup>2</sup>, K Kain<sup>3</sup>, E Teale<sup>4</sup>, A Forster<sup>4</sup>

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\* Unclear: Nonspecific symptoms; stroke felt to be highly unlikely in spite of no clear alternative diagnosis  
 \*\* Others: labyrinthitis, Parkinson dis., dehydration, diabetic microvascular 6<sup>th</sup> Cr nerve Palsy, radiological mimic, leg cramp, local eye problem causing visual symptoms...etc

**Background:** There is considerable variation in the reported incidence of stroke mimics (SM), depending on the timing, referral source, the service setting, and lack of a standardized definition. We aimed to determine the frequency and nature of SM diagnosis in our center (catchment population 273,327).

**Method:** We prospectively studied all consecutive suspected stroke presentations (aged  $\geq 18$  years) from 01/05/2013 to 30/04/2014 referred to the DGH. A final diagnosis of stroke or SM was made by a stroke specialist.

**Results:** A total of 916 patients were assessed. 664 (72%) consecutive acute stroke (Infarction, ICH and SAH) and 252 (28%) SM presentations by 241 patients were diagnosed. Among the 252 SM patients; 55% were female with mean age 62 years (range 17–98), Brain imaging was carried out in 90% (CT 54%, MRI 36%) of SM patients. Functional neurological disorder (FND) (22.2%), migraine (12.3%), seizure (8%) and sepsis (7%) accounted for 50% of all SM diagnoses. The breakdown of the causes of SM is shown in Fig. 1.

**Conclusions:** 28% of patients referred with suspected stroke were eventually diagnosed as SM; this is in line with other studies. However, in our cohort the FND and migraine are the first and second commonest causes of SM as opposed to seizure and syncope in a recent systemic review. Training of health professionals might improve recognition of SM in the A&E, warranting further research.

## ESOC-0666

## 06. Hyperacute Management

## The role of relatives in help-seeking for patients with stroke/TIA: Results from Stroke and TIA Awareness and Response to Symptoms (STARS) study

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**Background:** 999 calls for stroke are usually made by the patients' spouse or another relative. However the relatives' role in early symptom recognition and in decisions to call for help is unclear.

**Method:** We interviewed 214 consecutive stroke/TIA patients (and/or their relatives) presenting to the stroke unit at Royal Hallamshire Hospital, Sheffield in May to June and Aug to Oct 2014. Our hospital is the sole provider of hyper-acute stroke services for a catchment population of approximately 500,000.

**Results:** 123 (57.5%) patients were with someone else at symptoms onset e.g. spouse/partner (30.4%) or son/daughter (26.7%). In 47 (22%) cases the relative noticed the symptoms before the patient did. In 158 (73%) the first call for medical help was made by a relative, after a median of 30 minutes from symptoms onset. In comparison, when patients made the first call, they did so after a median 3.3 hours from symptoms onset ( $P = 0.02$ ). Relatives who called for help usually rang 999 whereas patients usually rang the GP ( $P < 0.001$ ). In 66 cases (31%) the relative was solely responsible for accessing help e.g. because the patient was incapacitated by the stroke/TIA (59%) or a comorbidity (9.1%) or because the patient refused to call (21.2%).

**Conclusion:** Relatives are often first to notice the symptoms of a stroke in a patient and usually make the first call to medical services for patients with stroke symptoms. Rapidity of access to stroke care may be improved if education campaigns (e.g. F.A.S.T.) target the relatives of patients at high stroke risk.

## ESOC-0918

## 06. Hyperacute Management

## Quality of acute stroke care in the 1st stroke unit in the U.A.E

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**Objective:** The objective of this study was to assess the quality of stroke care based on STK (Stroke) Measure Set, a standardized performance measure developed by Joint Commission in collaboration with American Heart Association/ American Stroke Association (AHA/ASA).

**Methods:** We prospectively analyzed data from the Stroke registry for a one-year period starting 01.01.2014. The quality of stroke care in the stroke unit was measured on the basis of 8 quality indicators STKs 1,2,3,4,5,6,8 and STK 10 from the STK measure set.

STK set no.	Stroke measure
STK-1	Deep vein thrombosis (DVT) prophylaxis
STK-2	Discharged on antithrombotic therapy
STK-3	Patients with atrial fibrillation receiving anticoagulation therapy
STK-4	Thrombolytic therapy administered
STK-5	Antithrombotic therapy by end of hospital day two
STK-6	Discharged on statin
STK-8	Stroke education
STK-10	Assessed for rehabilitation

Results: 237 stroke patients were admitted of which 84% were ischemic. Target ranges achieved for STK measure:

STK measure	Achieved target range (%)
STK1	87.8
STK2	98.3
STK3	100
STK4	61.1
STK5	98.9
STK6	98.4
STK8	80.2
STK10	95

Expected target ranges were achieved in 6 (STK2,3,4,5,6,10) of 8 STK measures. The achieved target range would be 100% for STK-4, if the therapeutic window for thrombolysis is considered to be up to 4.5 hours instead of 3 hours.

Conclusion: Findings from this study suggest that the quality of care in the 1st Stroke unit in the UAE is high. However, there is room for improvement in documentation of DVT prophylaxis (STK1) and stroke education (STK8)

## ESOC-0613

### 06. Hyperacute Management

#### A systematic review of the performance of stroke recognition instruments in pre-hospital and hospital settings

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Background: We undertook a systematic review to describe the performance of stroke recognition instruments applied prospectively by clinicians.

Methods: Literature search up to 31/12/2013 by two independent authors. Figure 1 describes the search adjudication process.

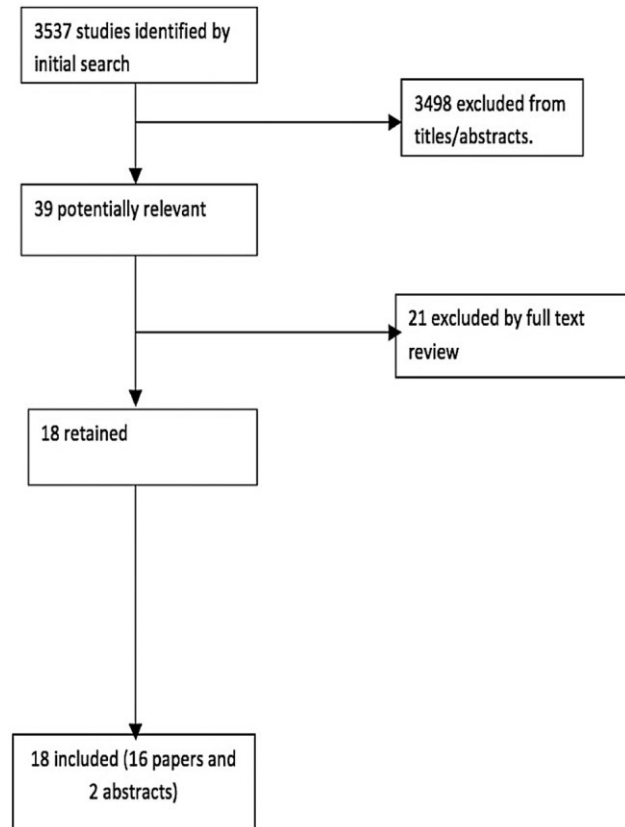


Fig. 1 Study selection process.

Results: Table 1 summarizes 7 included instruments. Study quality and performance indicators varied widely between studies (Table 2), precluding formal meta-analysis. Performance varied markedly between studies of the same instrument particularly specificity, reflecting heterogeneous setting and design.

Instrument	Facial weakness	Arm weakness	Grip strength	Speech problem	Leg weakness	Vision	Exclusions
Cincinnati Prehospital Stroke Scale (CPSS)	✓	✓	✗	✓	✗	✗	none
Face Arm Speech Test (FAST)	✓	✓	✗	✓	✗	✗	glucose <3.5 mmol/l; GCS <7
Los Angeles Prehospital Stroke Scale (LAPSS)	✓	✓	✓	✗	✗	✗	age <45; epilepsy; onset >24 hours; immobile; glucose <60 or >400 mg/dL
Medic Prehospital Assessment for Code Stroke (MEDPACS)	✓	✓	✗	✓	✓	✓	epilepsy; onset >24 hours; glucose <60 or >400 mg/dL
Melbourne Ambulance Stroke Scale (MASS)	✓	✓	✓	✓	✗	✗	age <45 yrs; epilepsy; onset >24 hours; immobility; glucose <60 or >400 mg/dL
Ontario Prehospital Stroke Screening tool (OPSS)	✓	✓	✗	✓	✓	✗	arrival >2 hrs of onset; GCS<10; seizure; terminally ill; glucose <4 mmol/l
Recognition Of Stroke In the Emergency Room (ROSIER)	✓	✓	✗	✓	✓	✓	glucose <3.5 mmol/l;

Instrument	Number of studies	Total patients	Sensitivity range	Specificity range	PPV range	NPV range
Cincinnati Prehospital Stroke Scale (CPSS)	7	3265	44–95	24–79	40–88	57–96
Face Arm Speech Test (FAST)	7	1529	79–97	13–83	62–89	48–73
Los Angeles Prehospital Stroke Scale (LAPSS)	5	2039	59–91	62–97	79–98	45–98
Medic Prehospital Assessment for Code Stroke (MEDPACS)	1	416	74	33	47	61
Melbourne Ambulance Stroke Scale (MASS)	2	950	83–90	74–85	64–90	74–90
Ontario Prehospital Stroke Screening tool (OPSS)	1	554	89	80	90	88
Recognition Of Stroke In the Emergency Room (ROSIER)	5	1418	83–97	18–83	64–94	33–88

**Discussion:** A reliable conclusion cannot be drawn about the superiority of any stroke recognition instrument. Desirable performance characteristics depend upon the intended role of the instrument in the clinical process and the boundary set for the service population. Differences in the underlying prevalence of clinical characteristics between cohorts and the inclusion or exclusion of cases by pre-screening contributed to differences in sensitivity. Further studies are needed to recommend instruments for use in specific settings.

## ESOC-1538

### 06. Hyperacute Management Decompressive craniectomy in malignant medium cerebral artery infarction

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Decompressive craniectomy (DC) reduces mortality and improves functional outcome in patients with malignant middle cerebral artery (MCAI) infarction. Although DC is included in the guidelines, there is still general uncertainty concerning optimal timing and characteristics of the suitable patient leading to reluctance to implement it.

**Methods:** Monocentric retrospective analysis of patients with MCAI treated with DC. Clinical outcome was assessed with modified Rankin Scale (mRS) at 1 and 12 months after stroke, mRS 0-3 was considered as good outcome.

**Results:** 14 patients with mean age 60.5 (44–71) years were included. Mean admission NIHSS score was 17 (9–24), 7 (50%) patients had dominant hemisphere infarction. Etiology was cardioembolic in 5 (36%), carotid atherosclerosis in 8 (57%) and cryptogenic in one case. 12 patients were treated with recanalization (intravenous thrombolysis, endovascular). 7(50%) patients had symptomatic hemorrhagic transformation. Mean time from onset to DC was 52 (12–96) hours. Outcome assessed at 1 month after DC was poor in all patients – 13 patients had mRS 5 and 1 died. Final outcome (12 months) was good in 5 (36%), 4 (28%) had severe disability (mRS 4–5) and 5 (36%) patients died.

**Conclusion:** In agreement with published data one third of our patients had acceptable outcome. DC outcome should be assessed later than in

other acute stroke trials – optimally at least after 12 months. Poor outcome was associated with rapid development of swelling and comorbidity. We did not observe any influence of hemorrhagic transformation, age, side of infarction, midline shift or timing of DC.

## ESOC-0109

### 06. Hyperacute Management The role of mannitol in the management of patients with severe acute ischemic stroke

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**Background/Aims:** Mannitol is frequently administered to patients with severe acute ischemic stroke, even though no randomized controlled study evaluated its safety and efficacy. We aimed to evaluate the effects of mannitol on the outcome of these patients.

**Patients and Methods:** We prospectively studied 539 consecutive patients hospitalized for acute ischemic stroke. Stroke severity was evaluated at admission with the National Institutes of Health Score Scale (NIHSS). The outcome was evaluated with dependency rate at discharge (modified Rankin scale 2-5) and with in-hospital mortality.

**Results:** Mannitol was administered to 49 patients. These patients had higher diastolic blood pressure (DBP) and higher serum glucose and triglyceride levels than patients who did not receive mannitol. Other cardiovascular risk factors did not differ between the 2 groups. The NIHSS at admission was higher in patients treated with mannitol (21.7 ± 9.2 vs. 7.0 ± 7.5 in patients who did not receive mannitol; p < 0.001). Among patients who received mannitol, 46.9% died during hospitalization and all the rest were dependent at discharge. In binary logistic regression analysis, independent risk factors for dependency at discharge were age (odds ratio (OR) 1.12, 95% confidence interval (CI) 1.03–1.22, p < 0.01) and the NIHSS at admission (OR 1.78, 95% CI 1.47–2.15, p < 0.001). Independent risk factors for in-hospital mortality were DBP at admission (OR 1.09, 95% CI 1.02–1.18, p < 0.05), NIHSS at admission (OR 1.23, 95% CI

1.12–1.35,  $p < 0.001$ ) and treatment with mannitol (OR 6.24, 95% CI 1.12–34.69,  $p < 0.05$ ).

**Conclusions:** In patients with acute ischemic stroke, treatment with mannitol appears to increase the risk of in-hospital mortality.

## ESOC-0383

### 06. Hyperacute Management Comparison of outcomes between acute ischemic stroke and transient ischemic attack: Data from the 'Triple Antiplatelets for Reducing Dependency after Ischaemic Stroke' (TARDIS) trial

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**Background:** Patients with TIA are expected to have a better outcome and return to normal as compared to those with ischemic stroke. We compared baseline characteristics and outcomes for stroke and TIA patients.

**Methods:** Data from 2078 patients (stroke 1388, TIA 690), with functional outcome data at day 90, enrolled into the ongoing TARDIS trial were assessed. TARDIS is comparing short term intensive vs guideline antiplatelet therapy. Data are number (%) or mean (standard deviation) and odds ratio (OR) or mean difference (MD) with 95% confidence interval (CI) relative to stroke.

**Results:** Overall patients had a mean age of 69 (10) and 63% were male. Although TIA patients had a better outcome than those with stroke, many had not returned to normal by day 90. Significant differences were present for; death OR 0.33, 95% CI (0.12, 0.89), dependency (modified Rankin Scale) MD -0.73, 95% CI (-0.86, -0.61), disability (Barthel Index) MD 5.56, 95% CI (3.63, 7.49), cognition (TICS-M) MD 2.78, 95% CI (1.50, 4.07), quality of life (EQ-5D) MD 0.10, 95% CI (0.07, 0.12), and mood (Zung depression scale) MD -3.79, 95% CI (-5.69, -1.89) by day 90. There was no significant difference in recurrence rates between stroke and TIA patients.

**Conclusion:** Although outcome after TIA is better than stroke, many patients do not make a full recovery. TIA patients may need monitoring of functional outcome, cognition and mood to ensure that they receive support where necessary.

## ESOC-0302

### 06. Hyperacute Management Help-seeking behavior and onset-to-alarm time after stroke

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**Background:** Many patients do not seek immediate medical attention after stroke onset, which may influence treatment and prognosis. Public campaigns have focused on public knowledge about individual stroke symptoms aiming to decrease patient's delay. We explored help-seeking behavior and evaluated whether knowledge, recognition, interpretation, socio-demographic and clinical characteristics of stroke were associated with onset-to-alarm time.

**Methods:** 161 patients admitted with acute stroke were included from November 2011 till May 2014. A semi-structured questionnaire was used to assess knowledge of stroke, recognition and interpretation. Action and reasons for this action were explored. Associations were evaluated using parametric and non-parametric test where appropriate.

**Results:** The median onset-to-alarm time was 30 minutes (IQR 10–150 min). Knowledge about individual stroke symptoms was not associated with recognition of own stroke symptoms neither with correct interpretation of a stroke situation, or onset-to-alarm time. However, correct interpretation of the stroke situation was associated with shorter onset-to-alarm time (15 vs. 45 min;  $p = 0.003$ ). Clinical characteristics of stroke associated with a shorter onset-to-alarm-time were higher NIHSS score (Kruskal Wallis,  $p = 0.003$ ) and stroke occurring at night (30 vs. 270 min;  $p = 0.002$ ). Additional factors associated with shorter onset-to-alarm-time were transport by ambulance (30 vs. 75 min;  $p = 0.04$ ) and immediate calling the emergency telephone number (Kruskal Wallis,  $p = 0.004$ ).

**Conclusion:** Help-seeking behavior after stroke is a complex process. Onset-to-alarm time after stroke is associated with correct interpretation of the stroke situation by the patient, stroke characteristics and logistics of stroke care, but not with knowledge about stroke symptoms.

## ESOC-1297

### 06. Hyperacute Management A pilot study proposing a clinical decision algorithm (CDA), which aims to improve clinical acumen in the recognition of patients with stroke or TIA

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**Background:** Recognition of strokes can be challenging for training clinicians. We developed a clinical decision algorithm (CDA), which aims to encourage clinical decision making. It is based on three questions. (1) Is there a focal neurological deficit? (2) Is it acute onset? (3) If yes, is this due to a stroke mimic (examples given) Responses would be 'Yes' 'No' or 'Unsure'. We undertook prospective pilot studies at two hospitals.

**Method:** Over two months acute medical and A&E trainees were asked to use a pro-forma which contains the ROSIER scale, CDA, and an opinion survey, the eventual diagnosis was sought retrospectively.

**Results:** Of 40 total cases, 18 (45%) were strokes by CDA (ROSIER also positive for these) of which 14 were eventually diagnosed with stroke/TIA (78%). 6 were mimics by CDA, all of which were true mimics, but ROSIER was positive for stroke in 3 of these. In 17, CDA result was 'unsure' (40%). 11 (65%) were mimics eventually. In 8 cases when CDA was 'unsure', ROSIER was positive, these were all mimics. Data from 33 opinion surveys revealed 29(88%) thought that CDA is user friendly and 25(76%) agree it improves clinical acumen. 18(56%) prefer CDA than ROSIER.

**Conclusion:** CDA seems useful for trainees, and has a positive trend towards more accurate prediction of stroke, the liberty to declare indecisiveness may be a reason for this. A majority believes CDA is user friendly and improves clinical acumen. This pilot paves the path for a larger study to develop and validate the CDA.



## Thrombolysis

### ESOC-1366

#### 07. Thrombolysis

##### Watching the stroke: Can door-to-needle time be reduced after a video visualization by the nursing staff?

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**Background:** The benefits of intravenous (IV) thrombolysis with alteplase (rtPa) are strongly time dependent. According to guidelines, IV thrombolysis should be administered as soon as possible, preferably up to 60 minutes after patients arrival. To ensure low door-to-needle times (DNT) close collaboration between many health care professionals is required and multiple interventions have been adopted with the goal of reducing DNT.

**Methods:** During the second semester of 2014 the nursing staff of the emergency department saw a video everyday for 7 consecutive days every two months. The video involved neurologists and emergency staff (nurses and doctors) and highlighted the importance of shorter DNT and reviewed information about stroke and thrombolysis. Regarding patients treated with IV rtPA, demographic and clinical data, DNT, and onset-to-needle time was recorded. The results were compared with the same data retrieved from the first semester of 2014. From the nursing staff, only the co-authors knew the purpose of the intervention.

**Results:** All the nurses have seen the video at least once. Comparing the intervention period with the previous semester the results were: 51 vs 33 patients treated, 74 vs 75 median patients age, median DNT 60 vs 65 minutes ( $p = 0.542$ ).

**Conclusions:** Although the number of patients treated with rtPA have increased and the median DNT have decreased 5 minutes, the results weren't statistically significant. This could be due to the small number of patients included. However, the results suggest that interventions targeting the non-medical staff can be effective in reducing DNT.

### ESOC-0884

#### 07. Thrombolysis

##### Safety and efficacy of mechanical thrombectomy in acute stroke of anticoagulated patients. An only hospital experience

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**Background:** Anticoagulated patients (AP) are excluded from the acute stroke management with alteplase. They could benefit from mechanical thrombectomy (MT), which wasn't undoubtedly proven. There are scarce

data about this results in such patients. Our aim is to analyze the efficacy and safety of MT in AP in our hospital.

**Methods:** Prospective observational study comparing 30 AP and 109 N-AP underwent to direct MT without alteplase. Demographic data, clinical severity (NIHSS), efficacy (recanalization TICI  $\geq 2b$  and mRankin  $\leq 2$  at 3 months), and security (symptomatic intracranial hemorrhage (SICH), mortality at 3 months were compared between both groups.

**Results:** AP were mostly men (63.3%), as N-AP (61.5%). Mean-age were 7a3 in AP and 67.2 in N-AP. Median NIHSS was similar (17 AP; 16 N-AP), also TICI  $\geq 2b$  (93.3% AP; 89.9% N-AP). The 3 months m-Rankin  $\leq 2$  was 46.7% in AP and 55.2% in N-AP ( $p = 0.40$ ). SICH was present in 16.7% of AP and 8.3% of N-AP ( $p = 0.15$ ). Mortality at 3 months was 6.7% in AP and 19% in N-AP ( $p = 0.08$ ).

**Conclusions:** MT seems to be a treatment for acute ischemic stroke in AP. It achieve as efficacy as in N-AP with a tendency to suffer from more SICH, but lower mortality. We hypothesize that cardioembolic clots may be easier removed than atherothrombotics and that embolic stroke in AP might be less severe than those in N-AP or might suffer less of other complications than atherothrombotics.

### ESOC-1242

#### 07. Thrombolysis

##### Off-label thrombolysis: A complex decision requiring a collegial agreement

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A study of medical practice has been based on the hospital stroke registry of the neurological emergencies network in the French Franche-Comté region, RUN-FC. The study put into perspective the management of stroke patients in the acute phase by intravenous thrombolysis in compliance or at variance with the May 2009 recommendations of the French Health Authority (HAS): "Stroke: early management".

All patients from the region who received rt-PA treatment in the initial phase of ischemic stroke were included in the study from 2009 to 2012, namely 393 patients. 265 thrombolyses satisfied the criteria defined by the HAS and 115 did not.

Exceeding time limits is the leading cause of protocol deviation. Rankin at 3 months (2,45/3,01) and the mortality rate (12/25%) were significantly higher in the group at variance with the recommendations, whereas there is no significant difference with the NINDS study groups (treatment or placebo). The group at variance with the HAS recommendations can be split into two subgroups: one where a considered medical decision was made on the administration of treatment, and one where a medical decision was made, but without deliberation. The criteria for time limit and for thrombolysis with a considered medical decision did not unfavorably modify Rankin at 3 months.

In accordance with results of European studies, this practice is common and is evidently beneficial for certain patients, subject to a strict prescription framework and to collegial and considered medical decisions that take into account the risk-benefit ratio on a case-by-case basis.

## ESOC-0944

## 07. Thrombolysis

## Usage rate of thrombolysis in an Italian county: Data from Progetto Nazionale Esiti (PNE) in Umbria

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**Background:** Purpose of the study was to investigate the relationship between ischemic stroke outcome and rate of thrombolytic therapy administration in Perugia and Terni counties, Italy.

**Methods:** Cases outcomes were extrapolated from the PNE database for all ischemic stroke admitted in Umbria Hospitals, (Jan2011-Nov2012) in the counties of Perugia and Terni. For ischemic stroke (ICD9 433.x1,434.x1,436) were available both risk adjusted 30 day mortality and 30 day re hospitalization rate. We reviewed the rate of thrombolysis usage in each hospital doing correlation analysis on outcome measures and lysis rate.

**Results:** We found 2272 patients with ischemic stroke included in the PNE database (men 1178). Among them the majority was admitted in the 2 general hospitals of Perugia and Terni (N: 1226) while the remaining half in other county hospitals (N: 1046). The rate of lysis in 2011 and 2012 was 5,7% and 5,9%. The overall mean 30 day mortality rate in the main hospitals of the survey was 10,38% (CI 95%:10.110.6) with a re-admission rate of 11,2% in 2011 and 11,5% in 2012. According to Pearson correlation analysis (R: 0.609; R: 0.698) we found a negative correlation between variables, with a tendency for high lysis rate to go with low mortality and low readmissions. Also the Spearman's analysis found (p: -0.707; p: 0.756) a significant (p = 0.004) inverse association between variables

**Conclusion:** The adjusted 30 day mortality and re admission rate of ischemic stroke were inversely correlated with the annual lysis rate. The lysis rate represents a marker of good stroke care providing a direct monitoring tool.

## ESOC-1317

## 07. Thrombolysis

## Association between I.V. thrombolysis volume and door-to-needle times in acute ischemic stroke

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**Background:** Concentration of intravenous thrombolysis (IVT) for acute ischemic stroke (AIS) in high-volume centers is often believed to result in shorter door-to-needle times (DNTs), but evidence for this assumption is limited. Our aim was to examine the relation between IVT volume and DNTs in the Netherlands.

**Methods:** All hospitals in the province of North-Holland that perform IVT were invited to participate. We retrospectively identified consecutive patients treated with IVT between January 2009 and January 2013. Based on annualized IVT volumes, hospitals were categorized as low-volume ( $\leq 24$ ), medium-volume (25–49) or high-volume ( $\geq 50$ ). We compared median DNTs and onset-to-needle times (ONTs) between centers.

**Results:** 11/13 hospitals agreed to participate in the study. 1822 of 1962 patients treated with IVT were included (mean age 70.1 years). Reasons

for exclusion were in-hospital stroke (n = 54) or missing DNT (n = 86). Overall, 80,5% of patients had a DNT $<$ 60 minutes. There were 2 low-volume (101 patients), 5 medium-volume (747 patients) and 4 high-volume hospitals (974 patients). The DNT was significantly shorter in high-volume centers (median DNT 30 minutes) compared to medium-volume (42 min, p $<$ 0.001) and low-volume hospitals (38 min, p $<$ 0.001). High-volume hospitals also more often achieved a DNT $<$ 30 minutes compared to the other two groups (43,8% vs. 17,4% and 26,7%, p $<$ 0.001). High-volume centers had shorter ONTs than medium-volume (median 113 vs. 120 min, p = 0.03), but not than low-volume hospitals (113 vs. 98 min, p = 0.04).

**Conclusion:** In this Dutch province with overall short DNTs, hospitals with the largest annual IVT volumes achieved the shortest DNTs.

## ESOC-1586

## 07. Thrombolysis

## How to half door-to-needle times: A single center strategy

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**Introduction:** In a time where treatment options for acute stroke are rapidly expanding and fast delivery of intravenous thrombolysis (IVT) is significantly associated with a good outcome and recanalization, we are challenged to reorganize acute stroke care. In our center we implemented a new acute stroke care pathway over the last year.

**Methods:** After consultation with emergency physicians, emergency room (ER) nurses and radiologists we started using a new stroke flowchart for acute stroke patient care (flowchart). Briefing by emergency physicians and patient registration is done by telephone before patient arrival. Two ER nurses, a radiology nurse, the CT scan and neurologist are standby before arrival. The ER is bypassed and the patient is taken straight to CT scan whilst blood pressure and blood glucose level is checked. Clinical investigation with NIH stroke scale is done bedside at CT scan. IVT, positioned at CT scan, is administered immediately at CT after exclusion of hemorrhagic stroke. Only after admission of thrombolysis further vascular imaging is done to look for proximal large artery occlusion for which additional thrombectomy can be done.

**Results:** By implementing this new acute stroke care pathway we were able to reduced door-to-needle times by over 50% (Table 1). Median door to needle times at the end of the implementation period were as low as 22 minutes, compared to 45 minutes before implementing the stroke pathway.

**Discussion:** Using several simple measures a reduction of door-to-needle times of over 50% can be readily achieved.

Month	Door-to-needle times (min)	
	Mean	Median
January	48	42
February	45	43
March	36	33
April	53	49
May	57	51
June	47	42
July	49	42
August	57	55
September	62	49
October	32	26
November	36	22
December	28	22

**Table 1** Mean and median door-to-needle times of 2014 in our center. The stroke pathway was implemented before the start of October.

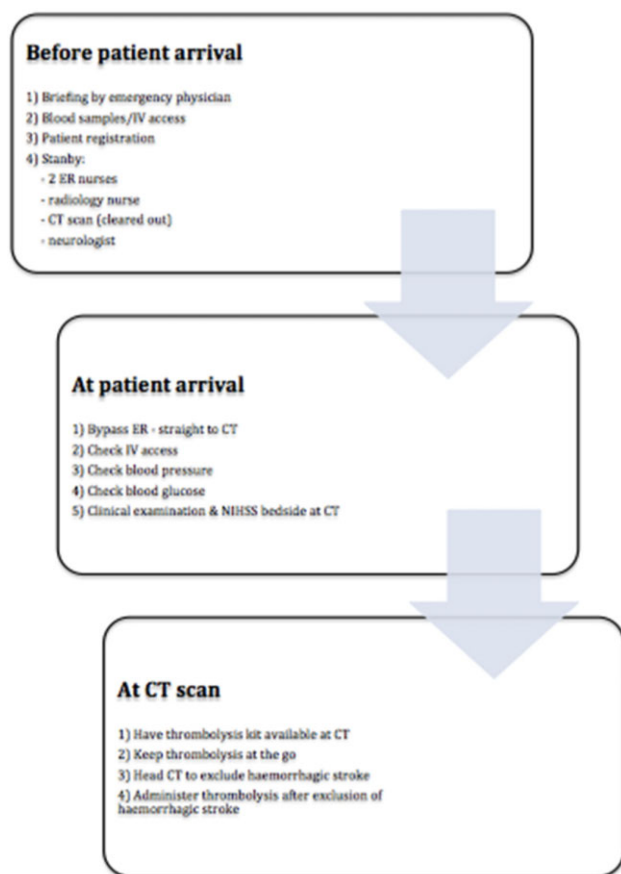


Fig. 1 Flowchart of the step-by-step stroke pathway

## ESOC-0986

### 07. Thrombolysis

#### Is the risk of TPA-related hemorrhage different in patients with posterior circulation stroke vs. anterior circulation stroke?

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**Background:** Acute ischemic stroke (AIS) in the posterior circulation differs in many aspects from AIS in the anterior circulation. We investigated whether the risk of symptomatic intracranial hemorrhage (sICH) or parenchymal hemorrhage (PH) was associated with affected circulation.

**Methods:** We included all patients of our local thrombolysis register who received systemic thrombolytic therapy. Anterior circulation stroke was defined as stroke in the vascular territory of the middle cerebral artery or anterior cerebral artery, whereas posterior circulation stroke was defined as stroke in the territory of the posterior cerebral artery or vertebrobasilar territory. Patients with concurrent stroke in anterior and posterior circulation were not included into the analysis. The end points were sICH according to SITS-definition and any PH.

**Results:** A total of 1277 patients were included. Posterior circulation stroke was present in 252 (19.7%) patients. Frequencies of sICH and PH were higher in anterior as compared to posterior circulation stroke but these differences did not reach statistical significance (sICH: 4.1% (42 patients) vs. 2.4% (6 patients),  $p = 0.20$ ; PH: 8.7% (89 patients) vs. 5.6% (14 patients),  $p = 0.10$ ). After adjustment for known risk factors (age,

stroke severity, blood glucose level, systolic blood pressure, antithrombotic therapy, statin therapy) and additional mechanical recanalization in multiple regression analysis, risks for sICH and PH were similar in posterior and anterior circulation stroke (sICH: OR 0.34, 95% CI 0.10–1.13,  $p = 0.08$ ; PH: OR 0.63, 95% CI 0.31–1.26,  $p = 0.19$ ).

**Conclusions:** The risk of sICH or PH was similar in patients with posterior circulation stroke compared to anterior circulation stroke.

## ESOC-1105

### 07. Thrombolysis

#### Hematological, hemorheological, hemostatic changes and CT-perfusion in ischemic stroke: The effect of IV thrombolysis

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Lack of microcirculation is believed to be one of mechanisms of impaired brain tissue perfusion in ischemic stroke (IS). The aim of the study was to evaluate the blood parameters and brain perfusion characteristics in patients with IS treated with intravenous thrombolysis (IVT) and without IVT.

**Methods:** 70 patients with IS (48M, 22W, mean age 61[54;69], mean admission NIHSS 14.5[11;17]) admitted at first 4.5 hours after stroke onset were treated with IVT (IVT-group). 63 patients with IS (31M, 32W, mean age 67[58;73], mean admission NIHSS 9[6;13]) were admitted after 4.5 hours after stroke onset (non-IVT group). Neurological examination, blood tests (evaluation of hemostasis, hematology, kinetics of erythrocyte aggregation/disaggregation and erythrocyte deformability, platelet aggregation (PA)), neuroimaging (brain MRI, CT-angiography, CT-perfusion) were performed at admission (before IVT in IVT-group) and 24 hours later.

**Results:** IVT-group had larger NIHSS score at admission ( $p < 0.001$ ) but improvement of their neurological deficit was more rapid than in non-IVT-group. In IVT-group adrenaline-induced PA (ADR-PA) was higher than in non-IVT-group and this difference had vanished after IVT. Increased ADR-PA in IVT-group was associated with lack of recanalization and neurological improvement. Erythrocyte sedimentation rate had lowered after IVT ( $p = 0.015$  comparing to non-IVT-group). Negative correlation of lymphocyte level with NIHSS score and infarct core size was showed for both groups and positive correlation of leukocyte level with those parameters was showed only for IVT-group. Hemorheological parameters were seemed to have no significant differences between groups.

IVT may influence blood properties in conjunction with infarct size and neurological deficit.

## ESOC-0955

## 07. Thrombolysis

## Does the recanalizing effect of intravenous thrombolysis depend on the actual applied dose of t-PA?

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**Objectives:** To determine if the recanalizing effect of intravenous t-PA depends on the actual applied dose (AAD).

**Methods:** We conducted a sub-analysis of a prospective study designed to assess t-PA misdosing in acute ischemic stroke patients treated with intravenous thrombolysis (IVT). T-PA dose was calculated according to estimated patient weight. Patients were weighed during the 24 hours following treatment with t-PA, and AAD was calculated. Recanalization rate according to the AAD was analyzed.

**Results:** AAD could be calculated in 97 of the 108 included patients. Mean AAD of t-PA was 0,927 mg/Kg (SD:0.081). Vascular status before and within 24 hours after IVT could be determined in 40 patients. Recanalization occurred in 17 patients (42.5%). AAD in recanalized patients was 0,933 mg/Kg (SD:0.078), and 0,920 mg/Kg (SD: 0.068) in non-recanalized patients,  $p = 0.58$ . Recanalization rate was 66.7% in patients treated with AAD  $\geq 0,99$  mg/Kg and 35.5% for AAD  $< 0,99$  mg/Kg ( $p = 0.09$ ). A higher rate of cerebral bleeding was observed in the AAD  $\geq 0,99$  mg/Kg group (29.4% vs 16.3%,  $p = 0.20$ ).

**Conclusions:** Our results suggest that the AAD of t-PA could affect the recanalizing effect of IVT. Doses  $\geq 0,99$  mg/Kg could have a higher recanalizing power, but also an increased risk of hemorrhagic complications. The optimal dose of t-PA in terms of clinical benefit and safety is probably different to the dose that provides the best results in terms of recanalization.

## ESOC-1135

## 07. Thrombolysis

## IV thrombolysis in patients dependent on others prior to stroke

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Thrombolysis in Stroke Patients study group (TriSP)

**Objective:** To compare outcome and complications in stroke patients treated with IV-thrombolysis (IVT) who were dependent on the help of others prior to stroke versus independent ones.

**Methods:** In a multicenter IVT-database, we compared patients with pre-stroke mRS  $> 2$  ('dependent') versus those with pre-stroke mRS 0–2 ('independent') with regard to favorable 3-month outcome (i.e., reaching pre-stroke mRS or better), death, symptomatic ICH (sICH) and any ICH (aICH). Unadjusted and adjusted odds ratios with 95%-confidence intervals (OR[95%CI]) were calculated.

**Results:** Among 7430 IVT-treated patients, 489 (6.6%) dependent patients were compared with 6941 (93.4%) independent ones. Dementia, prior stroke, heart failure and osteoarthritis were the most common causes for pre-existing dependency. Dependent patients were more likely to die (ORunadjusted 4.55[3.74–5.53]; ORadjusted 2.19[1.70–2.84]) or to suffer aICHs (ORunadjusted 2.17[1.75–2.70]; ORadjusted 1.56[1.22–2.01]). sICH occurred equally frequent in both groups (4.5% vs 4.8%). Favorable outcome was less frequent in dependent (39.5%) than in independent (60.4%) patients. However, among survivors the odds for favorable outcome were even higher in dependent than in independent

patients, after adjustment for age and stroke severity (ORadjusted 1.56[1.19–2.04]).

**Conclusion:** IVT-treated stroke patients who were dependent on the help of others prior to stroke had a higher 3-month mortality than independent patients, despite similar sICH rates. The unexpected observation, that – among survivors – the adjusted odds for reaching at least the pre-stroke mRS were higher in dependent than previously independent patients, deserves further research. Nevertheless, withholding IVT in such patients might not be justified.

## ESOC-1146

## 07. Thrombolysis

## Impact of body mass index on outcome in IVT-treated stroke patients

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**Objective:** To investigate the impact of body mass index (BMI) on functional outcome and complications in stroke patients treated with IV thrombolysis (IVT).

**Methods:** In a multicenter IVT-register based observational study, we studied the association between BMI and poor 3-month outcome (i.e., modified Rankin Scale scores 3–6), death and symptomatic intracranial hemorrhage (sICH) based on criteria of the ECASS-II trial. BMI was used as (i) continuous and (ii) categorical variable distinguishing underweight ( $< 18.5$  kg/m<sup>2</sup>), normal weight (18.5–24.9 kg/m<sup>2</sup>), overweight (25–29.9 kg/m<sup>2</sup>) and obesity ( $\geq 30$  kg/m<sup>2</sup>). Normal weight (18.5–24.9 kg/m<sup>2</sup>) served as the reference group. Univariate and multivariate regression analyses with adjustments for age and NIHSS were done and odds ratios with 95%-confidence intervals (OR[95%CI]) were calculated.

**Results:** Among 1797 IVT-treated patients 55 (3.1%) were underweight 730 (40.6%) normal weight, 717 (39.9%) overweight, and 295 (16.4%) obese. Compared to normal weight, none of the other BMI-categories was associated with poor outcome (OR[95%CI]unadjusted: 1.36[0.78–2.35]; 0.92[0.74–1.14]; 0.78[0.59–1.04]; death 1.63[0.74–3.59]; 1.02[0.72–1.45]; 0.77[0.67–1.27]; or sICH (OR[95%CI]: 1.44[0.42–4.89]; 1.13[0.67–1.90]; 0.70[0.32–1.55] in univariate analyses as well as in multivariate analyses. BMI as continuous variable was neither associated with poor outcome, death nor sICH in unadjusted (OR[95%CI]: 0.99 (0.97–1.01), 0.98 (0.95–1.02), 0.98 (0.94–1.04)), or adjusted analyses (OR[95%CI]: 1.01 (0.98–1.03), 0.99 (0.95–1.05) 1.01 (0.97–1.05)), respectively.

**Conclusion:** In this largest study to date investigating the prognostic impact of BMI in IVT-treated stroke patients, BMI was neither associated with poor 3-month outcome nor with death nor with sICH.

## ESOC-1365

## 07. Thrombolysis

## FABS: A prediction tool for screening of stroke mimics in the emergency department

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**Background and Purpose:** Around 5–31% of patients presenting with symptoms of acute ischemic cerebrovascular disease (iCVD) are stroke mimics (SM). Administration of IV-rtPA to SM is unnecessary and costly. In this study, we propose a scoring system (FABS) for screening of SM in the emergency setting.

**Methods:** We reviewed medical records of consecutive patients who received IV-rtPA for possible iCVD from January 2011 to December 2014. The diagnosis of SM was based on patient presentation, hospital course

and negative neuroimaging studies. FABS score includes six variables: absence of Facial droop, negative history of Atrial fibrillation, Age < 50, systolic Blood pressure <150 mmHg at presentation, history of Seizures, and isolated Sensory symptoms without weakness at presentation. One-point was given for every variable present. FABS score was calculated for all iCVD and SMs.

**Results:** Out of 588 patients, 125 (21.3%) were SMs. Mean age was 61.7 ± 14 [18–95]. 50.5% of patients were male. Median NIHSS at presentation was 7 ± 6.3 [0–31]. Receiver operating characteristic curve (area under curve 0.94, CI: 0.92–0.96) indicated that FABS ≥ 3 could identify patients with SM with 88% sensitivity (95%, CI: 81–93%) and 92% specificity (95%, CI: 90–95%). Only three (0.6%) patients with iCVD had FABS-score of 4 or more. FABS ≥ 4 showed a specificity of 99% (95%, CI: 98–99.8%).

**Conclusion:** FABS-score could be used to identify patients with SM. It can help clinicians consider alternative diagnosis and advanced imaging before administration of IV-rtPA.

## ESOC-1369

### 07. Thrombolysis

#### CT versus MRI in stroke thrombolysis: Evidence from the Safe Implementations of Treatments In Stroke (SITS)

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**Introduction:** Previous literature reports that magnetic-resonance-imaging-based thrombolysis has an improved safety profile in acute ischemic stroke patients. We evaluated this hypothesis.

**Methods:** We analyzed 35817 patients by type of imaging from the SITS-registry for whom information on type of imaging, age, sex, National Institutes of Health Stroke Scale (NIHSS), common cerebrovascular risk factors, safety outcome (symptomatic intracerebral hemorrhage [SICH] following SITS definition) and functional outcome (as measured by modified Rankin Scale on day 90) were available. We also determined the relationship of imaging type and stroke onset to time-to-treatment (OTT).

**Results:** Using a linear mixed effects model (random effects: NIHSS, OTT, center), MRI significantly prolonged OTT ( $P < 0.001$ ). In terms of safety, frequency of SICH/SITS was equal between computed tomography [CT] and magnetic resonance imaging [MRI] (1.6% vs. 1.6%,  $P = 0.85$ ). Adjusted binary regression analysis confirmed MRI a non-significant predictor of SICH/SITS (odds ratio [OR] 0.939, 95% confidence interval [CI] 0.845–1.044). Although less MRI- than CT-patients died within 3 months (10.2% vs. 15.8%,  $P < 0.001$ ), multivariate analysis (which included an adjusting variable that indicates high-volume MRI-centers) found the estimate of MRI (OR 0.831, CI 0.684–1.009) as non-significant. Stratifying for time window, we gained similar results predicting death (<4.5 h: OR 0.855, CI 0.695–1.053, >4.5 h: OR 0.710, CI 0.407–1.237).

**Conclusion:** (preliminary) For routine use – this study suggests that MRI gains no benefit compared to CT in stroke patients treated with intravenous thrombolysis.

## ESOC-1575

### 07. Thrombolysis

#### Reduction in door-to-needle thrombolysis times: A lean approach

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**Background:** Earlier thrombolytic therapy administered in acute ischemic stroke is associated the better functional outcomes. We aim to reduce thrombolysis Door-to-needle (DTN) times from a median of 80 minutes to 60 minutes in line with current international guidelines.

**Methods:** A Lean project involving stakeholder analysis and a process time-step-survey was undertaken to identify potential barriers to the timely provision of thrombolytic therapy. A fully revised 'Acute Stroke Thrombolysis Pathway' was generated to overcome these barriers.

**Results:** Fifty-three "out-of-hospital" ischemic stroke patients received thrombolytic therapy over a 9-month period following the introduction of the revised pathway. Mean age was 69.5 (±15.5), 50.4% were female, 80% pre-notified and 64% afterhours.

The median DTN-time is now 57 minutes (IQR 45–73). The median Door-to-CT (DTCT) time is 21 mins (IQR 12–29) and the CT-to-Needle (CTTN) time is now 33 mins (IQR 24–49).

Median DTCT (26.5 vs. 15 mins;  $P = 0.0005$ ) and DTN times (59.5 vs. 48 mins;  $P = 0.04$ ), but CTTN times (33 vs. 32;  $P = 0.9$ ) were significantly longer in the after-hours period.

**Conclusions:** The Door-to-Needle Project has dramatically reduced stroke thrombolysis DTN-times in line with international guidelines over a 24/7 period. During normal working hours the DTN time is now 48 minutes. Efforts are ongoing to further improve these figures.

## ESOC-1100

### 07. Thrombolysis

#### Thrombolysis in Qatar – A 1-year prospective descriptive study

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**Background:** Intravenous thrombolysis is currently the only approved treatment for acute stroke. Limited data is available from the Middle East.

**Methods:** Prospective data was collected over the year of 2014 for all thrombolysed patients at Hamad Medical Corporation (the sole provider of acute stroke care in Qatar). Demographics, stroke-type, stroke severity, door-to-CT times (DCT), door-to-needle times (DNT) and outcome were noted.

**Results:** Out of 892 stroke cases admitted; 51 cases (5.7%) received thrombolysis. Forty-four (86%) were males. Thirty-three (64.7%) were above 50 years of age. Arabs were 9(17.6%), Asians 41(80.4%) and 1(2%) Caucasian. Thirty-nine (76.5%) arrived by ambulance. (vs. 55% for non-thrombolysed) ( $p = 0.009$ )

Strokes subtypes (as per Bamford classification) were: TACI 13(25.5%), PACI 27 (53%), LACI 5(9.8%), POCI 6(11.7%) ( $p < 0.001$ ).

Stroke severity were; mild (NIHSS ≤4) 1(2%), moderate (5–10) 24(47%), severe (>10) 26(51%) ( $p < 0.001$ ).

Mean DCT was 22.2 + 16.2 minutes (Range 6–85) and mean DNT was 51.0 + 22.0 minutes (Range 12–113). Symptomatic bleeding occurred in 3(5.8%).

Outcome at discharge were good (mRs: 0–2) 23 (45%), moderate (mRs: 3–4) 23 (45%) and (poor: mRs: 5–6) 5 (10%) and when compared with non-thrombolysed patient it was significant ( $p < 0.05$ ).

**Conclusion:** Around 6% of strokes are thrombolysed in Qatar. Patients were more likely to be thrombolysed if they arrive by ambulance, if they present with cortical strokes and have moderate-severe strokes. DCT and DTN were within international benchmarks. Incidence of symptomatic bleeds is low and is comparable to the literature. Outcomes at discharge are good.

## ESOC-1581

### 07. Thrombolysis

#### Influence of treatment during working and nonworking hours on outcome of acute stroke patients treated with intravenous thrombolysis

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**Introduction:** The impact of working and nonworking hours might be relevant to the outcome of stroke patients treated with intravenous thrombolysis (IVT). The aim of our study was to compare the efficacy of IVT on outcome of acute ischemic stroke patients after 3 months who received IVT during working hours with those who received it during nonworking hours.

**Materials and Methods:** According to the time of entry into the hospital, acute stroke patients treated with IVT within 4.5 hours were grouped into those who were admitted during working hours on weekdays (08:00 to 13:59) and the other who were admitted during nonworking hours (14:00–07:59 on weekdays and 00–24 on weekends and holidays). Functional outcome of patients were evaluated by modified Rankin score (mRS).

**Results:** Out of 333 acute stroke patients treated with IVT, 62 (18.6%) were admitted during working hours. Univariate analysis showed no statistically significant differences in outcome after 3 months between the two groups of patients. Also, multivariate analysis showed no effect of working and nonworking hours on the excellent functional outcome (mRS 0–1), good functional outcome (mRS 0–2) or death after three months of stroke onset, as well as the occurrence of symptomatic intracerebral hemorrhage, after two groups were adjusted for confounders.

**Conclusion:** The majority of stroke patients were treated with IVT during nonworking hours. However, there was no impact of nonworking hours on outcome of stroke patients after 3 months of stroke onset, who were treated with IVT.

## ESOC-1285

### 07. Thrombolysis

#### Comparison of thrombolysis time delays during and beyond working hours in a telestroke unit network

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**Introduction:** Several publications indicate that quality of in-hospital treatment varies according to time of admission. Quality seems to be significantly lower beyond working hours. Effect of intravenous thrombolysis in acute stroke patients is time dependent and therefore reduction of time delays is a quality indicator for acute stroke care.

**Aims:** Comparison of time delays in patients treated with thrombolysis in the Telemedical Project for integrative Stroke care (TEMPiS) regarding time of admission. We hypothesized no significant differences between working and non-working hours will be found, as amount of staff and qualification of teleconsultants is constant over time in these settings.

**Methods:** All stroke patients receiving thrombolysis in the TEMPiS network were prospectively registered. For analysis we included all thrombolysis patients presented for teleconsultation in the years 2011 to 2013 and compared pre-hospital (onset-to-door), in-hospital (door-to-needle) and overall (onset-to-treatment) time delays depending on admission within and beyond working hours. Patients with basilar artery occlusion and in-hospital strokes were excluded.

**Results:** 781 patients were identified. 45.2% (352) of patients were admitted during and 54.8% (429) beyond working hours. During and beyond working hours median onset-to-door delay was 65 (IQR 45–104) and 64 (IQR 48–100) minutes ( $p = 0.909$ ), door-to-needle delay was 45 (IQR 33–62) and 48 (IQR 35–65) minutes ( $p = 0.069$ ), onset-to-treatment delay 123 (IQR 90–160) and 120 (IQR 95–159) minutes ( $p = 0.324$ ) respectively. No significant differences were seen in any of the delays.

**Conclusions:** Telemedicine for stroke appears to have an equalizing effect on differences in time delays during and beyond working hours.

## ESOC-1118

### 07. Thrombolysis

#### Short- and longterm effect of blood pressure variability after intravenous thrombolysis

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**Introduction:** Prognostic importance of blood pressure variability (BPV) for safety and outcome in patients treated with intravenous thrombolysis (IVT) is unclear.

**Methods:** 28.976 patients of the Safe Implementations of Treatments in Stroke (SITS) registry were analyzed. Blood pressure was measured on admission, two and 24 hours after IVT. Patients were dichotomized according to median of standard deviation (SD) of systolic BP (BPVSD). Successive variation (SV) of systolic BP (BPVSV) was entered as continuous variable in the outcome regressions. Early neurological improvement (ENI) was defined as 20% improvement of the NIHSS score during first 24 hours. Symptomatic intracerebral hemorrhage (SICH) was observed according to SITS definition. Excellent outcome was defined by the modified Rankin Scale (mRS) 0–1 at 3-month and functional independency by mRS 0–2.

**Results:** Regression analysis for higher BPVSD showed association to higher age, female sex, higher baseline NIHSS, higher baseline BP, longer time to treatment, and higher rates of cardiovascular risk factors. Regarding short-term outcome, BPVSV (OR 0.99,  $p = 0.005$ ) predicted ENI, and SICH/SITS (BPVSV: OR 1.02,  $p < 0.001$ ). Similar effect was observed regarding 3-months excellent outcome (BPVSV: OR 0.99,  $p = 0.04$ ), good outcome (BPVSV: OR 0.99,  $p = 0.001$ ), and mortality (BPVSV: OR 1.01,  $p < 0.001$ ) adjusted to age, sex, baseline NIH, baseline BP, and cardiovascular risk factors.

**Conclusion:** Higher BPV is a relevant negative predictor for favorable short- and longterm outcome after IVT and is associated with increased rates of SICH and mortality independently of absolute BP measurements. A randomized trial addressing the hypothesis of BPV as therapeutic target in acute stroke is necessary.

## ESOC-1341

## 07. Thrombolysis

### How safe is systemic intravenous thrombolysis (IVT) in periprocedural ischemic stroke after left heart catheterization and percutaneous coronary intervention?

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**Introduction:** Ischemic Stroke during or shortly after left heart catheterization or percutaneous coronary intervention is a rare but possibly devastating complication. Although periprocedural stroke is usually detected fast, intravenous thrombolysis (IVT) may be harmful because of preceding application of heparin and/or high-dose antiplatelet medication.

**Aim:** To analyze safety of IVT after periprocedural ischemic stroke focusing on occurrence of intracerebral hemorrhage and stroke mortality.

**Methods:** The Telemedical Project for integrative Stroke Care (TEMPiS) is a TeleStroke Unit network with 2 hub and 18 spoke hospitals. The TEMPiS registry includes all consecutive teleconsultation reports of the network. We retrospectively analyzed all documented strokes that occurred during or within 48 hours after a cardiac catheterization procedure in the period between January 2004 and December 2014.

**Results:** Within an 11 y-period 71 patients with periprocedural stroke were documented.

One patient (1.4%) was diagnosed ICH in the initial CT scan. Out of the remaining 70 patients with ischemic stroke, 20 (29%) (18 embolic infarcts, 2 TIA) received IVT. Of those, one patient (5%) was diagnosed hemorrhagic transformation in CT scan the following day without clinical deterioration. All other 19 patients (95%) had no hemorrhagic complications. Two patients (10%) died, both due to cardiac failure caused by their underlying heart disease.

**Conclusion:** Intravenous thrombolysis in periprocedural stroke after cardiac catheterization appears to be safe despite preceding treatment with heparin and/or antiplatelet medication.

## ESOC-1337

## 07. Thrombolysis

### Temporal trends in tPA use in a bi-ethnic US community from 2000 to 2012

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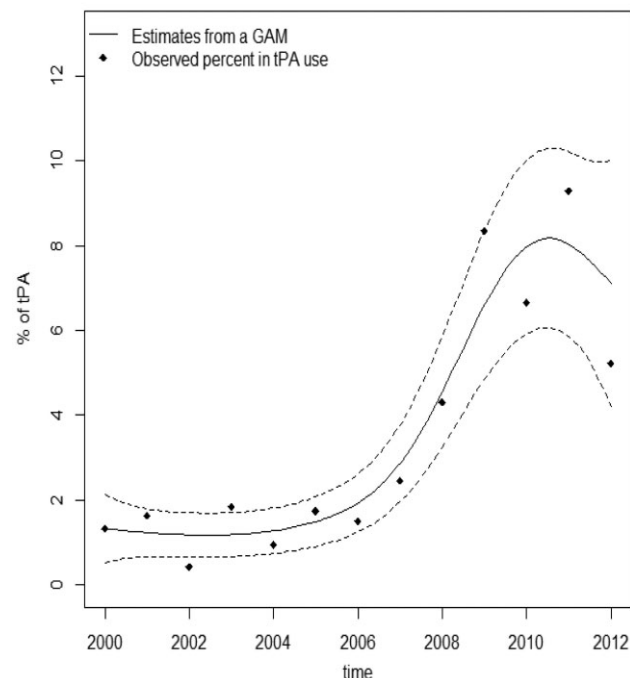
**Objective:** To explore trends in tissue plasminogen activator (tPA) administration for acute ischemic stroke (AIS) in a US community with a large representation of the minority population, Mexican Americans (MA), and to determine whether trends vary by age, sex, ethnicity and stroke severity.

**Methods:** Cases of AIS (n = 5,277) were identified from 7 hospitals in a population-based study (2000–2012). TPA, demographics and severity (National Institutes of Health Stroke Scale (NIHSS)) were abstracted from medical records. Trends were modeled using a generalized additive model with a smoothing spline for time adjusted for age, sex, ethnicity (MA versus non-Hispanic white (NHW)), and NIHSS; interaction terms were added to test modification of trends.

**Results:** Median age was 72 (IQR: 61–81); 56.7% were MA. TPA use was steady at 2% until 2006 when it rose considerably (Fig. 1). Those with

more severe strokes had larger increases in tPA use than those with lower severity ( $p < 0.001$ ). MAs were less likely to receive tPA (RR 0.64 [0.48,0.84]) than NHWs due to emerging ethnic differences in later years. **Conclusions:** Rapid increases in tPA use after 2006 were apparent in this community. Increases in tPA use were larger in higher compared with lower severity patients. A treatment gap between MAs and NHWs may be emerging which suggests the potential need to focus professional education on stroke treatment in MAs.

Estimated and observed % of tPA use



## ESOC-1402

## 07. Thrombolysis

### How do the outcomes of patients with ischemic stroke treated with thrombolysis differ from those untreated? Data from the Scottish Stroke Care Audit

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**Background:** There is ongoing public debate around the benefits of iv thrombolysis in ischemic stroke. A Cochrane review of clinical trials and the SITS registry both report benefits of thrombolysis in terms of improved outcomes.

**Aims and Methods:** To compare outcomes in 1239 patients who were thrombolysed and 11847 not thrombolysed using a national ischemic stroke cohort (2012–13) corrected for case mix.

**Results:** Case fatality at 7 days was 8.7% in those thrombolysed compared to 3.5% for those not treated. After case mix adjustment using the six simple variables (SSV), mortality was significantly higher at seven days for thrombolysed patients, but not at 30 days, 90 days or six months. Discharge home or to usual place was no different at 30 or 90 days.

	Death 7 days n (%)	Death 30 days n (%)	Death 90 days n (%)	Death 6 months n (%)	Home/usual residence 30 days n (%)	Home/usual residence 90 days n (%)
Not thrombolysed (n = 11847)	413 (3.5)	1120 (9.5)	1781 (15.0)	2254 (19.0)	7516 (63.4)	8286 (69.9)
Thrombolysed (n = 1239)	108 (8.7)	190 (15.3)	250 (20.2)	278 (22.4)	634 (51.2)	748 (60.4)
Adjusted OR (95%CI)	1.41 (1.11–1.80)	1.07 (0.89–1.30)	0.96 (0.81–1.14)	0.85 (0.72–1.00)	0.90 (0.78–1.04)	0.92 (0.79–1.06)

**Conclusions:** Similar to clinical trial findings, there is an increased risk of early death with thrombolysis, but no difference in later mortality. Case fatality at 30 days is broadly similar to that reported in the SITS registry (14%). We did not show a benefit in terms of discharge destination at 30 or 90 days: this may reflect the broad comparator population or use of a surrogate endpoint rather than a specific disability measure.

## ESOC-1247

### 07. Thrombolysis

#### Call protocol on transient ischemic attack (TIA): A cohort study in hospital school of Santa House of Mercy Fernandópolis-SP

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**Context:** Multicenter studies have shown low rates of antithrombotic use, low rates of neuroimaging and high subsequent risk of stroke within 90 days after a diagnosis of transient ischemic attack (TIA) given in an emergency unit

**Objectives:** Outline the emergency response protocol to transient ischemic attack in a given ER.

**Design, Target Population and Methods:** We conducted a retrospective cohort study 2010–2012 of patients who were discharged with TIA in the E.R. of a Health Reference Service in the State of São Paulo.

**Results and Discussion:** A total of 113 patients were analyzed through their records. The patients had the following characteristics: the mean age was 71.2 years (SD 13.8 years), 56.9% were female, 53.1% had a history of hypertension, 26.5% had a history of ischemic heart disease, and 17.1% had a previous stroke. The most frequent neurological deficit was the unilateral weakness (53.6%), and most deficits lasted more than 60 minutes (71.6%). Antithrombotic drugs were used for 96.7% of patients at discharge in PS. Neuroimaging was performed in 94.3% of patients, while in the PS. Our group had a 1.9% stroke rate after 90 days of diagnosis of TIA.

**Conclusion:** This study established that most patients diagnosed with TIA in the emergency room and imaging studies, receive antithrombotic agents. Physicians are encouraged to ensure that electrocardiograms are done routinely involved and Neurology in follow-up care. And more importantly, there has been a significant improvement in clinical outcome.

## ESOC-1391

### 07. Thrombolysis

#### Previous treatment with angiotensin converting enzyme inhibitors in patients with ischemic stroke submitted to intravenous thrombolysis

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**Introduction:** Angiotensin converting enzyme inhibitors (ACEi) are one of the most prescribed classes of antihypertensive drugs. Experimental studies showed modulation properties of the fibrinolytic system, associated with reduction of serum concentration of plasminogen activator inhibitor-1. Clinical relevance of these findings is still unknown.

**Objectives:** To evaluate the impact of previous treatment with ACEi on functional outcome of ischemic stroke patients submitted to intravenous thrombolysis.

**Methods:** Historical cohort study that included consecutively patients submitted to intravenous thrombolysis in our Stroke Unit due to ischemic stroke, between March 1st 2010 and March 31st 2014. Functional outcome at three months was rated according to modified Rankin Scale (mRS) and dichotomized into good (mRS ≤2) and poor (mRS >2). We excluded patients with no information on previous medication, previous mRS>2 and those submitted to intra-arterial thrombolysis. A multivariate logistic regression was adjusted for age, hypertension, baseline NIHSS and symptoms-needle time.

**Results:** We included 399 patients, mean age 73.16 years (SD: 11.36), 212 (53.1%) males, 112 (28.1%) on ACEi therapy. Seventy-eight (70.4%) of the patients on ACEi vs. 159 (55.0%) of those not on ACEi had poor outcome, p = 0.01. Previous treatment with ACEi was an independent predictor of poor outcome (OR: 1.94; 95%CI: 1.12–3.35, p = 0.018). Patients on ACEi suffered more hemorrhagic transformation (OR: 1.73; 95%CI: 1.05–2.85, p = 0.03). We found no statistically significant differences on recanalization or symptomatic intracerebral hemorrhage.

**Conclusions:** In ischemic stroke patients submitted to intravenous thrombolysis, previous treatment with ACEi seems to be associated with a worse functional outcome.

## ESOC-1328

### 07. Thrombolysis

#### Which steps in EMS operation predict early hospital arrival and prompt thrombolysis in acute stroke?

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Using emergency medical services (EMS) and early prenotification are associated with early hospital arrival and increased likelihood of



intravenous thrombolysis in acute stroke. We studied which dispatch and prehospital management features predict early hospital arrival (<90 minutes) and treatment (<2 hours) after symptom onset.

All stroke patients receiving recanalization therapy during 2010–2011 and transported by the EMS to the Helsinki University Hospital were recruited for this prospective, observational study. Individual emergency phone call tapes, time-stamped prehospital patient-care reports and hospital records were retrieved and analyzed.

In the sample of 308 eligible patients [55% male, median (interquartile range) NIHSS 8 (5–14)] the median (IQR) onset-to-call time was 6 (0–16) in early and 60 (18–104) minutes in late hospital arrival group while other differences in prehospital time intervals were modest. The stroke code was used by the emergency medical dispatchers in 206 (67%) and by the paramedics in 285 (93%) cases. High priority including lights and sirens was used in 258 (84%) dispatches and 269 (87%) patient transports. In a backwards logistic regression analysis, the onset-to-call time duration ( $p < 0.0001$ ) and ambulance transport using high priority ( $p < 0.01$ ) were independently associated with both early arrival and treatment but dispatch using high priority was not. Arm weakness was the only symptom in prehospital examination promoting early treatment ( $<0.05$ ).

Hesitation to activate the EMS remains as an important problem for acute stroke care. The importance of early emergency call and high priority transport to the stroke center should be emphasized in public education and prehospital guidelines.

## ESOC-0927

### 07. Thrombolysis

#### Safety and efficacy of intravenous tissue plasminogen activator in acute ischemic stroke

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**Objective:** To evaluate the safety and efficacy of intravenous thrombolysis using recombinant tissue plasminogen activator (rtPA) in patients with acute ischemic stroke.

**Methods and Materials:** This is a prospective, multicenter study from Chennai, India. 518 patients with acute ischemic stroke were treated with 0.9 mg per kilogram of body weight of rt-PA (Alteplase) within 41/2 hours from the onset of symptoms. The non tPA group was patients who refused or were ineligible for rtPA. The Primary, Secondary and Tertiary end points were; Barthel Index (BI) and modified Rankin Scale (mRS) at 90 days, 30-day mortality and early neurological recovery and duration of in-hospital stay, respectively. Safety parameters included mortality and incidence of hemorrhage.

**Results:** Demographics was similar in both groups. There was a significant difference in Primary outcome in favor of rt-PA treated patients ( $P < 0.033$ ). The combined BI and mRS was in favor of rt-PA patients ( $P < 0.001$ ) and neurological recovery at 90 days was significantly better ( $P \leq 0.003$ ). Speed of neurological recovery was significantly better at 7 days, 30 days and In-hospital stay was significantly shorter. There were no statistically significant differences in the mortality rate at 30 days or in the overall incidence of intracerebral hemorrhages among both groups. Large parenchymal hemorrhages was significantly more frequent in the rt-PA group.

**Conclusions:** rt-PA in acute ischemic stroke is effective in improving functional and neurological outcome. The safety and efficacy is well proven and hence, intravenous thrombolysis should be recommended for use in all eligible acute ischemic stroke patients.

## ESOC-0886

### 07. Thrombolysis

#### Blood pressure control in thrombolysed acute ischemic stroke patients requiring intravenous antihypertensive treatment at a London hyperacute stroke unit (HASU)

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**Introduction:** There is uncertainty about optimum early BP management in ischemic stroke patients being considered for thrombolysis. At our hospital a protocol for acute lowering of BP prior to administration of thrombolysis is followed. The aim of our study was to look at the effectiveness of this protocol on BP control over the first 24 hours and impact on door-to-needle (DTN) times.

**Methodology:** A retrospective observational study of all patients thrombolysed from January 2012 to November 2014 was conducted and the available notes of all patients requiring acute BP lowering treatment prior to thrombolysis were studied. The DTN times, medications on admission, interval BP scores and presence of complications were recorded. Statistical analysis was performed with SPSS 20.

**Results:** During the observed period 575 patients received thrombolysis. Fifty two(9%) patients required BP lowering prior to thrombolysis and complete case records were available for 36/52 patients. Median DTN was longer in the group requiring BP lowering (45 minutes versus 35 minutes,  $p = 0.10$ ). 47.2% of patients were already on antihypertensive drugs. Protocol violations were seen in 31% of the studied cases during the first hour of thrombolysis. Complications were seen in 4/36(two hemorrhage, one reinfarction and one anaphylaxis) patients. Median BP at 24 hours in the hypertensive group was 180/90 mmHg.

**Conclusion:** Over the period of observation 9% of patients treated with thrombolysis required prior treatment to lower BP. Protocol violations were seen in 31% of these patients during the first hour of thrombolysis and treatment was associated with a longer DTN times.

## ESOC-1521

### 07. Thrombolysis

#### Interval from onset of stroke to call of emergency

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**Background:** Time from stroke onset to beginning of treatment with thrombolysis (onset to treatment time, OTT) is composed of several time intervals. Concern is focused on the intra-hospital interval (door to needle time, DNT), but the prehospital intervals also influence the whole OTT. The very first is the time from onset of stroke symptoms to patient's emergency call (onset to call time, OCT). OCT can hypothetically be reduced by education of the public.

**Aim:** To determine OCT values and its correlation with OTT. Discover impact of educating the public on OCT.

**Method:** In period from 1/2012 to 12/2013 time intervals (OCT, OTT, DNT) of consecutive patients treated with thrombolysis in single stroke center were recorded. In the end of 8/2012 an educational article was published in local press (readers represent about 10% of target population). The article focused on recognition of stroke symptoms and the necessity of urgent call to emergency medical service.

**Results:** Data of 124 patients were collected, mean age 69 years (27–88), 71 men (57%). Median of OCT was 28,1 min (1–202), OTT 127,5 min (52–290) and DNT 45 min (15–175). There is a good correlation between OCT and OTT ( $R^2 0.665$ ), but not between OCT and DNT ( $R^2 0.001$ ). No significant change in OCT was observed after article publication – median

before it was 23 min, 3 months after 37 min ( $p=0.433$ ) and in whole period after publication 31 min ( $p=0.618$ ).  
**Conclusion:** OCT correlates with OTT, single-time educational attempt had no significant effect on OCT.

**ESOC-1432**

**07. Thrombolysis**

**Effect of clinical presentation and stroke etiology on outcome in acute ischemic stroke with or without thrombolytic treatment**

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**Introduction:** Despite broad demonstration of benefit from thrombolysis, better knowledge of prognostics factors could optimize acute stroke management.

**Aim:** To assess the predictors of functional outcome in patients with or without thrombolytic treatment.

**Methods:** From our stroke database we selected acute ischemic stroke patients arrived at our ER within 4.5 hours from symptom onset between March 2005 and April 2013. Clinical presentation and stroke etiology were categorized using OCSP and TOAST classifications.

**Results:** Among 386 patients included, 220 (55.7%) received IV thrombolysis. The two treatment groups showed similar baseline features except for lower age (67.9% vs. 71.7%,  $p .001$ ), lower proportion of diabetes (13.6% vs. 21.7%  $p .038$ ) and higher rate of cardioembolic strokes (39.6% vs. 28.9%,  $p .001$ ) in the rt-PA treatment group. At logistic regression analysis independent predictors of outcome were age (OR 0.97 [95%CI 0.95-0.99]), baseline NIHSS (OR 0.87 [95%CI 0.82-0.92]), TACS clinical presentation (OR 0.29 [95%CI 0.15-0.59]) and thrombolytic treatment. When interaction terms were added to the model we found no significant difference in the effect of thrombolytic treatment in the subgroups of patients classified according to OCSP and TOAST categories.

**Conclusions:** Despite a general poor prognosis of strokes with TACS clinical presentation, IV thrombolysis significantly improved their chance of favorable outcome. The beneficial effect of rt-PA treatment was maintained across the different stroke etiologies.

Subgroups	3 months mRS 0-2/ number of patients		Adjusted Odds Ratio (95% CI)	P value for interaction
	No rt-PA	rt-PA		
<b>TOAST</b>				0,738
Large vessels	7/30 (23.3%)	20/46 (43.5%)	2.23 (0.69-7.23)	
Cardioembolic	9/48 (18.8%)	37/87 (42.5%)	4.02 (1.58-10.26)	
Small vessels	4/11 (36.4%)	7/14 (50%)	1.92 (0.38-9.81)	
Other or undetermined	34/77 (44.2%)	48/73 (65.8%)	2.18 (1.03-4.63)	
<b>OCSP</b>				0,254
TACS	1/60 (1.7%)	25/95 (26.3%)	16.48 (2.14-126.65)	
PACS	29/57 (50.9%)	51/69 (73.9%)	2.34 (1.07-5.14)	
LACS	14/30 (46.7%)	23/38 (60.5%)	1.62 (0.6-4.36)	
POCS	10/19 (52.6%)	13/18 (72.2%)	2.68 (0.64-11.26)	
<b>Total</b>	<b>54/166 (32.5%)</b>	<b>112/220 (50.9%)</b>	<b>2.75 (1.61-4.68)</b>	

**Adjusted effect of treatment on 3 months mRS in OCSF and TOAST subgroups. Models are adjusted for age and baseline NIHSS.**

**ESOC-0959**

**07. Thrombolysis**

**ASTRAL-R score does not reliably predict non-recanalization after intravenous thrombolysis in M1-occlusive strokes**

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**Background:** Intravenous thrombolysis (IVT) alone for acute ischemic stroke (AIS) may be insufficient to achieve recanalization in certain patients. A simple 5-item score (ASTRAL-R) was recently shown to predict absence of complete and partial recanalization at 24 hours in patients treated with IVT.

**Aim:** The study aims to investigate the accuracy of ASTRAL-R score to predict for absence of recanalization in thrombolysed occlusive strokes of the M1 segment of middle cerebral artery.

**Methods:** Data from prospective AIS registries of six academic stroke centers (Lausanne, Bern, Basel, Geneva, Dresden and Caen) were examined. Patients with arterial occlusion in M1 on acute non-invasive imaging, treatment with IVT alone within proven time windows, and repeat arterial assessment at 24 hours were selected. Performance of ASTRAL-R-score was assessed by bootstrapping available data and cross validation.

**Results:** Of the 347 included patients, 127 (37%) did not achieve partial or complete recanalization within 24 hours. Both the ASTRAL-R score (OR 0.83, 0.69-0.99) and acute glucose levels on admission (OR 0.86, 0.76-0.97) [MP1] were identified as independent predictors of absence of recanalization. ASTRAL-R scores of 0, 3 and 6 for M1 occlusions corresponded to non-recanalization probabilities of 26, 38 and 52% respectively. The predictive ability of the ASTRAL-R for these patients was 0.57 (95%CI, 0.50-0.63).

**Conclusions:** The 5-item ASTRAL-R score accuracy to predict non-recanalization of M1 occlusions after IV thrombolysis was confirmed but seem insufficient for routine clinical use. Adding selective radiological parameters such as collateral vessel status, perfusion imaging and thrombus length may further improve this score for these patients.

## ESOC-1246

## 07. Thrombolysis

### I.V. thrombolysis and general stroke care in Latin America – Report from the SIECV-SITS Iberoamerican Stroke Register

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**Background:** 56 centers in 15 Latin American (LA) countries aimed to describe an unselected population of stroke patients, including those treated with iv thrombolysis (IVT), with baseline data and 3 months functional outcomes on the modified Rankin Scale (mRS).

**Methods:** Data for this study were entered into the Safe Implementation of Treatments in Stroke (SITS) registry September 2009-December 2013. For patients untreated with IVT, a minimal version of All Patients Protocol (APPM) was used, including baseline National Institutes of Health Stroke Scale (NIHSS) score, other baseline data and 3 m mRS. For IVT patients, the standard protocol for IVT (IVTs) was used, also including NIHSS 2 h/24 h, concomitant treatments, imaging. Parts of data were adjudicated. A Local Coordinator was responsible at each site. Each country had a National Coordinator.

**Results:** 5401 patients were entered; of these 301 were treated with IVT (5.6%). For APPM population, median age was 65 years, 46% were female, atrial fibrillation 14%, baseline NIHSS 6, functional independence (mRS 0-2) at 3 months 60% and mortality 11%. For IVTs population, median age 66 years, 45% female, atrial fibrillation 22%, baseline NIHSS 11, mRS 0-2 at 3 m 62% and mortality 11%.

**Conclusions:** This is the first study to confirm a level of IVT use in LA, although varying between centers, and lower than in many other countries. It is also the largest study of a general stroke population in LA. IVT patients had more severe neurological deficit than the general stroke population but similar functional outcome at three months.

## ESOC-1423

## 07. Thrombolysis

### Assessment of the feasibility of using wearable technology as an innovative tool for telestroke services: Initial results of Google Glass evaluation

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Wearable technologies offer potential Telestroke applications that are more mobile and less expensive than traditional telemedicine carts.

Several vendors have software for Google Glass that has encrypted video-streaming to ensure protection of patient privacy.

We evaluated products from two vendors for stability and quality of live streaming transmission. A brief neurological exam and NIH Stroke Scale was performed on 17 mock patients by an emergency medicine physician wearing the Google Glass and viewed remotely by a vascular neurologist. The users evaluated the device on a standardized set of questions.

Acceptable quality of the live-streaming transmission was achievable. The vascular neurologist judged the quality to make treatment decisions as “very confident” or better in 6 of 17 cases (2/9 & 4/8 in vendors 1 and 2, respectively). Instability of the transmission occurred with either vendor and led to slow, choppy or freezing video making patient evaluation inadequate in some cases. The components of the neurologic exam that yielded the lowest confidence ratings were ‘rapid alternating movement’ (35.3% very confident or better) and ‘pupil reactivity’ (41.2% very confident or better). Transmission lag time was significantly longer in the device provided by one of the two vendors ( $p < 0.005$ ). Heating of the device battery during video streaming limited its use to brief sessions of 5–10 minutes in both devices.

The quality of video-streaming using Google Glass may be adequate for remote assessment of patients, but connectivity limitations may affect the quality, reliability and duration of the assessment.

## ESOC-1564

## 07. Thrombolysis

### Assessing the need for routine CT head post-thrombolysis

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**Background:** A CT scan to rule out hemorrhagic transformation 24 hours post thrombolysis has been part of routine care since the original NINDS trial in 1995. Given the radiation exposure associated with CT scans, the necessity of routine scanning should be reconsidered, particularly in patients who are improving clinically.

**Method:** A retrospective study of 739 patients who received thrombolysis at Northwick Park hospital between March 2012 and February 2014 was carried out. 28 patients were identified as having hemorrhagic transformation on the 24 hour CT. An analysis of NIHSS scores within this cohort was undertaken to assess whether patients would have been scanned if a new protocol was used, where only patients who were not clinically improving at 24 hours were scanned. Subsequent management of clinically improving patients was evaluated to see if standard post-thrombolysis antiplatelet therapy changed as a result of scan findings.

**Results:** 3.8% (n = 28) of patients were identified as having a hemorrhage post-thrombolysis on imaging, of which the majority (82%; n = 23) had either no change, or a deterioration, in their NIHSS. These patients would have been identified clinically as requiring a CT scan. The remaining patients (n = 5) were clinically improving at 24 hours and did not have their management altered as a result of hemorrhagic transformation on CT.

**Conclusions:** A CT head scan may not be indicated in all patients post thrombolysis. Scanning protocols based on the clinical assessment of patients could reduce radiation exposure whilst maintaining clinical safety.

## ESOC-0923

## 07. Thrombolysis

## Early intravenous thrombolysis in the elderly after acute ischemic stroke in a telestroke network – A retrospective analysis

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**Background:** Recent studies showed that the beneficial effects of early intravenous (IV) thrombolysis on favorable outcomes in acute ischemic stroke patients are also seen in the elderly. We aimed to assess the applicability of these findings to telestroke.

**Methods:** We retrospectively analyzed 542 out of 1659 consecutive stroke patients treated with IV thrombolysis in our telestroke network in East-Saxony, Germany from 2007 to 2012. Outcome data were symptomatic intracranial hemorrhage (sICH) by ECASS-2-criteria, favorable outcome defined as a modified Rankin scale (mRs) of 0-2 at discharge and survival at discharge.

**Results:** Thirty-three percent of patients were older than 80 years (elderly). Baseline characteristics were similar to younger patients except for higher median NIHSS scores in elderly patients (14 (IQR 10) vs. 11 (11), p-value < 0.01). Being elderly was associated with higher risk of sICH (p = 0.003), less favorable outcome (p = 0.02) and lower survival rate (p = 0.01). Using logistic regression analysis earlier onset-to-treatment time was associated with favorable outcome in not elderly patients (adjusted odds ratio (OR) 1.18; 95 % CI 1.03–1.34; p = 0.01) and tended to be associated with favorable outcome in elderly patients (adjusted OR 1.13; 95 % CI 0.92–1.38; p = 0.25). Age caused no significant differences in onset-to-door-time (p = 0.25), door-to-treatment-time (p = 0.06) or onset-to-treatment-time (p = 0.29).

**Conclusion:** Earlier telestroke mediated thrombolysis tends to benefit favorable outcome following acute ischemic stroke in the elderly. Age is not associated with longer delivery times for thrombolysis in telestroke.

## ESOC-0776

## 07. Thrombolysis

## Our institutional experience with thrombolysis in acute ischemic stroke (AIS) in patients with nonvalvular atrial fibrillation (NVAF)

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**Background:** Non valvular atrial fibrillation (NVAF) is an independent risk factor for acute ischemic stroke (AIS). Intravenous administration of recombinant tissue plasminogen activator (rtPA) is known as the best treatment for AIS. Most ischemic strokes in NVAF patients are due to cardiogenic embolism of left atrial appendage thrombi. AF patients with stroke are typically older (averaging approximately 75 years) with large hemispheric strokes and with higher early mortality compared with ischemic stroke patients in sinus rhythm.

**Methods:** We identified prospectively all patients with AIS due to the NVAF who were referred to our Institution in six months period in 2014. We calculated the incidence of administered rtPA in these patients due to their gender, sex, medical history, clinical status on admission a previous oral anticoagulant therapy and outcome.

**Results:** A total of 199 patients with AIS due to NVAF was admitted to our hospital and 115 (57,7%) were female and 84 (42,3%) male. Mean age was 77,2 years (44–102 years). Among them 7 patients (3,5%) received rtPA.

Only one patient was previously on oral anticoagulation therapy (OAT). Other 192 patients (96,5%) received standard therapy for AIS. Among them 49 (25,5%) patients were previously on OAT. Two patients who received rtPA died and in the group of 192 patients died 48 pts (25%).  
**Conclusion:** Our institutional experience in patients with AIS due to the NVAF brings out dilemma – is there more space for thrombolytic therapy in reducing mortality in this particular group?

## ESOC-0074

## 07. Thrombolysis

## White matter lesions double the risk of post-thrombolytic intracerebral hemorrhage

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**Background and Purpose:** Cerebral white matter lesions (WMLs), a surrogate for small-vessel disease, are common in stroke patients and may relate to an increased intracranial bleeding risk following intravenous thrombolysis (IVT) for acute ischemic stroke. However, major guidelines lack a statement on WMLs as a possible contraindication.

**Objective:** We aimed to investigate the risk of symptomatic intra-cerebral hemorrhage (sICH) in presence of WMLs in a large cohort of IVT-treated ischemic stroke patients.

**Methods:** We analyzed 2485 consecutive patients treated with IVT at the Helsinki University Central Hospital. WMLs were scored according to five previously published CT visual rating scales from all baseline CT head scans. The inter-rater agreement was calculated for all four visual rating scales.

Occurrence of intra-cerebral bleeding after thrombolysis was considered as symptomatic applying the European Cooperative Acute Stroke Study II criteria for sICH.

The associations of sICH with nominal, ordinal, and continuous variables were analyzed in a univariate binary regression model and adjusted in multivariate binary regression models.

**Results:** In univariate and multivariate regression analyses, all five tested visual WML rating scales as continuous variables, or dichotomized at different cut-off points, were associated with increased risk of sICH: the odds ratio ranged from 2.22 (95% confidence interval 1.49-3.30) to 2.70 (1.87–3.90).

**Conclusions:** Relevant WMLs visible on CT are associated with more than a double risk of sICH in patients treated with IVT for acute ischemic stroke.

## ESOC-0079

## 07. Thrombolysis

## Series of patients of AIS with recurrent occlusion after recanalization with Solitaire

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**Background:** AIS due to large vessel occlusion is increasingly treated with mechanical thrombectomy device like solitaire. Many studies have reported the recanalization of large vessels to be better with mechanical thrombectomy compared to IV rTPA or standard medical management.

**Objective:** To evaluate the rate of recanalization and re-occlusion of major vessels after recanalization with mechanical thrombectomy within 24 hrs of intervention.

**Materials and Methods:** we treated 46 patients of AIS with mechanical thrombectomy from May 2012 to Dec 2014. the recanalization rate was noted. the patients were re-evaluated within 30 min to 24 hrs post thrombectomy for stable recanalization.

**Results:** We could achieve 86% complete recanalization (TICI 3) by thrombectomy with Solitaire. 10% of these patients had re-occlusion of the target vessel (the one underwent thrombectomy) who had otherwise had complete recanalization with thrombectomy with or without symptom. the reoccluded vessels had no angiographically proven native vessel disease.

**Conclusion:** The rate of immediate or delayed re-occlusion after successful recanalization with solitaire thrombectomy in patients with AIS is significant. it needs to be studied further to prevent such re-occlusion in such patients.

## ESOC-0418

### 07. Thrombolysis

#### The influence of stroke team assessment on door to needle time (DNT)

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**Introduction:** The West Midlands Regional Stroke Service Specification states that patients who have been identified for thrombolysis should have a door to needle time (DNT) of less than 60 minutes and ideally 30 minutes. In this audit we examine the current practice against these regional standards and also examine the diurnal variation of depending on the medical team delivering the treatment. Both teams have round the clock access to an on-call neurology consultant. The Stroke team consists of Stroke Fellows and Neurology Registrars from 08:30 am until 09:00 pm. and then medical registrars for the remainder of the time, completing 24 hours cycle

**Methods:** Data were collected retrospectively over a 12 month period using a local database and thrombolysis forms which, in turn, were collected in real time by stroke nurses on admission. This included identifying the team involved (stroke teams or medical teams), time of admission, time of thrombolysis and DTN time. Inpatient referrals were excluded from this audit.

**Results:** 131 patients were identified who had received thrombolysis. 106 patients were treated by the stroke team and 25 by the medical team. The median time for receiving thrombolysis for the stroke team was 55 min and the mean time was 58.5 min. This was 65 min and 73.2 min respectively for the medical team.

**Discussion:** Recent studies have shown that shortening DNT improves outcome. In this audit we found that DTN time was shorter when patients were assessed by the dedicated stroke team which is consistent with previous studies.

## ESOC-0176

### 07. Thrombolysis

#### Thrombolysed strokes at the Royal Berkshire Hospital: Their estimated and actual weights and the doses of alteplase given

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**Background:** NICE have recommended alteplase at for treating acute ischemic stroke. The recommended dose is 0.9 mg/kg. Studies have shown that higher doses may cause increased rates of intracranial hemorrhage.

However, when patients arrive in the Emergency Department weights often have to be guessed.

**Methods:** A random sample of 56 patients was taken from all patients thrombolysed at the Royal Berkshire Hospital over the last 3 years. Their notes were obtained and their estimated and actual weights looked at as well as the dose of alteplase given compared with what should have been given. Outcomes that were looked at from the notes included whether the patient died within 30 days of a stroke (from all causes), whether the patient had an intracranial bleed and what the eventual discharge destination was (used as a proxy for residual disability).

**Results:** Only 7 patients had their weight estimated exactly. 20 patients were estimated to be more than they were and 29 patients as less.

Overall 8 patients died within 30 days. 2 patients suffered intracranial bleeds. 43 patients were discharged home.

There was no statistically significant increase in risk of death or bleed or of difference in discharge destination in either the overestimation or underestimation group.

**Conclusion:** We found that wrong estimation of weight is a problem. However there was no evidence it affected the outcomes of intracranial bleed, death or discharge destination. We recommend the implementation of a bed with inbuilt scales in the resuscitation department so this problem can be overcome.

## ESOC-0341

### 07. Thrombolysis

#### Intravenous tissue plasminogen activator improves the outcome in very elderly Korean patients with acute ischemic stroke

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**Background:** In a recent pooled analysis of randomized clinical trials (RCTs), intravenous tissue plasminogen activator (TPA) improves the outcome in patients aged  $\geq 80$  years. However, it is uncertain whether the findings are applicable to clinical practice in Asians.

**Methods:** From a multicenter stroke registry database of Korea, we identified acute ischemic stroke patients aged  $\geq 80$  years. Using multivariable analysis and propensity score matching (PSM) analysis, we compared the discharge mRS outcome between patients treated with intravenous TPA within 4.5 hours and those without treatment.

**Results:** Among 2331 patients who met the eligible criteria, 236 were treated with intravenous TPA (mean age,  $83.5 \pm 3.2$ ; median NIHSS, 12.5 [IQR, 8–17]). At discharge, the TPA group versus the no-TPA group had a favorable shift on the mRS score (multivariable analysis, OR [95% CI], 1.50 [1.16–1.94],  $p = 0.0020$ ; PSM analysis, 1.49 [1.14–1.95],  $p = 0.0034$ ) and was more likely to achieve mRS 0–2 outcome (multivariable analysis, 1.98 [1.34–2.91],  $p = 0.0005$ ; PSM analysis, 1.69 [1.14–2.51],  $p = 0.0091$ ). TPA treatment was associated with more symptomatic hemorrhagic transformation (multivariable analysis, 5.44 [2.80–10.59],  $p < 0.0001$ ; PSM analysis, 4.65 [2.33–9.29],  $p < 0.0001$ ), but did not increase the mortality at discharge (multivariable analysis, 0.85 [0.50–1.47],  $p = 0.5672$ ; PSM analysis, 0.77 [0.44–1.36],  $p = 0.3673$ ).

**Conclusions:** In very elderly Korean patients registered in this multicenter registry, intravenous TPA within 4.5 hours improved the functional outcome despite an increased risk of symptomatic hemorrhagic transformation. The findings, consistent with those from pooled analysis of RCTs, strongly support the use of TPA for this population.

## ESOC-0856

### 07. Thrombolysis

#### A new interventional protocol cuts intravenous thrombolysis door-to-needle time in a tertiary hospital

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**Objective:** To determine if a new intravenous thrombolysis (IVT) protocol reduces door-to-needle time (DNT) in a tertiary hospital.

**Methods:** We retrospectively analyzed which factors were associated with in-hospital delays in treating acute stroke with IVT between 2009 and 2012. According to the obtained information, from February to December 2014, we introduced a series of consecutive interventions aimed to reduce DNT including personal history review and test request before patient admission, defined criteria to perform advanced neuroimaging before IVT only in selected patients and not waiting for coagulation laboratory results and/or use of point-of-care INR test before initiating IVT. In-hospital time results were reported monthly to the stroke team. Patients treated during this period were registered prospectively. We compared DNT and factors associated with in-hospital delays before and after protocol changes.

**Results:** 239 patients were included before and 59 patients after intervention. Median (IQR) DNT was 52 minutes (43–70) and 39 (30–51) respectively (25% reduction,  $p < 0.001$ ). Before the intervention, DNT was within 60 minutes in 65.4% and reached 86.4% after. During the pre-intervention period, 2 factors reduced DNT: pre-hospital notification (beta =  $-0.26$ ;  $p < 0.001$ ) and onset-to-door time (“3-hour-effect”) (beta =  $-0.15$ ;  $p = 0.02$ ), while advance neuroimaging before IVT increased DNT (beta = 0.13;  $p = 0.03$ ). After intervention, pre-hospital notification and 3-hour-effect did not affect DNT (beta =  $-0.13$ ,  $p = 0.30$  and beta =  $-0.05$ ,  $p = 0.69$ ), but the effect of advance neuroimaging persisted (beta = 0.35,  $p = 0.007$ ).

**Conclusions:** Our interventional protocol reduces DNT effectively. We overcame the 3-hour-effect and improved our capacity to proceed even without pre-hospital notification. Advanced neuroimaging before IVT persisted as a delaying factor of DNT.

## ESOC-0872

### 07. Thrombolysis

#### Reducing in-hospital delays in acute stroke patient care: Analysis of a new interventional protocol in a tertiary stroke hospital

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**Objectives:** To analyze the effect of different interventions aimed to reduce in-hospital delays of acute stroke care.

**Methods:** we prospectively included all acute stroke potential candidates for intravenous thrombolysis (IVT) admitted from February to December 2014 in a tertiary care hospital. A series of consecutive interventions were implemented during this period including personal history review and CT/blood test request before patient admission (in case of pre-hospital notification), not repeating electrocardiogram (EKG) if previously performed by the emergency medical services, defined criteria to perform advanced neuroimaging only in selected patients and not waiting for coagulation laboratory results and/or use of point-of-care (POC) INR test before initiating IVT. We analyzed the effect on door-to-CT, CT-to-needle, and door-to-needle times.

**Results:** 230 patients were included, median (IQR) door-to-CT was 16 minutes (13–21). 59 (25.7%) patients were treated with IVT, door-to-needle was 39 (30–51), CT-to-needle: 24 minutes (18–33). Door-to-CT was significantly reduced with pre-hospital notification and personal history review + CT/blood test request before patient admission: 15 vs 19 ( $p < 0.001$ ); not performing a new EKG 14.5 vs 19 ( $p < 0.001$ ) and IVT treatment: 14 vs 18 ( $p < 0.001$ ). Advance neuroimaging increased CT-to-needle (21 vs 38.5,  $p = 0.009$ ) and Door-to-needle time (35 vs 55,  $p = 0.003$ ). Not waiting for coagulation laboratory results and/or use of POC INR test reduced Door-to-needle: 35.5 vs 46.5 ( $p = 0.05$ ). The whole protocol could only be applied in 23% of cases. Two patients (3.4%) treated with IVT were proved to be “stroke mimics”.

**Conclusions:** Our interventional protocol seems to reduce in-hospital delays in acute stroke care. However, a better adherence to the protocol interventions is required in order to improve our results.

## ESOC-0791

## 07. Thrombolysis

## Impact of thrombolysis in acute ischemic stroke without occlusion: An observational comparative study

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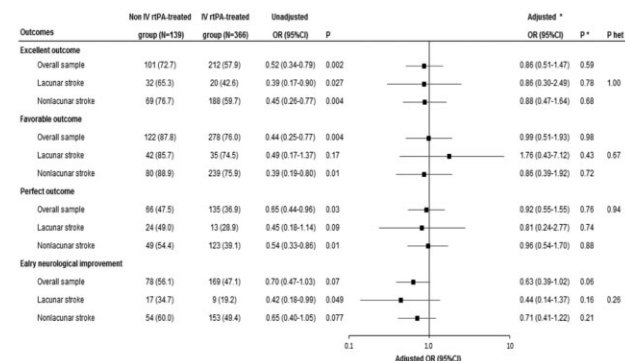
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**Objective:** The impact of intravenous (IV) recombinant tissue plasminogen activator (rtPA) is debated in acute ischemic stroke (AIS) patients without arterial occlusion. We examined the outcomes of patients with AIS and no arterial occlusion according to IV-rtPA use.

**Methods:** In center A, all eligible patients did not receive IV rtPA in cases of no documented occlusion (controls groups), while in centers B, all eligible patients were treated with conventional IV rtPA regardless of the arterial vessel status (cases group). The primary outcome was excellent outcome at 3 months after stroke, as defined by a modified Rankin scale score 0 to 1. Secondary outcomes included different clinical and safety outcomes.

**Results:** From January 2011 to June 2014, 139 AIS patients without arterial occlusion documented by angiography in center A and 366 patients in centers B were thrombolysed. After adjustment for baseline between-group differences, including admission NIHSS, hypercholesterolemia, lacunar stroke subtype, we found no significant difference whatever the clinical outcomes (OR 0.86 (0.51–1.47;  $p=0.59$ )). When analysis was stratified according to lacunar and nonlacunar stroke etiology, we found no significant heterogeneity in the effect size whatever the clinical efficacy outcomes. Sensitivity analysis excluding patients with pre-stroke disability or restricted to balanced groups after propensity score matching, yielded similar results.



\* adjusted for admission NIHSS, hypercholesterolemia, heart rate and lacunar stroke etiology. P-values for heterogeneity between lacunar and nonlacunar stroke (P het) were reported. Abbreviations: CI=confidence interval; IV=intravenous; NIHSS=national institutes of health stroke scale; OR=odds ratio; rPA=recombinant tissue plasminogen activator.

**Fig. 1** Clinical efficacy outcomes in non-IV and IV rtPA-treated groups, overall and according to lacunar stroke subtype.

**Conclusions:** In an observational comparative cohort of acute stroke without occlusion, we found no significant effect of IV rtPA on clinical outcome, independently of lacunar stroke mechanism or not. Further randomized controlled trials are warranted to address this issue.

## ESOC-0139

## 07. Thrombolysis

## Influence of neurologists' experience on the outcome of patients treated by intravenous thrombolysis for cerebral ischemia

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**Background:** Intravenous (i.v.) recombinant tissue plasminogen activator (rt-PA) should be available on a 24/7 basis in hospitals admitting patients with stroke. We aimed at evaluating the influence of the number of patients previously treated with i.v. rt-PA by neurologists on patients' outcome.

**Method:** For each patient consecutively treated with i.v. rt-PA for cerebral ischemia at the Lille University Hospital, we determined the number of previous treatments with rt-PA administered by the neurologist. We performed logistic regression analyses to determine the influence of the experience on the outcome evaluated by the modified Rankin scale (mRS) after 3 months, 0–1 meaning independence, and 0–2 meaning absence of handicap. We compared outcomes of patients treated by the 25% less experienced neurologists with those of trials.

**Results:** Forty-five neurologists treated 800 patients. The experience of the treating neurologist was independently associated with independence (adjusted odds ratio [adjOR] 1.062 for 10 patients more; 95% confidence interval [CI] 1.008–1.120), and absence of handicap (adjOR 1.076 for 10 patients more; 95%CI: 1.016–1.140) at 3 months, but not with symptomatic intracerebral hemorrhage and death. The proportions of patients from the 1st quartile who were independent and without handicap at 3 months were 37.9% and 51.1%.

**Conclusion:** Patients treated by less experienced neurologists, have similar outcomes than expected from trials, suggesting they benefit from thrombolysis. However, the outcome of patients treated by more experienced neurologists was slightly better. Less experienced neurologists should not be excluded from rt-PA programs, but their practices should be evaluated and educational programs organized.

## ESOC-0456

## 07. Thrombolysis

## Stroke nurse practitioners – The solution to maintaining a short door to needle time?

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The Royal United Hospital Bath is a 600 bed District General Hospital. Stroke Thrombolysis is led by the Emergency Department physicians. From January to March 2014, the role of a Stroke Nurse Practitioner (SNP) was being piloted with 1 WTE nurse in order to ensure national stroke targets are being met. The SNP attended all thrombolysis calls in hours.

**Results:** The overall DTN time was significantly reduced during the pilot. However, this was not maintained after the pilot had finished.

Time	Mean DTN	95 % CI for mean		Median DTN	SD	n	P-value
		(lower/upper)					
Pre-pilot (Jan to Mar 2013)	68.4	51.7; 85.0	60	32.3	17	Pre:during	0.027
During pilot (Jan to Mar 2014)	47.5	37.7; 57.3	42	19.7	18	During:post	0.021
Post-pilot (Apr to Jul 2014)	64.8	54.4; 75.2	57.5	25.8	26	Pre:post	0.689
During pilot with SNP	39.1	33.0; 45.2	37.5	8.6	10		
During pilot without SNP	58	37.1; 78.9	53	25.0	8		

Further benefits were the increase in the number of stroke patients who were scanned within 1 hour of arrival after a nurse-requesting CT policy was put in place from 1st of February, and the number of stroke patients having their swallow assessed within 4 hrs.

**Conclusion:** Stroke Nurse Practitioners can be the answer to maintaining short door to needle times and improve on national stroke target performance.

## ESOC-0402

### 07. Thrombolysis

#### Repeated intravenous thrombolysis after rapid recurrent cerebrovascular event

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**Background:** Thrombolytic therapy is the only approved treatment for acute ischemic stroke. Manufacturer's instructions do not recommend the use of alteplase (rtPA) within 3mo of stroke recurrence due to increased risk of bleeding. Published experience with repeated iv-thrombolysis in recurrent stroke is rare. We report a case of two rtPA-treatments within 8 hrs in a patient with an ulcerated carotid plaque and early recurrent stroke.

**Method/Case:** A 67-year-old man presented with a sudden onset left sided hemiparesis (NIHSS: 5, mRS: 4); RR150/80 mmHg. He had a history of prior posterior infarction 2 yrs ago with no remaining deficit. He was thrombolysed within 110 min after first onset of symptoms with 60 mg iv-rtPA, according to current guidelines (door-to-needle time (DNT): 35 min). Hemiparesis resolved within 1 hr (NIHSS: 1). 5.5 hrs after first iv-rtPA treatment was concluded he again developed a left sided hemiparesis (NIHSS: 6). A second thrombolysis (60 mg iv-rtPA) was administered after informed consent (DNT: 40 min). He fully recovered (NIHSS: 0, mRS: 0).

**Results:** A male with rapid recurrent cerebrovascular event and an ulcerated carotid plaque fully recovered from his hemiparesis by repeated iv-rtPA-thrombolysis within <8 hrs time interval. No bleeding was observed. We did not see any other suitable treatment option after clinically relevant reocclusion had occurred.

**Conclusion:** Our case adds individual experience with thrombolysis treatment beyond the guidelines in early recurrent arterio-arterial embolic stroke. Reevaluation of rtPA-exclusion criteria, such as recent ischemic stroke, should be further evaluated in formal trials, to closely address bleeding risks and possibly increase the number of patients who may benefit from repeated thrombolysis.

## ESOC-0361

### 07. Thrombolysis

#### Clinical outcome of intravenous tissue plasminogen activator for basilar artery occlusion

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**Background:** Benefit of intravenous tissue plasminogen activator (IV-t-PA) in basilar artery occlusion remains unclear. We evaluated the efficacy of IV-t-PA for basilar artery occlusion from our experience.

**Methods:** We retrospectively reviewed 20 patients who received IV-t-PA treatment for basilar artery occlusion in our hospital during 2006 and 2013. All patients received 0.6 mg/kg alteplase within 4.5 hours from onset. We analyzed their age, gender, stroke subtype, National Institute of Health Stroke Scale (NIHSS) at admission and discharge, modified Rankin Scale (mRS) at discharge, occurrence of intracerebral hemorrhage.

**Results:** Sixteen patients were treated with IV-t-PA alone and 4 patients were added mechanical embolectomy with Penumbra system. Mean age was 73 years (32-90) and 5 patients were female gender. Stroke subtype was cardiogenic embolism in 16 cases, atherothrombosis in 3 cases and other causes in 1 case. Recanalization was obtained in 15 patients (75%). Eight patients (40%) regained independence (mRS of 0-2) at discharge and their scores in NIHSS at admission were significantly lower than that of the others. Intracerebral hemorrhage occurred in 2 patients, but both of them were asymptomatic.

**Conclusion:** Efficacy of IV-t-PA for basilar artery occlusion may not be inferior to that for other large vessel occlusion. Our results suggest that low score in NIHSS at admission is associated with favorable outcome.

## ESOC-0325

### 07. Thrombolysis

#### Efficacy of intraarterial thrombolysis with tissue plasminogen activator in acute ischemic stroke. Uzbekistan results

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**Background and Purpose:** Intravenous tissue plasminogen activator (tPA) application within 3 hours after onset of acute ischemic stroke (AIS) is established therapy. The alternative for thrombolysis in patient admitted within 3-6 hours after onset is intra-arterial thrombolysis (IAT). The purpose was to evaluate the efficacy of IAT with tPA in AIS due to middle cerebral artery (MCA) occlusion.

**Methods:** Cerebral angiography (CA) and standard Seldinger technique was applied in IAT. After angiographic detection of MCA occlusion IAT with tPA in dose 15-25 mg was performed. 10 patients (7 male, 3 female, aged 48-75 years, average age 64.4 ± 8.6) were investigated. All patients were selected by National Institute of Neurological Disorders and Stroke recommendations. National Institutes of Health Stroke Scale (NIHSS), modified Rankin scale (mRs) were used.

**Results:** MCA occlusion was detected by CA in all patients. NIHSS average score at admission was 14.7 ± 3.9, 272 ± 36.5 minutes elapsed from symptom onset. We obtained the following clinical results: 5 patients (50%) had excellent outcome (mRs score 0 to 1), 3 patients (30%) a good outcome (mRs score 2), 2 patients (20%) had no changes (mRs score 3 to 4). In this patient brain ischemic zone was detected on control CT. In group with excellent and good outcomes 3 patient had asymptomatic hemorrhagic transformation (HT) with small petechiae along the margins of infarct zone.



**Conclusions:** IATT with tPA performed under CA control can be considered as effective method in patients with AIS. Thrombolysis-related HT is a marker of successful recanalization.

## ESOC-0326

### 07. Thrombolysis

#### Monitoring of thrombolysis efficiency in patients with acute ischemic stroke

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**Background and Purpose:** The purpose of this study was to evaluate diagnostic opportunities of such ray methods as transcranial dopplerography (TCDG), traditional cerebral angiography (TCA) and multislice computed tomography angiography (MSCTA) in monitoring of thrombolysis efficiency in acute ischemic stroke.

**Methods:** Since 2003 to 2014 we have 50 patients admitted in “therapeutic window” (3 hours after symptoms onset). 12 patients intravenous thrombolysis with actilyse and 38 patients intra-arterial thrombolysis with streptokinase were performed. Efficiency of thrombolysis (grade of recanalization) was monitored by TCDG, TCA and MSCTA.

**Results:** In patients with intra-arterial streptokinase administration TCDG and TCA were performed before and after thrombolysis. In case with streptokinase the most noninvasive method of monitoring TCDG in average showed hemodynamically (>75%) significant decrease of linear blood velocity in middle carotid artery (MCA) before thrombolysis. After procedure only in 10 of 38 patients TCDG showed full recanalization, in 14 patients – partial recanalization and in 14 patients – no recanalization sings were revealed. TCA only in 6 patients showed immediate recanalization after intra-arterial streptokinase administration while intra-arterial catheter was not removed. In case of 12 patients with actilyse intravenous thrombolysis hemodynamically (>75%) significant decrease of linear blood velocity in MCA before thrombolysis was also detected by TCDG. MSCTA revealed occlusion of MCA large branch. After thrombolysis procedure TCDG showed full in 5 and partial (60–80%) recanalization in 7 patients. MSCTA detected the same recanalization rate.

**Conclusions:** The gold standard of thrombolysis estimation are TCA and MSCTA. TCDG showed high sensitivity and specificity in comparison with TCA and MSCTA.

## ESOC-0656

### 07. Thrombolysis

#### Very early thrombolysis for acute ischemic stroke:

#### Native CT is enough, so why wait?

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We designed a case-control study by creating two groups of patients with confirmed acute ischemic stroke. We administered IV bolus directly after the native CT to patients with suspected stroke, as they were still lying in the CT. This group, called “very early IVT”, was compared to a control group, consisting of patients who benefited from IVT after the regular complete CT.

We assessed door-to-imaging, door-to-needle, symptoms-to-lysis time and, when available, time from IV lysis to thrombectomy. We also assessed NIHSS score at admission, at 24 h and modified Rankin score at discharge from the Neurology Department. The two groups were matched for age, male/female ratio, initial NIH and site of occlusion. The endpoints were the time gained with very early thrombolysis, as well as NIH at 24 h and mRS at discharge improvement. Hemorrhagic complications and mortality were also assessed.

We enrolled a total of 46 patients in the very early thrombolysis group and 92 patients in the control group. Door-to-lysis time was respectively 47 and 79 minutes ( $p < 0.001$ ). NIHSS at 24 h were 4.88 vs 7.43 ( $p < 0.03$ ) and mRS at discharge 2.13 vs 2.85 ( $p < 0.056$ ). We noticed favorable outcome (mRS 0-1) for 43% of patients in the very early IVT group vs 30% in the control group. We found a significantly lower incidence of acute hemorrhage and mortality in the very early IVT group.

This method has the advantage of being implementable in every center, in order to treat patients earlier and with a potential reduction of disability after an acute ischemic stroke.

## ESOC-0117

### 07. Thrombolysis

#### Validating the DRAGON score in Korean patients with ischemic stroke

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**Background:** The Dense Artery, Rankin Score, Age, Glucose, Onset to Treatment Time, NIHSS (DRAGON) score predicts functional outcome in the hyperacute phase of intravenous thrombolysis therapy of ischemic stroke patients. We assessed the validity of the DRAGON score in Korean ischemic stroke patients.

**Methods:** Prospectively collected data of consecutive ischemic stroke patients who received intravenous r-tPA in Hallym stroke center were reviewed ( $n = 185$ ). We assessed the performance of the DRAGON score with area under the AUC-ROC for both good outcome (mRS, 0–2) and miserable outcome (mRS, 5–6) at 3 months after stroke onset. We also compared the AUC-ROC of four prediction scores (DRAGON score, THRIVE, STROKE-TPI and SPAN -100) in identification of functional outcome in patients who received intravenous r-tPA.

**Results:** Among 158 eligible patients, good outcome was found in 94 patients (59.5 %), whereas miserable outcome occurred in 41 patients (25.9%). The AUC-ROC of the DRAGON score was 0.88 (95% CI 0.75–0.88) for miserable outcome and 0.86(95% CI, 0.80–0.91) for good outcome. Other prediction scores (THRIVE, STROKE-TPI and SPAN-100) had similar AUC-ROC of functional outcome; AUC-ROC for good outcome was 0.80(95% CI, 0.73–0.896), 0.84(95% CI 0.78–0.90) and 0.78(95% CI 0.70–0.86) respectively; AUC-ROC for miserable outcome was 0.81(95% CI 0.74–0.87), 0.90(95% CI 0.84–0.94) and 0.85(95% CI 0.78–0.90) respectively. When compared with four prediction scores, there was no significant difference of performance between four scores.

**Conclusions:** The DRAGON score reliably predicts good or miserable outcome at 3 months after intravenous r-tPA in Korean ischemic stroke patients.

## ESOC-0817

### 07. Thrombolysis

#### Improving the selection of patients for stroke code from the coordinating center urgent phone calls in Southern Spain. Evaluation and defining strategies

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**Background:** Ischemic stroke is the paradigm prevalent and potentially serious disease whose prognosis depends on the speed and effectiveness in the proceedings. The first 90 minutes are critical to identify candidates for

the treatment of acute and to improve prognosis. Since 1990, deaths related to stroke increased by 26% annually, so it can be said that we are experiencing an epidemic.

**Methods:** The sample analyzed patients are treated at the Coordinator of Emergency Center from 1 January 2011 to 31 December 2014, attended by a medicalized equipment and whose diagnosis by ICD-9 is 436. The telephone screening performed by expert personnel of the Coordinating Center using standardized questionnaires. The variables analyzed were age, sex, reason for the call, time of call entry, time of arrival at hospital, resource assigned code resolution of the case.

**Results:** The sample is found 2,462 cases with ICD-9 code 436. The reasons for calling are classified in 14 core reasons. As a second specification of the reason for call found inside the trunk neurological disorder to cause stroke, syncope, unconscious, dizziness and fainting. 852 were identified as stroke corresponding to 34% of the overall sample. The average age is 81 years and men 75. Less than 10%, 230 patients, received intravenous thrombolytic therapy (available until 22 May 2014).

**Conclusions:** The telephone screening performed by qualified personnel with standardized questionnaires selects 1 in 10 patients with acute ischemic stroke who benefit from thrombolytic treatment and 1 in 3 after diagnosis by prehospital emergency medical team.

## ESOC-0253

### 07. Thrombolysis

#### Effectiveness and safety of intravenous thrombolysis in patients receiving intra-arterial recanalization therapy

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**Background:** Intravenous thrombolysis (IVT) within 4.5 h of onset is the standard treatment that should be provided to patients with acute large artery occlusion and receiving intra-arterial therapy (IAT). However, the efficacy and safety of preceding IVT are unclear.

**Method:** From a multicenter stroke registry database of Korea, we identified patients with acute ischemic stroke who were treated with IAT within 8 h of onset. The efficacy outcomes were 3-month modified Rankin Scale score 0–2 and successful recanalization defined as the modified Thrombolysis in Cerebral Infarction score 2b–3. The safety outcome was

symptomatic hemorrhagic transformation (SHT). The effect of preceding IVT compared to no IVT was estimated with multivariable logistic regression analysis as an adjusted odds ratio (OR).

**Results:** Among the 639 patients (male, 61%; age  $69 \pm 12$  years; NIHSS 15 [11–19]) who met the eligibility criteria, 458 (72%) were treated with preceding IVT. The adjusted ORs of preceding IVT were 1.25 (95% confidence interval, 0.81–1.94) for functional independence, 1.61 (1.05–2.46) for successful recanalization, and 0.96 (0.50–1.84) for SHT. There was an absolute difference of 8.2% in successful recanalization in favor of preceding IVT (73.4% vs. 65.2%,  $p = 0.04$ ). There were no significant differences in functional independence (39.3% vs. 32.0%,  $p = 0.09$ ) or SHT (10.0% vs. 10.5%,  $p = 0.86$ ).

**Conclusion:** This retrospective registry-based analysis suggests that, in patients with acute large artery occlusion and treated with IAT within 8 h of onset, preceding IVT enhanced successful recanalization without additional risk of intracranial hemorrhage. But the better recanalization was not translated into better functional outcome.

## ESOC-0733

### 07. Thrombolysis

#### Long-term prognosis after intravenous thrombolysis in patients with ischemic stroke

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**Introduction:** Intravenous thrombolysis is undisputedly accepted as one of the interventions in acute ischemic stroke (IS) which significantly improves short-term prognosis. Little is known about long-term prognosis (>12 months).

**Aim:** Evaluate 5-year prognosis of IS patients submitted to thrombolysis  
**Methods:** Review of a prospective registry of patients with IS submitted to intravenous thrombolysis between February 2007 and November 2009. Review of hospitals' clinical records and telephonic interviews with the patient/next of kin/caregiver to determine living settings, stroke recurrence and functional status at 5 years after IS. Favorable prognosis was defined as Modified Rankin Scale (mRS) <3.

**Results:** Long-term prognosis information was retrieved for 105/155 patients. Mean age was 68 years, there was a high prevalence of vascular risk factors, atrial fibrillation was present in 17.1%, median admission NIHSS was 13 and median discharge NIHSS was 5. At 5 years, 38 patients (36.2%) had a favorable prognosis, 10 patients (9.5%) were institutionalized or living in next of kin's household, and 44 patients had died (41.9%). Recurrent IS occurred in 9 patients. Annual IS recurrence or death incidence was 14.1% / patient year. The only clinical predictors of 5-year IS recurrence or death were admission NIHSS (HR = 1.12, IC 95% = 1.06–1.18,  $p < 0.001$ ) and discharge NIHSS (HR = 1.10, IC 95% = 1.05–1.15,  $p < 0.001$ ).

**Discussion:** Analysis of 5-year prognosis after thrombolysis revealed a high annual IS recurrence or death incidence. Severity of neurological deficits on admission and discharge were found to be the only predictors of long-term prognosis.

## ESOC-0739

## 07. Thrombolysis

## Orolingual angioedema in acute stroke treatment with recombinant tissue plasminogen activator

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**Introduction:** Orolingual angioedema (OA) is a potentially life-threatening complication of acute stroke treatment with recombinant tissue plasminogen activator (rtPA), occurring in about 0.2%- 5.1% of patients. Those with insular involvement and prior use of angiotensin-converting enzyme inhibitors seem to be especially at risk.

**Objectives:** To describe the occurrence, clinical presentation and outcome of OA.

**Methods:** Analysis of the prospective register of patients who were treated with systemic rt-PA, between February 2007 and December 2014, in our department.

**Results:** From the 564 patients who underwent thrombolysis in the study period, 24 (4.3%) developed OA, median age 78 years old (IQR = 65–81) and 83.3% were female. Eighteen (75%) were taking angiotensin-converting enzyme inhibitors and/or angiotensin receptor antagonists. One patient had a posterior circulation stroke. Admission median NIHSS was 17 (IQR = 10–21) and median ASPECTS 8 (IQR = 7–10). OA occurred during rtPA perfusion in 17 patients (70.8%), was bilateral and symmetric in 13 (54.2%) and asymmetric, predominantly ipsilateral to the deficits, in 7 (29.2%). Medical treatment was necessary in 22 patients (91.7%) and OA resolved spontaneously in 2. Control CT scan at 24h showed insular involvement in 14 patients (58.3%). At 3 month follow-up 29.2% were independent.

**Conclusions:** AO occurred most frequently during rtPA perfusion and was mainly bilateral and symmetric. Prompt treatment resulted in resolution without complications.

## ESOC-0354

## 07. Thrombolysis

## Repeated intravenous treatment with RT-PA in patients with acute ischemic stroke

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**Background:** Growing use of systemic thrombolysis, demographic changes and higher chances to survive first-ever strokes anticipates an increasing number of patients with recurrent ischemic strokes (IS). However, data on repeated thrombolytic treatment are limited.

**Methods:** Consecutive IS patients repeatedly treated with rt-PA were included into a prospective single center registry. Basic demographic and stroke related variables were documented. Intracerebral hemorrhages (ICH) were assessed on follow-up brain imaging. All anaphylactic reactions were recorded; 3-month clinical outcome was evaluated using the modified Rankin Scale (mRS).

**Results:** Within 15 years, 24 patients were included [male 46%; median age at 1st event: 75 years; median time between treatments: 346 days (IQR 120–932)]. Onset-to-treatment times did not differ between the events ( $p = 0.237$ ) and no difference concerning treatment procedures was present (1st treatment: 79% rt-PA alone, 21% additional thrombectomy; 2nd treatment: 71% rt-PA alone, 29% additional thrombectomy;  $p = 0.726$ ). No allergic or anaphylactic reactions were recorded after first, but one oral angioedema occurred after recurrent treatment. No symptomatic ICH was observed. After the 1st treatment, an mRS  $\leq 2$  was present in 75%; 54% recovered to the status before stroke. In contrast, after 2nd treatment an mRS of  $\leq 2$  was observed in 38% and only 29% recovered to the status before the respective stroke. An mRS 5–6 (versus 0–4) after 2nd treatment was associated to atrial fibrillation ( $p = 0.05$ ) and higher initial NIHSS values ( $p = 0.01$ ).

**Conclusions:** Repeated thrombolysis is feasible and safe. However, the clinical outcome appears to be less satisfying compared to the results after the first treatment.

## ESOC-0848

## 07. Thrombolysis

## Predictive variables for mortality in patients with ischemic stroke treated with intravenous thrombolysis

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**Objectives:** To determine which variables are associated with a higher risk of mortality in patients treated with intravenous thrombolysis (IVT).

**Methods:** Descriptive observational study of patients treated with IVT during 2003–2013. We analyzed: age, sex, hypertension, onset-to-needle time, door-to-needle time, previous stroke, previous modified Rankin scale (mRS), baseline glucose levels, NIHSS score and pretreatment systolic blood pressure (pSBP). We considered early mortality (EM) (1–7 days) and late mortality (LM) (8–90 days). 5 causes of death were considered: symptomatic intra-cerebral hemorrhage (ICH), cerebral edema caused by ischemic damage, infections, heart failure (HF) and other.

**Results:** 412 patients included. 46 died (11,2%): 28 EM (60%) and 18 LM (40%). Causes of death were: cerebral edema 18 (39,1%), infections 14 (30,4%), ICH 10 (21,7%), HF 2 (4,3%) and other 2 (4,3%). ICH and cerebral edema were the main causes of death in EM while infections were more frequently related with LM. Factors associated with mortality were: age (HR 1,051, 95% CI 1,020–1,084,  $p = 0,001$ ), hypertension (HR 3,459, 95% CI 1,614–7,415,  $p = 0,001$ ), previous stroke (HR 3,002, 95% CI 1,400–6,438,  $p = 0,005$ ), pSBP (HR 1,016, CI 1,004–1,027,  $p = 0,007$ ), glucose (HR 1,005, 95% CI 1–1.01,  $p = 0,046$ ) and baseline NIHSS score (HR 1,137, 95% CI 1,078–1,  $p < 0,001$ ). Age, previous stroke and baseline NIHSS score were retained as independent predictors of mortality after multivariate analysis.

**Conclusions:** Mortality is similar to other series recently published. Advanced age, previous stroke and stroke severity were the main factors associated with mortality.

## ESOC-0652

## 07. Thrombolysis

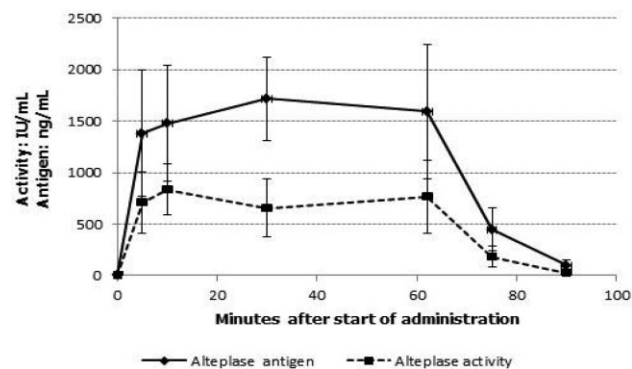
## First description of alteplase's pharmacokinetics and activity in acute ischemic stroke (AIS) patients

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**Background:** Despite increasing use of alteplase in AIS, and despite its unique administration regimen in this indication, to our knowledge alteplase's pharmacokinetic profile hasn't been described before in this patient population.

**Methods:** As a reference in a THR-18 trial (ClinicalTrials.gov NCT01957774; Approval: the Central Clinical Hospital of Ukrzaliznytsia Ethics Committee), 0.9 mg/kg alteplase (Actilyse®, Boehringer Ingelheim GmbH, Germany) was administered i.v. over 60 minutes (10% as a 1-minute initial bolus), without THR-18, to 12 AIS patients, of whom 10 had evaluable data (all Caucasians, age (mean ± SD) 69 ± 7.46 years, 8 females). Total alteplase concentration and activity were determined using the rtPA Combi Actibind ELISA Kit (Technoclone, Vienna, Austria) in plasma sampled immediately before administration (time 0), and 5, 10, 30, 62, 75, and 90 minutes after bolus initiation. Non-compartmental analysis was performed with PK Solver v2.0.

**Results:** Alteplase's AUC<sub>0-t</sub> was 113,325 ± 22,085 ng/mL\*min, C<sub>max</sub>: 1,911 ± 288 ng/mL, T<sub>max</sub>: 31 ± 23 minutes and t<sub>1/2</sub>: 7.74 ± 3.02 minutes (means ± SD). Mean alteplase time-concentration and -activity plots:



There was an excellent linear correlation between alteplase's activity and concentrations up to ≈2000 ng/mL (correlation coefficient: 0.984 ± 0.015).

**Conclusions:** alteplase's current administration regimen in AIS produces stable concentrations throughout the 60-minute infusion. Alteplase's activity parallels alteplase's blood concentrations. These data may help in designing alternative alteplase administration regimens.

## ESOC-0657

## 07. Thrombolysis

## First administration of THR-18 to acute ischemic stroke (AIS) patients treated with alteplase: Safety, imaging and clinical outcome data from a phase IIA trial

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**Background:** THR-18 is a plasminogen activator inhibitor-1-based peptide, aimed at reducing alteplase-associated brain bleeding and edema.

**Methods:** In a double-blind trial (ClinicalTrials.gov NCT01957774; Approval: Central Clinical Hospital of Ukrzaliznytsia Ethics Committee), 30 i.v. alteplase-treated AIS patients (19 females, age (mean ± SD)

69.7 ± 8.2 years) were randomized to i.v. THR-18 0.18 mg/kg (n = 6), 0.54 mg/kg (n = 12) or placebo (n = 12) as a 1-hour infusion paralleling alteplase's. Safety, NIHSS, mRS, non-contrast CT (NCCT, day 2), pharmacokinetic and pharmacodynamic data were collected through day 30. **Results:** The overall rates of adverse events and drug-related adverse events were similar across the 3 groups; 3 fatalities occurred with THR-18 and 1 with placebo (none considered drug-related). The THR-18 0.54 mg/kg group tended towards greater systolic blood pressure reduction, peaking ≈7:30 hours after drug initiation (mean ± SD, mmHg): -19.8 ± 27.2 vs. -9.1 ± 13.4 with placebo, (p = 0.234, ANOVA); these blood pressure changes did not correlate with clinical outcome. On day 2 NCCT, 1 hemorrhagic infarction and 2 parenchymal hemorrhages type 1 were observed with placebo vs. 0 in both THR-18 groups (p = 0.054, Fisher exact test). On this NCCT, the prevalence of acute hypodensities was similar across all groups (range: 75–83%): 40% of the THR-18-treated subjects with hypodensities developed brain edema vs. 89% in placebo (p = 0.033, Fisher exact test). Mean baseline NIHSS scores were 9.3, 9.7, and 11.1 in the 0.18 mg/kg, 0.54 mg/kg and placebo patients, respectively; 33%, 42% and 17% attained a day 30 NIHSS score of 0-1, respectively. **Conclusion:** These safety, clinical and imaging results merit further clinical research with THR-18.

## ESOC-0720

## 07. Thrombolysis

## Stroke thrombolysis experience in Oradea

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**Introduction:** Thrombolytic treatment for stroke patients is used in our hospital only since 2012.

**Material and Method:** In 2012 we developed our own Algorithm and Protocol for Thrombolysis treatment and since 2013 we are part of the Romanian National Program for Thrombolysis Treatment in Stroke Patients.

**Results:** There are 78 patients that underwent thrombolysis treatment in our hospital: 25 in 2012, 30 in 2013 and 23 in 2014. The age distribution was between 32 and 80 years, with mean age 68 years. The time from the onset to ED was between 30 and 165 minutes. The time from the onset to the CT scan was 30 to 180 minute. The time from the onset to blood tests results was 75 to 225 minute. The time from onset to thrombolysis treatment was 75 to 240 minute. The door to needle time was between 30–135 minutes. At 2 hours 64% of the patients have improved, 7% had the same NIHSS Score and 29% worsened. At 24 hours, 81% of the patients have improved and only 19% worsened. There were 18% patients with hemorrhagic transformation and 20% deaths – 6.4 % because of the hemorrhagic transformation, 7.6% because of the stroke and 6.4% by other causes.

**Discussion and Conclusion:** The clinical evolution of our patients motivates us to enhance this kind of treatment. It is necessary to develop educational programs for the population as well as for pre-hospital healthcare so that a greater number of stroke patients could benefit from IV thrombolysis treatment.

## ESOC-0567

## 07. Thrombolysis

**Thrombolysis accelerated the breakdown of unstable plaque – Uncommon case of neurological deterioration post-thrombolysis**S Saber<sup>1</sup>, J Li<sup>1</sup>, H Elshimy<sup>1</sup>, G Zachariah<sup>1</sup>, V Umachandran<sup>1</sup><sup>1</sup>Stroke Medicine, Broomfield Hospital, Chelmsford, United Kingdom

**Introduction:** Early neurological deterioration is relatively common event with first few days following acute ischemic stroke. We observed unusual complications in 3 patients following thrombolysis.

**Case Report:** 84 year old man presented with left arm weakness and paresthesia. His initial NIHSS score was 6. He was thrombolysed with Alteplase at 123 minutes from the onset of symptoms. His 1 Hour NIHSS score improved to 1.

Next day post thrombolysis his clinical condition deteriorated with reduction of GCS, headache, drowsiness and new onset lateral rectus palsy and marked increased of NIHSS score to 12 within 24 hours.

MRI scan showed multiple foci of restricted diffusion mostly in the territory of middle cerebral artery, multiple infarcts demonstrated in right parietal and occipital lobe which was highly suggestive of embolic nature. He was in sinus rhythm, Echocardiogram was normal.

CT angiogram showed mild plaque at carotid bulb extending in to right proximal internal carotid artery causing 50% stenosis.

**Conclusion:** We have noticed similar complications in another 2 cases where thrombolysis accelerated the breakup of an unstable plaque from carotid artery leading on to shower of emboli. This case study showed there was no other source of thrombus detected in heart or any other vasculature in the imaging.

This is likely an uncommon complication of stroke thrombolysis.

## ESOC-0416

## 07. Thrombolysis

**Safety and efficacy of IV RT-PA therapy for acute ischemic stroke presenting with minor symptom**K Shindo<sup>1</sup>, K Kamiyama<sup>1</sup>, T Osato<sup>1</sup>, H Endo<sup>1</sup>, M Mikamoto<sup>1</sup>, K Takahira<sup>1</sup>, K Fumoto<sup>1</sup>, T Watanabe<sup>1</sup>, T Kataoka<sup>1</sup>, H Sugio<sup>1</sup>, T Ogino<sup>1</sup>, K Honjo<sup>1</sup>, H Nakamura<sup>1</sup><sup>1</sup>Neurosurgery, Nakamura Memorial Hospital, Sapporo, Japan

**Background:** The Japan Stroke Society recommends careful administering intravenous recombinant tissue plasminogen activator (IV rt-PA) to patients with minor stroke symptoms. We explained some of these, which especially had a major trunk occlusion or stenosis, had poor prognosis. So we positively administrate IV rt-PA to patients with minor stroke symptoms.

**Purpose and Method:** We retrospectively evaluated the safety and efficacy of IV rt-PA therapy for minor symptomatic stroke. We defined minor symptom as NIHSS score  $\leq 4$ . Outcome was assessed using the modified Rankin scale (mRS) score at discharge and was dichotomized into good (mRS 0-2) versus poor (mRS 3-6). In addition we evaluated risk of hemorrhagic complications.

**Result:** There were 110 cases who received IV rt-PA therapy between January 2012 and August 2014 in Nakamura Memorial Hospital. Of those, 21 (male 76% [n = 16]) cases were minor symptomatic stroke. The median NIHSS score was 3. Stroke etiology was identified as: cardiogenic embolism (14 cases), large vessel atherosclerosis (5 cases), small vessel occlusion (1 case), paradoxical embolism (1 case). Sixteen cases (76.2%) had a major trunk occlusion or stenosis. There were two asymptomatic hemorrhagic infarction cases but no symptomatic case. Other hemorrhagic complication was only one, which didn't give a disadvantage for a patient. Compared with admission, 19 cases (90.5%) were better condition and no case

became worse condition at discharge. Seventeen cases (81.0%) were good prognosis.

**Conclusion:** This retrospective study suggests that administering IV rt-PA to patients with a minor symptomatic cerebral infarction can lead to improved clinical outcome with low risk of bleeding.

## ESOC-0614

## 07. Thrombolysis

**Intravenous thrombolysis is delayed in posterior circulation strokes: Results from the Austrian Stroke Unit Registry**P Sommer<sup>1</sup>, L Seyfang<sup>2</sup>, J Ferrari<sup>3</sup>, E Fertl<sup>1</sup>, W Serles<sup>4</sup>, S Greisenegger<sup>4</sup><sup>1</sup>Neurology, Krankenhaus Rudolfstiftung, Vienna, Austria<sup>2</sup>Klinische Neurowissenschaften und Präventionsmedizin, Danube University, Krems, Austria<sup>3</sup>Neurology, Krankenhaus Barmherzige Brüder, Vienna, Austria<sup>4</sup>Neurology, Medical University of Vienna, Vienna, Austria

**Background:** Therapeutic effect of recombinant-tissue-activator (rt-PA) is highly time-dependent. Previous smaller studies reported that rt-PA treatment was delayed in patients with posterior circulation strokes (PCS). We analyzed in a large multicenter cohort whether patients with PCS had prolonged onset-to-door-times (ODT) and door-to-needle-times (DNT) compared to patients with anterior circulation strokes (ACS).

**Methods:** We studied ODT and DNT of patients enrolled into the Austrian Stroke Unit Registry (ASUR) and treated with rt-PA. Classification into PCS or ACS was based on clinical presentation at onset according to the Oxfordshire Community Stroke Project. The relationships between ODT respectively DNT and several explanatory variables were modeled by multivariate linear regression.

**Results:** Out of 74,591 patients with acute ischemic stroke enrolled into the ASUR between 2003 and 2014, 9185 were treated with rt-PA (846 with PCS and 8,339 with ACS). Univariate, ODT and DNT were significantly longer among patients with PCS as compared to patients with ACS: ODT – median 80 minutes (IQR 52–120) vs. 72 (50–109),  $p < 0.001$ ; DNT – 55 (35–90) vs. 45 (30–68),  $p < 0.001$ . After adjustment for confounding, localization within the posterior circulation was significantly associated with delay in the DNT ( $p < 0.001$ ). Patients with PCS lost on average 11 minutes (95% CI 8–15min) before treatment with rt-PA. There was no significant association of PCS or ACS with ODT after adjustment for confounding.

**Conclusions:** We detected a delay in treatment with rt-PA in patients with PCS. Given the observational character of our study, future studies analyzing in-hospital stroke protocols specifically for patients with PCS are needed.

## ESOC-0030

## 07. Thrombolysis

**Is there clear indication for routine repeat CT head 24 hours post-thrombolysis in acute stroke?**H Taylor<sup>1</sup>, G Pinches<sup>2</sup><sup>1</sup>Surgery, Great Western Hospital NHS Trust, Swindon, United Kingdom<sup>2</sup>Medicine, Cheltenham Hospital, Cheltenham, United Kingdom

**Background:** Current practice at North Bristol NHS Trust is to perform a CT head in acute stroke patients at approximately 24 hours post-thrombolysis to rule out a significant secondary hemorrhage before

aspirin administration. Guidelines advise CT head after 24–48 hours<sup>1</sup> and aspirin to be considered after 24 hours<sup>2,3</sup>.

**Method:** Retrospective audit of all patients (46) admitted with acute stroke and thrombolysed with Alteplase, between 24/03/2013 and 11/10/2013. Data was collected from imaging software and patient notes.

**Results:** 98% of patients were scanned within 36h and 100% within 48h. 6.8% showed no clinical deterioration in the first 24h but the CT scan revealed a hemorrhage that altered management. Time of aspirin administration after thrombolysis ranged from 25–45h with 74% receiving aspirin within 36h and 100% within 48h. The mean time from CT head to aspirin administration was 6.9 hours and rose to 9.4 h if scanned outside of normal working hours.

**Key Messages:** Overall NBT is doing well at performing repeat CT scans. We consider a change in management of 6.8% patients as a result of the CT head to be a significant finding, supporting continued use of the repeat CT head. There was a significant delay to aspirin administration, especially out-of-hours.

#### Referens

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#### ESOC-0828

##### 07. Thrombolysis

##### Achieving door-to-needle times below 10 minutes in stroke thrombolysis with favorable outcomes

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**Objective:** Because efficacy of IV thrombolysis for acute ischemic stroke decreases with time elapsed from symptom onset, the in-hospital door-to-needle time (DNT) should be kept as short as possible. Here we present all 6 stroke patients in whom we achieved a DNT below 10 minutes.

**Methods:** All patients were treated according to our local stroke care protocol which resembles the Helsinki model: 1) ambulance prenotification with patient details (including name, date of birth, symptoms, onset time, comorbidity, medication, weight) alerting the stroke team to meet the patient on arrival; 2) patients transferred directly from triage onto the CT table on the ambulance stretcher; and 3) pre-prepared alteplase bolus delivered in CT immediately after the interpretation of scans by the neurologist without waiting for coagulation results. Early outcome was assessed at discharge from the stroke unit.

**Results:** All 6 patients (5 men, 1 woman) were treated in the period August 2014 to December 2014. Mean age was 72.7 (range 46–93) years, mean baseline National Institute of Health Stroke Scale (NIHSS) score was 7.2 (range 2–15), mean DNT was 7 (range 3–9) minutes, and mean onset-to-treatment time (OTT) was 59.3 (range 48–85) minutes. All patients had substantial early improvement (complete restitution: n = 3; NIHSS 1: n = 2; NIHSS 7: n = 1).

**Conclusion:** In selected stroke patients with a clear-cut clinical scenario and physician access to full information on patient history and medica-

tion, dedicated acute care can keep the DNT below 10 minutes and the OTT below 90 minutes improving the odds for favorable outcomes.

#### ESOC-0839

##### 07. Thrombolysis

##### Helsinki model in Wels: Stroke thrombolysis door-to-needle time cut by 20 minutes in 5 months

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**Objective:** When IV thrombolysis is initiated within 90 minutes of symptom onset after acute ischemic stroke, the number needed to treat (NNT) to achieve little or no symptoms is 4.5. As the NNT increases by 1 for every 20 minutes of extra delay, the in-hospital door-to-needle time (DNT) should be kept as short as possible. We hypothesized that adherence to the Helsinki model could improve the DNT in our large general hospital.

**Methods:** The stroke team gradually restructured the stroke care protocol in cooperation with the ambulance and emergency teams to improve adherence to key components of the Helsinki model: 1) ambulance prenotification with patient details alerting the stroke team to meet the patient on arrival; 2) patients transferred directly from triage onto the CT table on the ambulance stretcher; and 3) alteplase delivered in CT immediately after imaging. We analyzed our prospective stroke registry for effects of these changes on the DNT over the course of 5 months.

**Results:** From mid-July to mid-December 2014, 66 stroke patients were treated with IV thrombolysis. The median (interquartile range) DNT was reduced from 49.5 (35–95) minutes in the first month of the observation period to 29 (8.5–64.5) minutes in the fifth month. Longer DNT was associated with lack of ambulance prenotification, unclear symptom onset, use of MRI as initial imaging modality, and service out of business hours.

**Conclusion:** Adherence to key components of the Helsinki model was highly efficacious by cutting the DNT by 20 minutes within only 5 months.

#### ESOC-0175

##### 07. Thrombolysis

##### Thrombolysis-associated parenchymal hemorrhage is not associated with CT perfusion volumes

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**Introduction:** Intracerebral hemorrhagic transformation, in particular parenchymal hemorrhage (PH), remains a feared complication of intravenous thrombolysis (IVT) with recombinant plasminogen activator (rt-PA). Several epidemiological, clinical and radiological risk factors have been established. We aim to identify parameters based on CT-perfusion (CTP), which can predict the risk of PH, alone or in combination with other variables.

**Methods:** In this observational cohort study, we reviewed the prospective Acute Stroke Registry Analysis of Lausanne from 2003 to December 2013.

We selected patients with Acute Ischemic Stroke involving the Middle Cerebral Artery (MCA) territory who were thrombolysed within 4.5 hours and who had a good quality baseline CTP immediately before or at the beginning of the IVT. Demographic and clinical data, the Alberta Stroke Program Early CT Score (ASPECTS) and volumes of penumbral and infarcted tissue on CTP using a validated threshold model were compared in patients with and without PH.

**Results:** Of 193 thrombolysed patients with good quality CTP, 24 (12%) presented a PH transformation (11 PH1, 13 PH2). In univariate analysis, later IVT within 4.5 hours (OR:1.97 per hour, 95% CI:1.09–3.56), presence of atrial fibrillation (OR:2.55, 95% CI:1.04–6.23), and a lower ASPECTS (OR: 0.77 per point, 95% CI: 0.67–0.9) were associated with PH. CTP volumes of penumbra (OR:1.00, 95% CI:0.99–1.01) and infarct size (OR:1.00, 95% CI:0.99–1.01 respectively) were similar between the two groups.

**Conclusion:** In this small sample of thrombolysed MCA strokes undergoing acute CTP, we confirmed that later treatment, atrial fibrillation and a lower ASPECTS, but not volumes of thresholded CTP, are correlated with PH.

## ESOC-0371

### 07. Thrombolysis

#### The natural history of ischemic stroke not treated with IV thrombolysis because of mild or rapidly improving symptoms

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**Background and Purpose:** Intravenous thrombolysis (IVT) is the only registered treatment for acute ischemic stroke (AIS). However, the number of patients with an ischemic stroke receiving IVT is small. Common cited reasons for not treating with IVT are the deficits being too mild or rapidly improving. The aims of this study were investigating the natural history of patients not treated with IVT solely because of mild or rapidly improving symptoms and to assess predictors of an unfavorable outcome.

**Methods:** Patients with an AIS at the emergency department who were not treated with IVT solely because of mild or rapidly improving symptoms were included. The mRS and NIHSS scores on admission were registered and follow-up mRS scores were obtained 3 months later. Variables were obtained to evaluate possible predictors of an unfavorable outcome.

**Results:** Eleven of the patients with initial mild or rapidly improving symptoms did receive IVT after deterioration on the ward, and 8 had an unfavorable outcome after 3 months. A total of 148 patients with an AIS did not receive IVT because of mild or improving deficit. The mRS scores declined in a significant amount of patients, nonetheless 34.5% (95% CI 27.3–42.4%) had an unfavorable mRS score (2–6) after 3 months. In the multiple model, female sex, higher initial NIHSS score and unfavorable mRS on admission were significant predictors of unfavorable outcome.

**Conclusions:** The natural history of patients with ischemic stroke and mild or rapidly improving symptoms is not always favorable.

## Neurointervention

### ESOC-1116

#### 08. Neurointervention

##### Association of radiation dose, contrast volume and number of microcatheter injections with post-procedure intracranial hemorrhage following interventional treatment for acute ischemic stroke

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**Introduction:** Intracranial hemorrhage (ICH) after thrombectomy has been reported to be related to microcatheter delivered angiographic contrast in patients undergoing thrombectomy for stroke.

**Methods:** We examined local registry data to establish whether there was an association between contrast and radiation exposure and intracranial hemorrhage within 24 hours in 144 patients who were treated by mechanical thrombectomy for anterior circulation strokes. Analyses were conducted in SPSS v.21.

**Results:** Forty-eight (33%) developed post-operative ICH and 12 (8%) subarachnoid hemorrhage (SAH); 6 (4%) and 2 (1%) respectively were clinically significant. On univariable binary logistic analysis there was no correlation between radiation dose, contrast volume, number of microcatheter contrast injections (MCIs) and overall rates of post procedure ICH or SAH. After adjustment for contrast dose, radiation dose, MCIs, pre-procedure NIHSS, perfusion TICI score, systolic blood pressure, intra-arterial alteplase dose, procedure duration, number of thrombectomy attempts to primary lesion and the primary occlusion site, multi-variable logistic regression analysis showed no association for SAH, but there was an association between ICH and the number of MCIs.

#### Adjusted analysis

		OR	Sig.	N (n)
ICH	Radiation dose	1.000	0.140	114(33)
	Contrast volume	1.000	0.922	
	MCIs	1.123	0.019	
SAH	Radiation dose	1.000	0.078	116(11)
	Contrast volume	1.013	0.068	
	MCIs	0.920	0.318	

**Conclusion:** The likelihood of ICH increases with higher number of MCIs, but not with contrast volume after adjustment for confounding factors. No such relationship was found for SAH. This needs confirmation in a clinical study, but might suggest that the number MCIs should be kept at a minimum.

### ESOC-0937

#### 08. Neurointervention

##### Intravenous thrombolysis and thrombus length are predictive factors for successful recanalization in acute ischemic stroke treated by mechanical thrombectomy

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**Aims:** Several factors determine the outcome after acute ischemic stroke treated by mechanical thrombectomy. Among other factors not receiving intravenous thrombolysis and an incomplete revascularization were shown to predict unfavorable outcome at 90 days. Therefore the aim of this study was to investigate whether intravenous thrombolysis influences the revascularization efficacy.

**Methods:** Retrospective analysis of all patients who presented with an anterior circulation stroke with underlying large artery occlusion and who received mechanical thrombectomy between 07/12 and 12/13 and at two German Stroke Centers. Imaging data was graded and evaluated according to the mTICI scale and the respective vessel occlusion site definitions. Outcome measures included NIHSS, mRS, and procedural timings.

**Results:** We identified 129 patients; 91/129 (71%) did receive intravenous-thrombolysis prior to mechanical thrombectomy; of these 66/91 (73%) presented with a middle cerebral artery occlusion and 25/91 (27%) presented with a Carotid-T occlusion. We could not find significant differences for baseline NIHSS; time from symptom onset to groin puncture or age when comparing these patients to those who did not receive intravenous thrombolysis. We found that the rate of successful recanalization (mTICI  $\geq$  2b) was significantly higher in those patients with underlying middle cerebral artery occlusion and intravenous-thrombolysis prior to mechanical thrombectomy ( $p = 0.01$ ). Stepwise logistic regression identified intravenous thrombolysis and thrombus length as predictive factors for a favorable recanalization result ( $p = 0,0039/p = 0,0016$ ).

**Conclusion:** Intravenous-thrombolysis and thrombus length are predictive factors for successful recanalization in acute ischemic stroke with underlying middle cerebral artery occlusion that might help to avoid futile treatment in acute ischemic stroke.

### ESOC-0282

#### 08. Neurointervention

##### Endovascular rescue interventions in cervical artery dissection

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**Background:** Cervical artery dissections (CAD) are a major cause of stroke in young adults. Despite the often benign condition, a stenosis, occlusion or embolization may lead to an acute ischemic stroke. In such cases, endovascular interventions may be the only treatment option.

**Methods:** We retrospectively analyzed all patients presenting with a CAD at our hospital from 2008 to 2014.

**Results:** We identified 52 patients with CAD treated on our stroke unit ( $n = 29$  male;  $n = 23$  female; mean age 45.2 years). The affected vessels were the internal carotid artery ( $n = 32$ ; 61%), the vertebral artery ( $n = 17$ ; 33%) and multiple arteries ( $n = 3$ ; 6%).



Due to severe progressive symptoms (NIHSS 6–21; mean 13) endovascular therapy was performed in 8 of 52 patients: in 3 cases a combined intravenous thrombolysis and endovascular treatment (ET) without stenting of the CAD, in 3 cases a stenting of the CAD and ET of the intracranial occlusion, in 1 case extracranial stenting only.

7 procedures were technically successful with clinical significant improvement in 6 patients. 1 patient had a symptomatic intracranial reperfusion hemorrhage at day 1. In 1 case endovascular access was technically impossible. After acute therapy the NIHSS of the endovascular treated patients was 2–18, mean 7 (Table 1).

n	NIHSS admission	mRS admission	Vessel status and intervention	NIHSS discharge	mRS discharge
1	6	3	VA-dissection, basilar embolism, ia. thrombolysis, aspiration thrombectomy, tirofiban, stenting VA	3	2
2	21	5	ICA-dissection, media embolism, iv. thrombolysis, stentriever thrombectomy	18	5
3	13	5	ICA-dissection, carotid-t-embolism, ia. thrombolysis, tirofiban, stenting ICA	2	2
4	12	5	ICA-dissection, media-embolism, iv. & ia. thrombolysis	5	3
5	18	5	ICA-dissection, media-embolism, ia. thrombolysis, stentriever thrombectomy, tirofiban, stenting ICA	12	5
6	6	3	ICA-dissection, tirofiban, stenting ICA	2	2
7	9	3	ICA-dissection, media-embolism, iv. thrombolysis, aspiration thrombectomy	3	3
8	17	5	ICA-dissection, endovascular access technically impossible	10	5

**Conclusion:** In CAD patients suffering progressive hemodynamic or embolic stroke, ET should be considered in the acute phase depending on multimodal CT imaging. We describe the successful combination of intravenous and intraarterial thrombolysis as well as endovascular recanalization strategies for acute stroke in CAD.

## ESOC-1220

### 08. Neurointervention

#### Trevo XP 3x20 in patients with M2 occlusion selected with CT perfusion: Preliminary results

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**Background:** Stentriever are increasingly used to recanalize intracranial artery occlusion in acute ischemic stroke (AIS). However, also small vessels occlusion can lead to poor prognosis. We report our preliminary experience in using the Trevo XP 3x20 stent for M2 occlusion.

**Methods:** Five AIS patients with left M2 occlusion admitted <6 hours from stroke symptom onset underwent endovascular treatment with Trevo XP 3x20 (2 pure thrombectomy and 3 rescue therapy). All patients underwent NCCT, CTA and CTP at onset and at 24 hours. Selection criteria were NIHSS>6, ASPECTS>7 and large mismatch visually assessed on CT perfusion (CTP) maps. The difference between final infarct volume and admission CTP-MTT lesion volume, outlined on admission CTP and 24 hour-NCCT respectively, represented the amount of post-treatment rescued brain tissue. Recanalization was assessed on 24 hour-CTA according to TIC1 criteria. Good outcome was defined as 3 month-modified Rankin scale (mRS) ≤2.

**Results:** Successful recanalization was achieved in 4/5 patients. No infarct signs on 24 hours-NCCT and a complete rescue ischemic tissue were found in all recanalizers in whom was sufficient just 1 pass with a puncture-to-recanalization time ranged from 35 to 70 min. No patients had procedure-related complications or hemorrhagic transformation at follow-up CT scans. A good outcome was achieved in all 5 cases.

**Conclusions:** Our results suggest that thrombectomy using Trevo XP 3x20 stentriever in M2 occlusion is safe and effective. These findings also indicate that CTP seem to be a promising tool for the patient selection.

## ESOC-1561

### 08. Neurointervention

#### Disentangling the entangled vessels: Clinical presentation of intracranial arteriovenous malformations

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**Background:** Intracranial Arteriovenous Malformations (IAVM) are brain vascular malformations that present with hemorrhage, seizure, headache, or focal neurologic deficit.

We aim to describe the clinical presentation of patients with IAVM.

**Methods:** Retrospective observational study of patients with IAVM diagnosed or submitted to endovascular treatment in 4 years. IAVM was defined as abnormality of intracranial vessels that constitute a connection between arterial and venous systems without an intervening capillary bed. Data on demographics, clinical and morphological characteristics, diagnostic and therapeutic procedures was collected. We present descriptive and inferential statistics using chi-square test and Mann-Whitney.

**Results:** Of 32 patients diagnosed with IAVM (62.5% men, median age 35 years, range 8–83), 26 were embolized. IAVM were located in the frontal lobe in 10, occipital in 8, parietal in 8, temporal in 6 and cerebellar in 4 patients. According to Spletzer-Martin classification, 4 were grade I, 14 grade II, 6 grade III and 8 grade IV. Ruptured IAVM was seen in 11 patients (34.4%).

Clinical presentation included headache (n = 19), focal neurological deficits (n = 10), seizure (n = 6), intracranial hemorrhage (n = 5) and incidental (n = 1).

A total of 41 embolization procedures were performed, median 1 (range 1–3), and complete exclusion was achieved in 4 (15.4%). Seizure as presentation (31.3%) was associated with frontal location (p = 0.038).

**Conclusion:** We had more headache as initial presentation than other studies, probably because our hospital is a reference neurosurgery center receiving patients with brain hematomas. Our study suggests, as previously reported, that seizures mainly occur in frontal lobe IAVM.

## ESOC-0318

## 08. Neurointervention

**Mechanical thrombectomy in cerebral venous thrombosis: A systematic review of 185 cases**

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**Background and Purpose:** Cerebral venous thrombosis (CVT) is generally treated with anticoagulation. However, some patients do not respond to medical therapy and these might benefit from mechanical thrombectomy (MT). The aim of this study was to gain a better understanding of the efficacy and safety of MT in patients with CVT, by performing a systematic review of the literature.

**Methods:** We identified studies published between January 1995 and February 2014 from PubMed and Ovid. We included all cases of CVT in whom MT was performed with or without intra-sinus thrombolysis (IST). Good outcome was defined as normal or mild neurological deficits at discharge (modified Rankin Scale 0–2). Secondary outcome variables included peri-procedural complications and recanalization rates.

**Results:** Our study included 42 studies (185 patients). Sixty percent of patient had a pretreatment intracerebral hemorrhage (ICH) and 47% were stuporous or comatose. AngioJet was the most commonly used device (40%). IST was used in 131 patients (71%). Overall, 156 (84%) patients had a good outcome and 22 (12%) died. 9 (5%) patients had no recanalization, 38(21%) had partial and 137(74%) had near to complete recanalization. The major peri-procedural complication was new or increased ICH (10%). Use of AngioJet was associated with lower rate of complete recanalization (OR 0.2, 95% CI 0.09–0.4) and lower chance of good outcome (OR 0.5, 95% CI 0.2–1.0).

**Conclusion:** Our systematic review suggests that MT is reasonably safe but controlled studies are required to provide a definitive answer on its efficacy and safety in patients with CVT.

## ESOC-0514

## 08. Neurointervention

**Acute stroke due to tandem (internal carotid artery/middle cerebral artery) occlusion: Efficiency and safety of the association of the three main treatment modalities**

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**Introduction:** Stroke caused by acute tandem ICA/MCA occlusion is associated with a poor prognosis.

In acute stroke due to large vessels lesion, intravenous thrombolysis (IVT) leads to poor recanalization rate while endovascular therapy (stenting and thrombectomy) is a promising treatment. Double antiplatelet therapy (APT) is then used to prevent reocclusion and distal embolization.

We wanted to evaluate the efficiency and safety of the association of those treatments in patients with acute stroke due to MCA/ICA tandem lesions.

**Method:** We reviewed data of five 60-year-old patients with tandem ICA/MCA stenosis and mean NIHSS of 16 at admission.

Primary end points were safety of the procedure and good clinical outcome (as defined by mRS = 0–2 at 90 days).

**Results:** All had IVT followed by endovascular therapy. Stenting was performed on four of five ICA lesions (three stenoses, two occlusions).

Then the five MCA occlusions were treated by mechanical thrombectomy performed with Solitaire FR2.

Antiplatelet therapy was delayed by 24 hours due to IVT.

Revascularization was achieved for all (TICI2c-3). IVT was efficient at temporary recanalizing proximal lesion in two individuals.

We observed two reocclusions of carotid stent (one with clinical worsening) and two asymptomatic intracerebral hemorrhages.

**Conclusion:** To our knowledge, this is the first series fully related to ICA/MCA lesions combining those three modalities of treatment.

This association is often effective as IVT temporary reopens ICA occlusion before endovascular procedure although it delays the APT set up.

A timing question remains in post-procedure APT since reocclusion has occurred in two people.

## ESOC-0783

## 08. Neurointervention

**Thrombectomy after intravenous thrombolysis versus intravenous thrombolysis alone in acute ischemic stroke: Results of a multicenter prospective observational with retrospective case control study**

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**Background:** We prospectively developed a protocol of thrombectomy performed after IV thrombolysis in patients with acute ischemic stroke and proximal MCA or distal internal carotid artery (ICA) occlusion. We compared the clinical outcome of those patients with a pooled data of acute stroke patients treated with iv thrombolysis alone.

**Material and Method:** Between August 2011 and October 2014, all patients fulfilling the criteria's for iv thrombolysis underwent an angio-CT scan before IV thrombolysis. In 34 consecutive patients with proximal occlusion and no clinical recovery at the end of iv thrombolysis, a thrombectomy was performed with the Solitaire FR device. A retrospective comparison was performed with a pooled data of 84 stroke patients treated with iv thrombolysis alone before August 2011. A t-test of student was used for statistical analysis.

**Results:** The thrombectomy and the thrombolysis cohorts were similar in term of age, stroke severity and time delay of iv thrombolysis from stroke onset. Time delay of thrombectomy (recanalization) from stroke onset was  $321 \pm 77$  min. At 3 months, 67.6 % (n = 23) of the thrombectomy cohort had a clinical good outcome (mRS  $\leq 2$ ) whereas 35,7% (n = 30) of the iv thrombolysed cohort had a mRS  $\leq 2$  (p < 0.001).

**Conclusion:** Thrombectomy performed after iv thrombolysis in patients with proximal MCA occlusion seems to have significant clinical benefit when compared with patients treated by iv thrombolysis alone. Although our series is too small to give definite conclusions, it should encourage to go further in determining the place of thrombectomy in the treatment of acute ischemic stroke.

## ESOC-0836

## 08. Neurointervention

### Why carotid stenting and intracranial thrombectomy for treatment of acute stroke due to tandem occlusions is associated with a high risk of intracranial hemorrhage?

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**Background:** Tandem occlusion is a rare but severe presentation of stroke that involves an occlusion of the internal carotid artery (ICA) with an ipsilateral intracranial cerebral artery occlusion. Primary stenting of the ICA combined with intracranial mechanical thrombectomy can be an effective treatment, but may be associated with a high incidence of symptomatic intracranial hemorrhage (SIH). We described our experience with such endovascular treatment and discussed factors of SIH.

**Methods:** Consecutive cases of emergency carotid stenting followed by mechanical intracranial thrombectomy were retrospectively reviewed from March 2012 to December 2014. Patients were selected with MRI. Clinical outcomes were assessed at admission, at discharge and at 90 days. Morbidity and mortality data were collected and analyzed.

**Results:** In our stroke unit, 13 patients (mean age of 61,8 [42–86]) were identified. Mean initial NIHSS score was 12,8. Nine patients (69%) received IV tPA prior to the procedure. 12/13 treated patients achieved a TICI score  $\geq 2b$ . On discharge the mean NIHSS score was 11,4 and 50% of patients achieved a MRS  $\leq 2$  at 90 days. Hemorrhagic transformation within 48 h occurred in 77% of patients, including SIH in 5/13 patients (38%). There were 3 stent thrombosis, without clinical relevance. Two patients died, but neither THS nor stent thrombosis were associated with mortality.

**Conclusion:** Primary stenting of the ICA combined with intracranial mechanical thrombectomy can be performed with a high rate of technical success but the incidence of SIH poses challenges for clinician. We discussed, analyzing our experience, and the factors of SIH.

## ESOC-0649

## 08. Neurointervention

### Hemicraniectomy in ischemic stroke: Important to consider

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**Aim/ Introduction:** In spite of trials demonstrating potential benefit, hemicraniectomy following severe ischemic stroke remains a controversial intervention due to the potential for severe disability and concern over future quality of life. We analyzed the outcomes of patients undergoing hemicraniectomy at a tertiary stroke and neurosurgical center in Edinburgh.

**Methods:** Using ISD/ coding, we retrospectively identified patients who had undergone hemicraniectomy over the last five years. For outcome, we analyzed notes and followed-up by phone. Rated functional level using modified Rankin Scale.

**Results:** 14 patients underwent hemicraniectomy. The mean age was 51 years (median 49 years), 9 (64%) were female, 5 (36%) were male. 10 patients (71%) had surgery within 48 hours of onset of symptoms, 4 patients (29%) were greater than 48 hours. Time from onset to assessment of outcome was a mean of 25 months (range 0 to 59) 7 patients (50%) had a right middle cerebral artery (MCA) territory infarct, 4 patients (29%) had a left MCA territory infarct, 3 patients (21%) had posterior cerebral artery territory infarcts.

mRankin Score- 2 (1, 7%), 3(6, 43%), 4(1, 7%), 5(2, 14%), 6(4, 29%). Mortality in this series was 29%. 50% had an mRS of less than or equal to 3.

**Conclusion:** In this case series, and in keeping with hemicraniectomy trial data, mortality was lower than would be expected with conservative management. We also found in this highly selected population that although there was disability, in half of the population this was at a level that would allow independence.

## ESOC-0931

## 08. Neurointervention

### Balloon test occlusion of an ophthalmic artery aneurysm with subsequent treatment and retinal preservation with pipeline embolization

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Treatment of ophthalmic artery aneurysms can be challenging surgically and endovascularly given their location and issues related to recurrence and preservation of vision. Flow diversion provides an additional tool for treating these aneurysms, but some questions remain regarding preservation of the ophthalmic artery and vision. We present a case of a 27-year-old female with a growing 5 mm ophthalmic artery aneurysm in which the ophthalmic artery arose from the dome of the aneurysm. The patient underwent balloon test occlusion of the periorbital internal carotid artery with intraoperative retinography showing decreased perfusion and loss of vision with decreased blood pressure. As such, coil embolization of the aneurysm was deferred. Instead, pipeline embolization was performed, which resulted in no loss of vision and no compromise of retinal perfusion. Prior to placement of the device, therapeutic levels of dual anti-platelets were verified with laboratory testing. Six-month followup angiography demonstrated complete obliteration of the aneurysm. While others have published clinical experience with flow diversion in ophthalmic aneurysms, we present for the first-time, correlative management and followup with retinal examinations.

## ESOC-0534

## 08. Neurointervention

### Mechanical thrombectomy versus systemic thrombolysis in MCA stroke: A distance to thrombus-based outcome analysis

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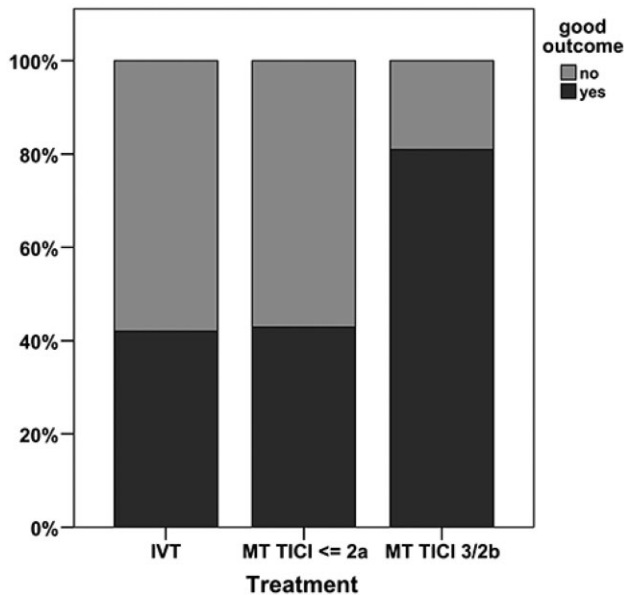
**Background and Purpose:** Acute ischemic stroke due to occlusion of the MCA has a poor outcome. The distance to thrombus from the carotid T can predict the outcome after intravenous thrombolysis. With a distance to thrombus  $<16$  mm, fewer than 50% of patients treated with intravenous thrombolysis achieve a favorable outcome. We compared stent retriever-based endovascular mechanical thrombectomy with additional intravenous thrombolysis versus intravenous thrombolysis alone.

**Materials and Methods:** Patients with MCA occlusion proven by computed tomography angiography with a DT  $<16$  mm, treated either with intravenous thrombolysis alone or with stent retriever-based endovascular mechanical thrombectomy with additional intravenous thrombolysis,

were included in the present study. Changes in NIH stroke scale (NIHSS), the 7d NIHSS and the 90d modified Rankin Scale (mRS) scores were analyzed by treatment modality.

**Results:** Of 621 patients, 87 fulfilled all inclusion criteria. Fifty-nine patients were treated by intravenous thrombolysis and 28 by mechanical thrombectomy with additional intravenous thrombolysis. Although patients treated with mechanical thrombectomy with additional intravenous thrombolysis had significantly more severe strokes (NIHSS  $17.1 \pm 4.5$  vs.  $14.3 \pm 6.1$ ;  $p = 0.032$ ), both the short- and long-term outcomes were significantly in favor of this patient group (7d NIHSS:  $10.9 \pm 6.3$  vs.  $6.7 \pm 6.7$ ;  $p = 0.008$ /90d mRS: 4 [2–6] vs. 2 [0.75–2.5];  $p = 0.003$ ).

**Conclusions:** Mechanical thrombectomy with additional intravenous thrombolysis leads to a significant improvement in clinical outcome compared with intravenous thrombolysis alone in patients with proximal MCA occlusion with a distance to thrombus <16 mm.



## ESOC-1428

### 08. Neurointervention

#### Mechanical thrombectomy using the new ERIC-retriever is safe and reveals high rates of successful vessel recanalization in acute ischemic stroke

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**Background and Purpose:** Mechanical thrombectomy (MT) with new generation devices such as stent-retrievers are highly effective in acute ischemic stroke with large vessel occlusion (LVO). The aim of this pilot study was to determine the safety and feasibility of MT using the new ERIC-retrieval-device consisting of several interlinked cages.

**Methods:** Twenty-one consecutive patients suffering from acute ischemic stroke with LVO who have been treated with ERIC-retriever were included into this pilot study. Onset to intravenous thrombolysis time  $\leq 4.5$  h or wake-up-stroke with relevant CT-perfusion mismatch and NIHSS  $\geq 4$  represented the main inclusion criteria. We assessed baseline/stroke characteristics, treatment related parameters and outcome.

**Results:** Mean age was  $69 \pm 12$  years, 62% women. Median NIHSS on admission was 16 [IQR11–20] and onset to MT time was 7h59m [IQR 6h50m–11h07m]. Eight patients received intravenous thrombolysis, 2 intraarterial urokinase. The new ERIC device was used as the sole retriever in 14/21 patients (67%) and as a rescue device in 7, with 3 of them supported by thrombus aspiration. Excellent recanalization was achieved in 17 patients (81%) with TICI3 in 10/21 and 2b in 7/21, respectively. The median procedural time was 106 min [IQR 72–166]. No intraprocedural complications occurred. At 3 months, fair outcome (mRS  $\leq 3$ ) was achieved in 62%, with 54% of them being independent (mRS  $\leq 2$ ). Symptomatic intracerebral hemorrhage unrelated to the device developed in 2 patients (mRS at 3 mo 3+6) and mortality at 3 months was 29%.

**Conclusion:** The new ERIC-retrieval-device is technically safe and effective in removing thrombi in patients with acute ischemic stroke due to large vessel occlusion.

## ESOC-0155

### 08. Neurointervention

#### Endovascular embolization of the middle meningeal artery: Morphological aspect

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**Introduction:** The endovascular embolization of the middle meningeal artery (MMA) is considered as one of the basic methods of acute bleeding and posttraumatic aneurism treatment nowadays. The aim of present research is to correlate the morphological characteristics of the MMA with the individual shape of skull.

**Material and Methods:** A total of 50 patients who underwent routine magnetic resonance angiography examination of the head and neck were involved into our prospective cohort study. The length and outer diameter of extracranial, intraosseous, and intracranial segments of the MMA were measured in patients with dolichocephalic, mesocephalic, and brachycephalic types of the skull construction.

**Results:** The morphological characteristics of the MMA in different groups were estimated in order to determine the possibility of using minimal invasive procedures. The brachycephalic patients had the most inauspicious anatomical precondition for endovascular intervention on MMA due to the narrowest lumen of the vessel, high probability of torture of its extracranial part, and pronounced inflexion at the transmission of the interosseous segment to the intracranial one.

**Conclusion:** The morphological characteristics of the MMA have close correlation with the individual shape of skull. Estimating the shape of the skull gives valuable information for involved specialists, helping them to predict probable types of variability of the MMA and to foresee the possibility of the manipulation and risk of iatrogenic trauma at the early diagnostic stage.

## ESOC-1570

### 08. Neurointervention

#### “Moving forward following the MR CLEAN trial”: A retrospective analysis of how our acute stroke service could be improved by provision of intra-arterial treatment

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**Introduction:** The recent Mr Clean Trial demonstrated favorable functional outcomes following IAT compared to usual care. We conducted a retrospective observational study to ascertain what proportion of our patients may benefit from IAT.

**Method:** All acute stroke patients with hyperdense changes in the internal carotid and middle cerebral arteries (MCA) were identified from 2013. Images and case details were assessed by an interventional neuroradiologist and stroke physician to determine whether they would be considered for IAT.

**Results:** Of 393 patients, 46 patients (35 TACIs and 11 PACIs) had vascular hyperdensity on non-contrast brain CT corresponding to the terminal ICA, M1, M1 bifurcation or proximal M2. 22 of the 46 patients may in retrospect have been radiologically and clinically suitable for consideration of IAT. Of these 22 patients, 12 received IV thrombolysis with a range of improvement in NIHSS -3 to 20. Of the 10 patients unable to receive thrombolysis reasons included no clear time of onset, raised INR and high NIHSS. With the aid of CT perfusion a proportion of these 10 patients could have received IAT. 16 of the 22 patients were admitted between 9am and 5pm.

A further group of patients without hyperdense changes with would have benefitted from CT angiogram (CTA) to assess suitability for IAT.

**Conclusion:** 5.6% of our patients could potentially benefit from IAT. We are evaluating our service based on this. Increased usage of CTA and/or perfusion in addition to plain CT is likely to increase this number.

## ESOC-0815

### 08. Neurointervention

#### Percutaneous cerebrovascular intervention vs. intravenous thrombolytic therapy for acute ischemic stroke: A systematic review and meta-analysis

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**Purpose:** Percutaneous cerebrovascular intervention (intra-arterial recanalization therapy) offers a new approach to the treatment of acute ischemic stroke. The purpose of our systematic review and meta-analysis was to examine whether this intervention is more effective and safer than intravenous thrombolytic therapy.

**Methods:** We searched MEDLINE, EMBASE, and the Cochrane Central Register of Controlled Trials for randomized-controlled trials up to January 1st 2015 that compared percutaneous cerebrovascular intervention with intravenous thrombolytic treatment in patients with acute ischemic stroke. Good functional outcome was defined as a modified Rankin Scale score of 0 to 2. We searched Clinicaltrials.gov, Current Controlled Trials, and Stroke Trials Registry for on-going trials. We contacted authors for additional unpublished data.

**Results:** We identified four trials with a total of 450 patients. Percutaneous cerebrovascular intervention was not associated with an improved proportion of patients with good functional outcome (relative risk (RR) 1.01, 95% confidence interval (CI) 0.82 to 1.25, P=0.92). At the end of follow-up there was a non-significant increase in the proportion of patients who died in the percutaneous cerebrovascular intervention group (RR 1.34, 95% CI 0.84 to 2.14, P=0.21).

**Conclusions:** Percutaneous cerebrovascular intervention was not superior to intravenous thrombolytic treatment for the treatment of acute ischemic stroke. Endovascular devices are rapidly evolving, and new trials of the latest generation devices (stent-retrievers) are warranted.

## ESOC-0631

### 08. Neurointervention

#### Spinal radicular artery pseudoaneurysms presenting with spontaneous spinal subarachnoid hemorrhage – An unconsidered diagnosis with a benign course?

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Spinal subarachnoid hemorrhage is rare, representing <1% of all subarachnoid hemorrhage (SAH). Underlying etiologies are trauma (including lumbar puncture), vascular lesions (arteriovenous malformations, arteriovenous fistula, aneurysm), neoplastic lesions, coagulopathy, vasculitis (polyarteritis nodosa, systemic lupus erythematosus, Behçet's disease), hypertension, and coarctation of the aorta.

Spontaneous subarachnoid hemorrhage of unknown pathogenesis is diagnosed after underlying causes are ruled out with selective spinal angiography, computed tomography (CT), magnetic resonance (MR) imaging or autopsy.

We present two cases of radicular artery pseudoaneurysms, one arising from the radicular medullary artery (supply to the Anterior Spinal Artery) and the other, the radiculopial artery (supply to the Posterolateral Spinal Artery). Each case presented with spontaneous spinal subarachnoid hemorrhage. Early spinal angiography disclosed the underlying etiology in both cases. Both patients were treated conservatively with good outcome. Follow up spinal angiography showed not only resolution of the pseudoaneurysm, but loss of the radicular arteries. Without the prior spinal angiogram, follow up angiography would have been reported as normal due to the significant variations in supply of radicular arteries to the spinal cord. These patients would then have been mischaracterized as "Spontaneous SAH of unknown pathogenesis".

Literature review discloses many cases of spontaneous spinal SAH of unknown etiology either have no or delayed angiography potentially missing this diagnosis. This suggests that spinal radicular artery pseudoaneurysm causing spinal SAH may be more common than thought. These two cases suggest that this disease is self-limiting with good prognosis. The clinical and imaging features of these two cases are presented.

## ESOC-0152

### 08. Neurointervention

#### Possibilities of interventional treatment of patients after extensive ischemic stroke

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**Introduction:** The research investigates the possibility of interventional restoration of cerebral perfusion in patients after extensive ischemic stroke.

**Methods:** We examined 1238 patients aged 29–81 (average age 74) with various types of atherosclerotic disorders of cerebral vessels: 916 male (73.99%), 322 female (26.01%).

Of these, 93 patients after extensive ischemic stroke were selected.

**Examination plan:** CT, MRI, SG, REG, cerebral MUGA, laboratory diagnostics, CDR, MMSE, IB.

**Test Group:** 69 (74.19%) patients. For revascularization of the main intracranial arteries high-energy lasers were used; for revascularization of distal intracranial branches and stimulation of angiogenesis low-energy lasers were used.

**Control Group:** 24 (25.81 %) patients underwent therapeutic treatment.

**Results:**

**Test Group:**

Cerebral arterial blood flow restoration was achieved in 66 (95.65%) patients.

In 12-24 months the following positive tendency was observed:

- good clinical outcome – IB90-100 – 14 (20.29%) patients;
- satisfactory clinical outcome – IB75-85 – 27 (39.13%) patients;
- relatively satisfactory clinical outcome – IB60-70 – 28 (40.58%) patients;
- relatively positive clinical outcome – IB below 60 – was not obtained in any case.

**Control Group:**

In 12–24 months the following was observed:

- good clinical outcome was not obtained any case;
- satisfactory clinical outcome was not obtained in any case;
- relatively satisfactory clinical outcome – 4 (16.67%) patients;
- relatively positive clinical outcome – 20 (83.33%) patients.

**Conclusion:**

Transluminal laser revascularization of cerebral blood vessels is a significantly more effective treatment for the effects of extensive ischemic stroke than the therapeutic treatment.

## ESOC-1468

### 08. Neurointervention

#### Mechanical thrombectomy for acute ischemic stroke managed in peripheral stroke centers: Timing, safety and prognosis

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**Introduction:** Endovascular therapy seems to achieve better outcome than intravenous fibrinolysis in acute ischemic stroke with intracranial occlusion. Our goal was to evaluate the feasibility, efficacy and safety of the thrombectomy in a regional protocol, comparing patients initially managed in the referential vascular center with a stroke unit and a neuroradiologist department (local patients), and patients managed in another stroke unit and transferred to the referential center for thrombectomy (regional patients).

**Methods:** From September 2010 to December 2012, consecutive patients with acute ischemic stroke of the anterior circulation were included if they had clinical-diffusion mismatch (defined by National Institute of Health Stroke Scale (NIHSS)  $\geq 8$  and a DWI-ASPECT score  $\geq 5$ ) and large intracranial artery occlusion. Time window for thrombectomy was 6 hours. Intravenous fibrinolysis was administered according guidelines. Safety and clinical outcome at 3 months was compared in local and regional patients (good outcome was defined as modified Rankin scale (mRs)  $\leq 2$ ).

**Results:** 179 patients were included (93 local, 86 regional). There was no difference between groups in terms of initial NIHSS (median 18) and ASPECTS (median 7). Delays for thrombectomy were higher in the regional group (median: 337 versus 249 minutes,  $p < 0,001$ ). Predictive factors of good outcome were low initial NIHSS and age. 44 % of local patients and 40% of regional patients had good clinical outcome ( $p = 0,56$ ).

**Conclusion:** Despite the increased delay of treatment in regional patients, our regional organization for thrombectomy with only one neuroradiologist interventional unit seems to be safe and effective.

## ESOC-1120

### 08. Neurointervention

#### Revascularization of subacute and chronic total occlusion of the internal carotid artery and VA

**O Mansour**<sup>1</sup>

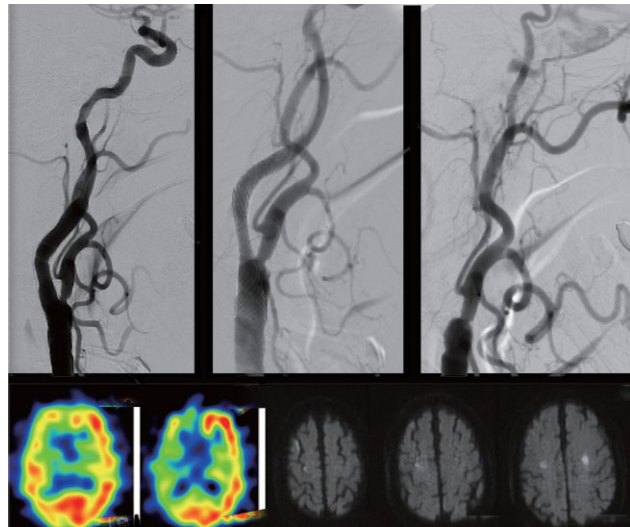
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**Background and Purpose:** The natural course of symptomatic carotid or vertebral artery occlusion with hemo-dynamic impairment is poor. Surgical revascularization may improve the outcome; however, its efficacy has not been established yet. The goal of this study was to characterize the technical and clinical outcomes protection. following endovascular recanalization of the ICA and Vertebral cerebral circulatory

**Materials and Methods:** Endovascular recanalization was attempted in 14 patients with symptomatic 11 ICA occlusions and 3 VA occlusions . The duration of the occlusion ranged from 10 days to 6 months (mean, 2.5 months), and the mean length of the occlusion was 95 mm. Cerebral hemodynamics ipsilateral to the side of the occlusion were severely impaired in all patients. The endovascular procedure was performed under total cerebral circulatory protection, beginning with proximal protection with a subsequent switch to distal protection (in 11 cases) after successful guide wire passage.

**Results:** The occlusion was recanalized successfully in 12 out 14 of patients (85.7%), resulting in improve-ment of ipsilateral cerebral hemodynamics without symptomatic stroke. Small asymptomatic ischemic lesions were detected in 3 of 14 patients (21%) on DWI, and 1 patient developed a mild groin hematoma. Ischemic episodes did not recur during the mean follow-up period of 19 months. However, 2 patients experienced asymptomatic reocclusion, which was retreated successfully without complications due to failure maintenance of antiplatelet and anticoagulant therapy.

**Conclusions:** Endovascular revascularization of an ICA occlusion is feasible and well-tolerated inpatients with subacute or chronic total occlusion of the ICA.



## ESOC-0280

## 08. Neurointervention

**External carotid artery percutaneous angioplasty and stenting – From an idea to a good alternative for patients with ischemic events**

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**Introduction:** In patients with internal carotid artery (ICA) occlusion the ipsilateral external carotid artery (ECA) may supply the cerebral circulation through collateral vessels. Although endarterectomy for ECA stenosis has been described in the literature, angioplasty and stenting has rarely been reported. The aim of our study is to present nine cases with ECA stenosis and ipsilateral ICA occlusion in whom stenting of ECA was performed.

**Methods:** Our study consists of 5 male and 4 female patients aged between 48-73 years who were admitted to our clinic for transient ischemic attack (five patients) or ischemic stroke (four patients). All the patients had medical history of arterial hypertension, dyslipidemia and cardiac ischemic disease. One male patient had diabetes, another impaired fasting glucose. All patients underwent Doppler ultrasonography of the cervico-cerebral arteries that revealed bilateral (four cases) or unilateral ICA occlusion associated with a hemodynamically significant contralateral ICA stenosis (five cases), and ECA stenosis ipsilateral to the symptomatic occluded artery. These findings were confirmed by digital subtraction angiography, with ECA stenosis between 80-99% (eight of the left ECA and one of the right ECA).

**Results:** We proceeded to angioplasty and stenting of the ECA with optimal postangioplasty results and improved intracranial cerebral blood flow, without periprocedural incidents. The patients were discharged few days later with double antiplatelet therapy.

**Conclusion:** We choose to present these cases underlining the importance of preventing further ischemic events and vascular cognitive impairment in patients with occluded ICA and ipsilateral ECA stenosis using angioplasty and stenting of ECA.

## ESOC-0290

## 08. Neurointervention

**Monitoring by aggregometry to adjust antiplatelet therapy in neurointerventional stent applications for vessel recanalization**

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**Background:** Patients' responses to oral antiplatelet therapy, necessary for peri-interventional stent management, vary. We report the incidence of pharmacological therapy resistance in this cohort and assess whether tailored therapy reduces the risk of complications.

**Methods:** Between August 1996 and June 2013 patients that underwent a stent implantation for recanalization were prospectively entered into a local database. Since 2006 platelet reactivity tests by whole blood aggregometry were carried out and the cohort was divided into two groups: without (standard treatment) and with aggregometry. We then

assessed retrospectively the frequency of resistance to therapy and analyzed whether complications were less frequent in the monitoring group. **Results:** A total of 648 patients could be included (78% extracranial, 22% intracranial). 227 (35%) patients were in the monitoring group and 421 (65%) in the standard group. 91.2% of patients had a good response to both aspirin and clopidogrel, 0.8% showed no response to both drugs. 7.5% patients had a response to only one of the drugs. Only six patients required an additional drug bolus. During hospital stay there were no significant differences in complications like TIA (4.4% vs. 5.2%,  $p = 0.7$ ), stroke (12.7% vs. 10.5%,  $p = 0.36$ ), ICH (3.9% vs. 2.1%,  $p = 0.2$ ) and death (0% vs. 1.4%,  $p = 0.1$ ). Other complications were less frequent in the monitoring group (17.6% vs. 28%,  $p = 0.005$ ).

**Conclusions:** The frequency of pharmacological therapy resistance to aspirin and clopidogrel resistance was low in this cohort. Except a lower rate of non-neurological complications, both groups showed no significant differences in relevant outcome parameters.

## ESOC-0551

## 08. Neurointervention

**Carotid artery stenting safety – Protection devices comparison**

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**Background:** International carotid stenting study proved significantly more microembolic brain lesions after carotid artery stenting (CAS) compared to carotid endarterectomy and considered cerebral protection devices (CPD) ineffective. Although microembolic lesions after CAS usually remain asymptomatic, we assume, that higher number of new lesions may lead to decline in cognitive functions.

**Objectives:** To compare safety and efficiency of distal protection devices (filters) to the proximal protection device (Mo.Ma system) during CAS and to determine an effect of microembolic lesions after CAS on cognitive functions.

**Methods:** 54 patients were randomized into two groups by used CPD (Filter vs. Mo.Ma group). All patients underwent brain magnetic resonance imaging (MRI) before and after stenting. 32 patients were tested before and 30 days after stenting with Adenbrook cognitive examination (ACE) tests.

**Results:** 31% ( $n = 17$ ) of all patients had new ischemic lesions on MRI after CAS, in Filter group ( $n = 37$ ) it was 35% of patients ( $n = 13$ ), in Mo.Ma group ( $n = 17$ ) it was 24% of patients ( $n = 4$ ). Only 41% of all new ischemic lesions were localized only in the territory of intervened artery. Significant decline in ACE test was found only in 1 patient (3%).

**Conclusions:** New ischemic lesions on MRI after CAS were present in both groups, but reduction in Mo.Ma group was not significant. Significantly more lesions were localized outside the territory of intervened artery in Filter group. We did not prove impact of new lesions on results in ACE tests.

## ESOC-1089

## 08. Neurointervention

## Endovascular embolization of arteriovenous malformations: Report from University Medical Centre Ljubljana

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**Background:** Endovascular embolization is one of the treatment modalities for cerebral AVM. The aim of this study was to analyze embolization-related complication rate at our department.

**Methods:** We retrospectively reviewed patients with AVM embolization from 2009 to 2014. Patients were assigned into two groups according to clinical presentation: ruptured (R) and unruptured AVM (UR). We analyzed the obliteration rate, periprocedural complications and clinical outcome reported as NIHSS and mRS. Study was approved by Slovenian-National-Medical-Ethics-Committee.

**Results:** 25 patients with AVM were enlisted (56.0% male, age at treatment  $41.7 \pm 14.9$  years). There were 4 Spetzler–Martin grade I, 9 grade II, 8 grade III, 3 grade IV and 1 grade V. Group R consisted of 9 patients with initial NIHSS 8.8 and group UR of 16 patients with NIHSS 0.1. Eleven embolizations were performed in R and 18 in UR group. Complete AVM obliteration was achieved in 77.8% of R and 62.5% of UR patients. Favorable outcomes (mRS  $\leq 2$ ) at discharge were observed in 33.3% of R and in 87.5% of UR patients. Clinically significant procedure-related complications defined as increase of NIHSS  $\geq 4$  or death occurred in 9.1% of procedures (11.1% of patients) in R and in 7.1% of procedures (12.5% of patients) in UR group.

**Conclusions:** Our findings show that in spite of being a center with few annual cases of AVM, endovascular embolization was a generally safe procedure with low complication rates for patients with ruptured and according to ARUBA also for patients with unruptured AVM.

In our experience the treatment alone with intravenous fibrinolysis in vertebrobasilar strokes present a limited results when they are caused by large vessel occlusion.

**Methods:** We review 408 consecutive patients treated with neurointerventional treatments, from April 2010 to September 2014 in our comprehensive stroke center. We analyze patients with acute vertebrobasilar occlusions. The grade of perfusion pre and postprocedural were measured by TIMI and TICI score. Clinical results and good outcome were rated using 3 month-NIHSS and Rankin scale. Successful recanalization (TICI 2b-3), functional and clinical good outcome (mRankin 0–2 and 0–3 respectively) at day 90, mortality and symptomatic hemorrhage were prospectively assessed.

**Results:** Forty-five patients with acute occlusion of the vertebral or basilar arteries were treated (mean age 65 years; range 48–80 years, 71 % men). Twenty patients had a wake-up stroke or progressive brain stem stroke and median NIHSS was 20. Ninety percent of patients had baseline Rankin 0–1, and pre-procedural TICI 0–1 was 81%. After neurointerventional treatment the acceptable recanalization rate was achieved in 61% (TICI 2b-3). Clinical results after 3 months showed a functional recovery of 24% (mRankin 0–2) and good clinical prognosis in 38% (Rankin 0–3). Mortality was 45% (six patients recanalization failed and four presented symptomatic hemorrhage)

**Conclusions:** It is feasible and reasonably safe to use neurointerventional treatment in severe strokes associated to acute vertebrobasilar artery occlusions. However the percentage of functional recovery after follow-up is very low.

## ESOC-0401

## 08. Neurointervention

## Focal hemodynamic changes after successful stent retrievers' thrombectomy in acute stroke: A sign of vessel wall injury?

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**Background:** Stent retrievers with rapid recanalization and acceptable safety have revolutionized intracranial endovascular treatment of acute ischemic stroke. However, animal studies showed that mechanical thrombectomy may cause endothelial injury leading to myointimal hyperplasia. Using transcranial duplex sonography (TDS) monitoring, we observed post-procedural hemodynamic changes in the treated vessel.

**Methods:** We studied acute ischemic stroke patients with single large intracranial artery occlusion in whom mechanical thrombectomy using stent retrievers was performed. Only those with complete vessel recanalization (modified TICI 2b or 3) as assessed by post-procedural DSA and MRA and in whom early control TDS was performed were retained. Patients treated with intra-arterial thrombolysis or stenting were excluded.

**Results:** In 28 patients (26 MCA, 2 BA), post acute MRA confirmed complete recanalization without residual stenosis or vasospasm. However, in 24 of them TDS (mean 3.4 days after thrombectomy) showed very segmental acceleration of blood flow velocities in the affected arteries (MCA PSV<sub>max</sub> at least >35%) as compared with the contralateral side at same depth; BA PSV<sub>max</sub> >40% as compared to velocities measured in the same vessel). None showed clinical deterioration. Follow-up TDS (mean 20 days) showed normalization in 11 /14.

**Conclusion:** This is the first TDS study showing focal acceleration of blood flow velocities after stent retrievers' thrombectomy. Without residual stenosis, thrombosis or vasospasms, this may be a sign of intimal injury in humans. Whether this is due to local inflammatory agents, neothrombosis or myointimal hyperplasia is yet not clear.

## ESOC-1559

## 08. Neurointervention

## Thrombectomy in vertebrobasilar stroke. Futile or insufficient treatment

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**Background:** Treatment of vertebrobasilar occlusions with thrombectomy could restore cerebral flow and improve clinical outcome in acute stroke.



## ESOC-0112

## 08. Neurointervention

## Regional collateral flow evaluation predicts infarction during stroke endovascular procedures

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**Background:** We developed a new system for grading of leptomeningeal collateral flow in angiography. We investigated its diagnostic value for the prediction of infarction during stroke endovascular procedures.

**Material and Method:** We evaluated all consecutive patients treated for an anterior circulation occlusion between 2009 and 2013. Two readers performed a zonal collateral circulation evaluation in 5 cortical regions based on the vascular anatomy. Regional scores were correlated with the presence of infarction in the same cortical region on pretreatment and follow-up imaging. Global collateral scores were correlated with initial and final infarct volumes and clinical scores.

**Results:** In 89 patients with 408 cortical zones we found good correlation between the degree of collateral flow and the absence of infarction in the same region on pretreatment imaging (AUC of ROC curve 0.82,  $p < 0.0001$ ).

In a subgroup of 37 recanalized patients (TICI 3) with 173 cortical regions, retrograde collateral flow to the proximal M4 segment predicted the absence of infarction in the same region on follow-up imaging (PPV 88,7% , NPV 83,8%). We found good inter-rater agreement for the presence of collateral flow to the M4 proximal segment or further – kappa 0.77 ( $p = 0.05$ , 95%CI 0.66–0.88).

The number of cortical regions with good collateral flow (0–5) was correlated with the initial infarct volume ( $p = 0.003$ ). All patients with 4–5 cortical regions had infarct volumes  $\leq 70$  ml.

**Conclusion:** Anatomic collateral flow evaluation can provide a real-time estimation of the size and location of irreversible ischemia during stroke endovascular procedures.

## ESOC-0445

## 08. Neurointervention

## Peri-interventional management of sedation and airway during the endovascular therapy of acute ischemic stroke: SIESTA (Sedation vs Intubation for Endovascular Stroke Treatment) – A randomized trial

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**Background:** Although intravenous thrombolytic therapy within 4.5 hours after onset is still the gold standard in acute stroke treatment, this therapy leads to recanalization results in only 30 % of patients if large proximal cerebral arteries are occluded.

Hence, endovascular recanalization methods are increasingly applied. In addition to the degree of recanalization, the peri-interventional management is probably a crucial factor for success. An important and controversially discussed issue the ideal sedation concept and airway management

According to the available data the widely favored general anesthesia seems to be disadvantageous with regard to functional outcome compared to “conscious sedation” in non-intubated state. However, only retrospective studies have addressed this issue, so far.

**Methods:** This study is a first prospective, monocentric, randomized parallel interventional study comparing non-intubated vs. intubated patients receiving endovascular treatment (EST) of acute ischemic stroke of anterior circulation (study registered under [www.clinicaltrials.gov](http://www.clinicaltrials.gov), NCT 02126085).

Primary endpoint is the improvement of the National Institute of Health Stroke Scale (NIHSS) after 24 hours. Secondary endpoints include: functional outcome after 3 months as by modified Rankin Scale, duration of ventilation, mortality, feasibility and safety, i.e. complications during EST. An inclusion of 50 patients in each arm of the study is intended. Recruitment started in April 2014, 42 patients have been included so far. The detailed study protocol and preliminary results will be presented.

**Conclusion:** The aim of this study is the prospective randomized investigation of potential advantages of the non-intubated compared to the intubated state in patients receiving acute EST.

## ESOC-1262

## 08. Neurointervention

## Embotrap revascularization device: Initial experience in 49 patients from two European centers

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We here report our initial experience with a novel stent-retriever for removal of intracranial clots, the Embotrap revascularization device (Neuravi, Galway, Ireland).

**Methods:** 83 patients have been treated with the Embotrap device. Outcome data for the patients in this study was collected from the two centers with complete follow up of all patients.

42 Patients (17 female/25 male) presenting with acute ischemic stroke in two European centers underwent intra-arterial therapy using the Embotrap device. 57% of these patients had received IV tPA prior to commencing thrombectomy. Baseline NIHSS was 15, and the average clot length was 12.7 mm. Immediate angiographic results, procedural techniques, and 90 day clinical outcomes are presented.

**Results:** The Embotrap alone was successful in achieving revascularization in 36/42 patients (86%) with a final Thrombolysis in Cerebral Infarction (TICI) score 2b. 93% of the patients in achieved successful revascularization (TICI  $\geq 2b$ ).

18/36 (50%) of these patients achieved TICI 2b in one pass with the Embotrap device, and 77% had a good clinical outcome (mRS 0-2) at 90 days. 25/38 (66%) of the overall series achieved a good clinical outcome. Four patients still lack 90 days follow up.

The mortality rate was 18%. There were no device related complications. The average time from 1st deployment of the Embotrap device to procedural completion was 9 mins 30 secs.

**Conclusions:** The Embotrap device alone provided an 86% recanalization rate. There were no device related complications. The procedure was fast with few passes.

77% of the patients had a good clinical outcome.

## ESOC-1485

## 08. Neurointervention

## Identifying patients at high risk for poor outcome after endovascular treatment for acute ischemic stroke

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**Background:** The aim of our study was to determine the ability of the iScore (www.sorcan.ca/iscore) to predict bad clinical outcome after endovascular treatment.

**Methods:** We retrospectively reviewed patients who underwent endovascular therapy for acute anterior circulation ischemic stroke from January 2009 to December 2013. iScore was calculated using following parameters: age (years), male (+10), NIHSS 14–22 (+40), NIHSS >22 (+105), nonlacunar stroke (+30), atrial fibrillation (+10), heart failure (+10), glucose >7.5 mmol/l (+15), cancer (+10), renal dialysis (+35), preadmission disability (+15). Bad clinical outcome was defined as mRS score of 3 to 6. Patients were categorized into 3 risk groups: low-risk (iScore <139), medium-risk (iScore 140–179) and high-risk (iScore >180).

**Results:** 80 patients were included, mean age was 61.6 (18–85) years; median NIHSS score was 13.5 (range, 2–31). Successful recanalization TICI 2b–3 was achieved in 61/80 (76.3%) patients. Clinical outcome at 90 days was good (mRS 0–2) in 37 (46.3%). Poor clinical outcome (mRS 3–6) was in 8/28 (28.6%) patients in low-risk group, in 20/34 (58.8%) patients in medium-risk group and in 15/18 (83.3%) patients in high-risk group. Odds ratio for bad outcome (mRS 3–6) was in respective groups following: in high-risk group OR = 6.071 (95% CI 1.59–23.1, p = 0.004), in medium-risk group OR = 1.429 (95% CI 0.58–3.5, p = 0.43) and in low-risk OR = 0.194 (95% CI 0.07–0.53, p = 0.001). The iScore correlated well with clinical outcome expressed as mRS (r = 0.68, p < 0.001).

**Conclusion:** The iScore may be informatively used to predict clinical outcome after endovascular therapy.

## ESOC-1259

## 08. Neurointervention

## Role of non-contrast CT aspects score in the selection of patients with ischemic stroke for endovascular treatment

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**Background:** Alberta Stroke Program Early CT Score (ASPECTS) <7 of baseline noncontrast CT (NCCT) has been considered as an exclusion criterion for endovascular treatment (EVT). Currently, a controversy

exists regarding the use of this score to select patients. We analyze the evolution of patients receiving EVT according to ASPECTS.

**Methods:** Retrospective analysis of the Madrid North East Stroke Network registry of eligible patients for EVT. Demographics, NIHSS and radiological data on admission, recanalization rate and complications were collected. Outcome measures were symptomatic intracranial hemorrhage (SICH), functional independence (mRS 0–2) and mortality at three months.

**Results:** Included were 152 patients. Age: 68 years (57;5; 76); baseline NIHSS: 18 (14; 21); onset-to-recanalization time-lapse: 315 minutes (250; 409;5) [median (IQR)]. NCCT-ASPECTS 0 to 4: 4 patients; 5 to 6: 12 patients; 7 to 10: 136 patients. Recanalization rate (TICI 2b/3): 118 (81 %).

For ASPECTS 0 to 4; 5 to 6 and 7 to 10, respectively, functional independence rates were 25%, 33% and 62%, mortality rates were 50%, 25% and 7% and SICH rates 0%, 8% and 4%. When recanalization occurred independence rates were 50%, 33% and 70%, mortality 50%, 22% and 6% and SICH 0%, 11%, 4% respectively.

**Conclusion:** Although higher ASPECTS is associated with higher probability of good outcome, up to one third of subjects with ASPECTS <7 could benefit from EVT so this score should not be, by itself, an exclusion criterion.

## ESOC-1161

## 08. Neurointervention

## Mechanical thrombectomy with a self-expanding retrievable intracranial stent (SOLITAIRE AB) in acute ischemic stroke patients: Our initial experiences

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**Introduction:** Patients with contraindications for IV thrombolysis may be considered for endovascular revascularization, particularly when baseline imaging suggests proximal cerebral vessel occlusion. This retrospective analysis describes our initial experience with self-expanding retrievable intracranial stent (Solitaire AB) for thrombectomy in acute ischemic stroke (AIS) patients.

**Material and Methods:** AIS patients who underwent endovascular treatment between February 2011 and January 2014 in Neuroradiology Unit were evaluated. Baseline and outcome data were retrieved from computerized records. National Institute of Health Stroke Scale (NIHSS) and the modified Rankin Scale (mRS) were used as outcome parameters. Periprocedural complications were recorded.

**Results:** Age range of 17 patients (11M:7F) was 40–77 years. Baseline mean NIHSS score was 21.1 ± 2.9 (18–26). Occlusion sites were: internal carotid (n = 4), internal carotid bifurcation (n = 2) and middle cerebral artery (n = 11). Recanalization was achieved with Solitaire thrombectomy as the single treatment technique in 12 patients and in combination with intra-arterial administration of urokinase in the remaining five patients. Post-procedural intracerebral hemorrhage occurred in only one case (5.5%), with an all-cause mortality of two (11%) patients. Demographic data, time to treatment, complications, NIHSS at the beginning and 24th hour and mRS at discharge were evaluated.

**Conclusion:** The aim of AIS treatment is early revascularization of occluded vessels. Mechanical thrombectomy (primary or in combination with a bridging thrombolysis) by Solitaire stent appears to be safe and is capable of achieving high rate of canalization. Favorable clinical outcomes may be obtained in selected patients with proximal vessel occlusions without or in combination with fibrinolytic treatment.

## ESOC-1307

## 08. Neurointervention

## Restenosis post-carotid angioplasty (CA) : Associated factors and predictors

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**Objectives:** We aimed to estimate the frequency and consequences of restenosis and its predictors in a cohort of patients with carotid stenosis treated by carotid angioplasty( CA).

**Methods:** All patients with carotid stenosis treated with angioplasty (n = 1,100) in a single University Hospital were included [from 2002 to 2013]. Follow-up was done prospectively evaluating restenosis by ultrasonography, ipsilateral stroke or death. Restenosis was defined as a narrowing of >70% of a previously treated vessel. Predictors of restenosis and association of restenosis and outcome were determined by Kaplan Meier Curves. Independent predictors of restenosis were assessed by Cox regression analysis.

**Results:** Of the 1,100 patients treated, 8.8% of patients experienced >70% restenosis during follow up (median 12 (9–32) months). Mean age was 69 years and 79.8% were male. Restenosis during follow up was related to age older than 70 (p = 0.005), hypertension (p = 0.001), angioplasty without stent (p < 0.0001), postprocedure stenosis >30% (p < 0.0001), impaired cerebral vasoreactivity (0.003), and treatment of a previous restenosis (p < 0.0001). Occurrence of restenosis was strongly associated with ipsilateral stroke during follow-up (p < 0.0001). After Cox regression analysis, hypertension (HR = 5.9[1.8–18.9], p = 0.003), impaired vasoreactivity (HR = 1.7[1.06–2.7], p = 0.027) and angioplasty without stent (HR = 0.34[0.14–0.79], p = 0.12) were independent predictors of >70% restenosis.

**Conclusions:** Carotid restenosis after CAS is strongly associated with ipsilateral stroke, especially within the first two years after procedure. In our sample, hypertension, angioplasty without stent and impaired vasoreactivity work as independent predictors of restenosis.

## ESOC-1158

## 08. Neurointervention

## Thrombectomy in acute ischemic stroke: Stentriever experience in Modena hospital

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**Background:** Endovascular treatment (ET) in ischemic stroke patients produces high rate of recanalization and may improve good outcome in patients with documented large vessel occlusions.

**Methods:** We analyzed acute ischemic stroke patients admitted at the Nuovo Ospedale Civile S.Agostino-Estense in Modena in the period 2008-2014 and underwent to endovascular therapy. All patients were registered in the Italian Registry of Endovascular Treatment in Acute Stroke. Efficacy measures were arterial recanalization (TICI 2b-3), and 3-month functional outcome (mRS 0–2) and mortality.

**Results:** In the period 2008-2014 we treated 236 patients with ET. We analyzed 212 patients (n = 180 with thrombectomy) with completed 3-month follow-up. Mean age was 71.5 years, male gender 52%, median baseline NIHSS 17. Bridging and rescue treatments were performed, respectively, in 3 (1.4%) and 77 (36.3%) patients. Intraarterial drugs were given to 94 patients (44.3%). In the thrombectomy group 119 patients (66%) were treated with stentriever (in order of use: Trevo®, Solitaire®, Mindframe Capture®, Merci®, Revive®, Penumbra Separator 3D®, Aperio®, Catch®, Eric®). In only 4 cases 2 different stentriever were used during the same ET.

The TICI score 2b-3 was reached in 77.3% in stentriever group (versus 65.5% in 'no stentriever group'). 3-months mortality was 22.1% (vs 17.8%), and mRS 0-2 was 46.1% (vs 37.5%).

**Conclusion:** Stentriever in ET may be useful and safe in acute ischemic patients as demonstrated in recent RCTs.

## Rehabilitation and Recovery

### ESOC-0909

#### 09. Rehabilitation and Recovery

#### Effect of neuromuscular magnetic stimulation on the hemiplegic upper extremity in subacute stroke patients

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**Objects:** To investigate effects of neuromuscular magnetic stimulation (NMMS) on the wrist and hand muscle comparing with neuromuscular electric stimulation (NMES) in subacute stroke patients.

**Subject and Method:** Patients with subacute hemiplegic stroke were recruited to the study, excluded if they have a cognitive dysfunction (MMSE <20). Participants were randomized into 2 groups, that is a NMMS group (N = 10) and a NMES group (N = 10). Both group received 15-minute session at least twice a day for 5 days a week for 3 weeks. NMMS (10 Hz, duration 10 s, 10 min treatment time and 3000 total pulse) and NMES (a symmetrical, biphasic waveform; 30 us pulse width; 40 Hz) was applied to the affected upper extremity in alternating extensor/flexor muscle contraction. Outcome measurements were done at baseline, after 1 week, and at the end of the treatment period (after 3 weeks). The primary outcome measure was for hand function: Box and blocks test, Jebsen-Taylor hand function test and 9-hole peg board test. Secondary outcome measure was for motor performance: Wrist and hand muscle strength (manual muscle test), grip power, and spasticity.

**Results:** There were statistically significant improvements in measures of wrist flexor and hand flexor/extensor strength over the treatment period, but not significantly different between the groups.

**Conclusions:** Both stimulations of wrist and hand muscle improves muscle strength, but there were no significant change between the stimulations.

### ESOC-1312

#### 09. Rehabilitation and Recovery

#### Information provision after stroke: A qualitative synthesis of the views and experiences of stroke survivors and their carers

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**Background:** The provision of information is frequently reported as being an unmet need of stroke survivors and their carers. Optimal strategies to address this lack of adequate information provision have not yet been identified and it is currently unclear why information interventions do not consistently show benefit with these people. In this review, we evaluated qualitative studies of patients' and carers' perspectives of information provision after stroke, to understand how these may inform the development of future strategies of information delivery.

**Method:** An electronic search of relevant databases was conducted, and all results were screened by title and abstract by two independent reviewers. Qualitative studies which gathered the perspectives of stroke survivors and/or their carers about the provision of information after stroke were included. The studies were summarized, and findings synthesized using tabulation and thematic analysis.

**Results:** Eight studies were included in the synthesis, and the following themes were derived: The adequacy of the information including the timing of information; access to information, including information con-

sistency; and the delivery of information including specific views on information topics, delivery method and format.

**Conclusions:** The timing and format of information was important to the participants of the included studies, and the information requirements and preferences for how it should be delivered varied greatly between participants. The findings suggest that while information is an important component of post-stroke care for both the survivor and their carer, a personalized approach to information provision might be required.

### ESOC-1290

#### 09. Rehabilitation and Recovery

#### Driving a car does not make you happy 2–5 years after stroke

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**Background:** Most adults in Norway hold a driver license. After brain injury this can be withdrawn. National regulations including satisfactory mental speed and attention, satisfactory problem solving and intact field of view are required. Getting back the driver license is a huge goal for many stroke survivors.

In a Norwegian follow up study of former stroke patients discharged from specialized rehabilitation, psychiatric problems according to The General Health Questionnaire (GHQ-30) and Hospital Anxiety and Depression Scale (HADS) were found in almost 50 % averagely 3 ½ years after their stroke. Fifty four percent reported driving a car at follow up, and 43 % had lost their driver license due to the brain injury. There was no information regarding the last three percent.

**Method:** Univariate and multiple regression analyses were performed in 100 included persons (35 % women, average age 59 years).

**Results:** Dependency in toileting during rehabilitation predicted emotional distress (HADS > 10) at follow up. Well-being (GHQ-30 <6) at follow up was predicted by age > 65 years, independent walking ability, perceiving proxies as supportive and holding a job (occupation). Well-being was strongly associated with emotional distress at follow up. There was no association between the outcome measures and holding a driver license.

**Conclusion:** Even if loosing the license to drive a car for many patients seems to feel like a huge loss, in this study no association were found between having a driver license and mental health or psychological well-being in the long run after cerebral stroke.

### ESOC-0964

#### 09. Rehabilitation and Recovery

#### Be aware of differences when comparing results of rehabilitation in different countries

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**The objective** of the study was to describe the diversity between Latvian and Swedish populations for persons who undergoes in-patient rehabilitation after stroke.

**Methods:** The data of 1117 patients from Latvia and 3723 patients from Sweden who received post-acute inpatient rehabilitation after stroke was used for this retrospective cohort study. Basic medical (type of stroke diagnosis, side of lesion in brain) and sociodemographic information (age and gender of patients), as well as information on organization of reha-

bilitation (time since onset of stroke, length of stay, involvement of physiotherapist, occupational therapist, speech therapist and psychologists in the rehabilitation process) was compared between both populations.

**Results:** The populations were significantly different in all compared factors ( $p < 0.0005$ ). Most substantial differences between Latvian and Swedish population was in time since onset of stroke at the beginning of rehabilitation and length of rehabilitation. Average time between stroke onset and admittance for in-patient rehabilitation was 15 weeks in Latvia and 5 weeks in Sweden. Length of stay was 15 days, whereas in Sweden 51 days.

**Conclusion:** Basic medical and sociodemographic characteristics, as well as organization of rehabilitation are significantly different between patients after stroke selected for inpatient rehabilitation in Latvia and Sweden. Therefore, before comparing the results of rehabilitation in different countries for persons after stroke, they have to be adjusted for diversities in the systems.

## ESOC-1514

### 09. Rehabilitation and Recovery

#### Cardiorespiratory fitness after TIA and minor ischemic stroke: Baseline data of the MOVEIT study

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**Background and Purpose:** Cardiorespiratory fitness is reduced in patients with stroke. It is unclear whether patients with a TIA or minor stroke also have reduced cardiorespiratory fitness.

**Methods:** 113 patients with a TIA or minor stroke (64 (SD = 10) years of age; 49 (IQR 27–86) days post TIA or stroke) were included in a randomized controlled trial investigating the effect of physical exercise on cognition. The peak oxygen consumption (VO<sub>2</sub>peak) was determined in a symptom-limited ramp exercise test with gas exchange and noninvasive hemodynamic measurements. Physical activity level, vascular risk factors, history of vascular or pulmonary disease and stroke characteristics were evaluated at inclusion.

**Results:** Mean VO<sub>2</sub>peak was 22 ml/kg/min (SD = 6.4), which is the 5th percentile of age and sex related normative values. Forty-five percent had a value less than 21 ml/kg/min, which is associated with an increased mortality. Higher age ((B(95%CI) per 10 years (-2.57(-3.75;-1.40)) and female sex (-5.84(-8.06;-3.62)) were associated with a lower exercise capacity. Age- and sex-adjusted linear regression analyses showed that a history of cardiac ischemic disease or other vascular disease and pulmonary disease were associated with a lower VO<sub>2</sub>peak. In addition, a lower level of physical activity, hypertension, smoking and overweight were associated with a lower VO<sub>2</sub>peak. Prior TIA or stroke and stroke characteristics were not related to VO<sub>2</sub>peak.

**Conclusions:** Patients with a TIA or a minor ischemic stroke have a poor cardiorespiratory fitness. Our findings suggest that premorbid cardiovascular and pulmonary disease and vascular risk factors, but not stroke-related factors contribute to a reduced cardiorespiratory fitness.

## ESOC-1345

### 09. Rehabilitation and Recovery

#### Complications in the acute phase after stroke – A ten years comparison

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**Background:** Complications after stroke is associated with poor outcome. The main aim of this study was to investigate whether the timing and frequency of complications during the first week after stroke has changed in patients treated in a stroke unit in 2003 compared to 2013.

**Methods:** A total of 489 patients in 2003 and 185 patients in 2013 were included and followed for one week, examining the frequency of 12 pre-defined complications. Informed consent was given by all patients or a next of kin.

**Results:** Baseline characteristics: Mean (SD) age was 77.2 (10.2) and 76.9 (8.5) in 2003 and 2013 respectively,  $p = 0.455$ . Severity of stroke, measured by the Scandinavian Stroke Scale, was 39.4 (16.8) and 37.0 (16.4),  $p = 0.011$ . Complications: 51,1 % experienced one or more complications in 2003, versus 45,4 % in 2013,  $p = 0.156$ . Only 2 of the complications recorded showed a significant difference between the two cohorts: progressing stroke 18.4 % in 2003 versus 5.9 % in 2013,  $p \leq 0.001$ , and myocardial infarction 4.5 % versus 0,5 %,  $p = 0.012$ , while the frequency of recurrent stroke, fever, seizures, non-serious falls, serious falls, chest infections, urinary tract infections, pressure sores, deep vein thrombosis and pulmonary embolisms remained unchanged.

**Conclusions:** Complications are still common in 2013, even though the frequency of progressing stroke and myocardial infarction has decreased significantly since 2003.

## ESOC-1385

### 09. Rehabilitation and Recovery

#### The impact of stroke on driving status at six months – The ASPIRE-S study

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**Background:** Driving is an important activity of daily living. Following stroke, a patient's ability to drive safely can be affected in various ways. ASPIRE-S (Action on Secondary Prevention Interventions and Rehabilitation in Stroke), a prospective multi-center study, comprehensively assessed patients six-months following IS. This included an assessment of the impact of stroke on driving.

**Methods:** Consenting patients admitted with IS to three Dublin hospitals were recruited over one year, from October 2011. At six months post IS, a comprehensive assessment was completed to review secondary prevention

and rehabilitation status. Patients completed a questionnaire about their driving experience post-stroke during this assessment.

**Results:** 302 patients (58% male; mean age 69 years, range 22-95) consented to participate, of whom 256 (85%) were followed-up at six months. 226 (88%) completed the driving questionnaire. 149 respondents could drive, of whom 129 patients (86%) were driving pre-stroke. Two-thirds resumed driving post-stroke, mostly (62%) after one month. Medical advice was the commonest reason (75%) to cease driving. Other transport forms utilized post-stroke included 'getting lifts' (66%), 'walking' (53%) and 'public transport' (47%). Of those driving pre-stroke, almost one-quarter (23%) reported that driving had become an issue post-stroke.

**Conclusion:** This multi-center survey shows that many patients lost their ability to drive post-stroke. This may lead to depression, dependence and social isolation. Although returning to driving after a stroke is an important part of the recovery process, it is not routinely evaluated. Rehabilitation programs post-stroke should incorporate driving assessments to encourage more stroke survivors to safely resume driving.

### ESOC-1083

#### 09. Rehabilitation and Recovery

##### Why do stroke patients not receive the recommended amount of active therapy? Preliminary findings from a qualitative, case-study investigation in English stroke units

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**Introduction:** Evidence suggests increased frequency and intensity of therapy leads to better outcomes for stroke patients. National Clinical Guidelines (UK) recommend forty-five minutes of each active therapy be provided on at least five days a week if therapy is appropriate and patients can tolerate it. National Audit data (2014) identified this standard was not achieved for most patients. Existing research has not explored how therapists manage their practice to deliver this standard, or explained factors influencing their decision making regarding therapy provision.

**Methods:** Multi-site case study design in six stroke units, including process mapping, non-participant observation, documentary analysis and interviews with therapists, managers, patients and carers.

**Results:** Preliminary findings from observations in three units identify five key areas influencing frequency and intensity of therapy: i) Amount of time spent by therapists in non-patient contact activity. ii) Professional and organizational factors impacting on times when therapy is or is not provided. iii) Limited evidence of timetabling or advance planning of therapy. iv) Variability in frequency and intensity of therapy provided between units with similar staffing levels. v) Uncertainty amongst therapists within and between units regarding interpretation of the forty-five minute therapy standard.

**Next Stages:** Observations in three further stroke units will focus on these areas; interviews will explore therapists' perceptions of their work and their reasoning for their working practices. Findings from this in-depth

work will be explored with therapists not involved in the study through consensus conferences and will lead to recommendations for therapy practice in stroke units.

### ESOC-1091

#### 09. Rehabilitation and Recovery

##### Not all multidisciplinary stroke teams are the same: The influence of team type on implementation of a structured caregiver training intervention

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**Introduction:** A key component of effective stroke unit care is treatment provided by a coordinated multidisciplinary team (MDT). The Training Caregivers After Stroke (TRACS) trial implemented a complex, multicomponent caregiver training intervention in 18 stroke units. The intervention was to be implemented and delivered by MDT members within usual care. The results of TRACS reported variability in compliance with the intervention, half of the units had a compliance rate of >60% and half <45% (range 0% to 93%). Parallel process evaluation undertaken in 6 intervention centers identified differences in how intervention unit teams organized and managed their work, this included teams working in interdisciplinary ways, and those with strong and weak multidisciplinary affiliations.

**Methods:** Secondary analysis of caregiver training records from 18 stroke units in England. Observational and interview data from the process evaluation undertaken in 6 stroke units were compared with compliance data from the TRACS trial to determine whether team type and functioning impacted upon compliance with implementation and delivery of the intervention.

**Results:** Teams displaying interdisciplinary characteristics were more commonly associated with increased intervention compliance and were observed to display collaborative working patterns which increased team members' involvement in and delivery of the caregiver training intervention.

**Conclusions:** Multidisciplinary team working in stroke units may have important limitations in terms of delivering complex interventions which rely upon collective action and collaborative working. The observed variability in intervention compliance rates can be partly explained with reference to the team working types evident in different stroke units.

### ESOC-1221

#### 09. Rehabilitation and Recovery

##### A systematic overview of Cochrane reviews of interventions feasible for stroke survivors and carers in the community beyond 6 months

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**Introduction:** Long-term outcome after stroke is poor, depression is prevalent, inactivity common and quality of life often deteriorates. Effective community-based interventions to improve these outcomes are required, but there is little information to guide service provision.

**Method:** We completed a systematic overview of Cochrane reviews to identify effective interventions that may be relevant to long-term stroke survivors or their carers. We searched the Cochrane library (May 2014) for reviews of community interventions for stroke survivors or carers at least six months post-stroke. Because of this long-term focus, outcomes of

interest were perceived health status, mood, participation and quality of life. One reviewer extracted data, which another checked. Quality was assessed by NICE criteria.

**Results:** We included 28 reviews (353 studies) of which ten reported perceived health status, nine reported mood, one reported participation and two reported quality of life. There was limited evidence that information provision, inspiratory muscle training, fitness training and telerehabilitation can improve perceived health status. There was limited evidence that information provision and fitness training can improve mood. There was no evidence of effect on participation. There was very limited evidence that information provision could improve quality of life. Although other interventions may improve these outcomes they are rarely assessed.

**Conclusion:** There is insufficient evidence to establish whether community interventions can improve quality of life, participation, mood or perceived health status of stroke survivors or their carers. Future research should evaluate the effect of interventions on these outcomes so a more relevant evidence base can be established.

## ESOC-0841

### 09. Rehabilitation and Recovery Self-report and objective measures of cognitive and physical functioning after mild stroke

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**Background:** Cognitive and physical difficulties are common following stroke and can have a significant impact on the individual's quality of life. Following mild strokes, these cognitive and physical difficulties may be more subtle and it is unclear whether self-report measures are as reliable as objective measures in these cases. We aimed to determine whether self-report measures of cognitive and physical functioning are related to objective measures in patients with mild stroke.

**Methods:** Patients in the Mild Stroke Study completed measures of cognitive and physical functioning three to four years after a mild ischemic stroke. Self-reported cognitive and physical functioning were measured using the Stroke Impact Scale (SIS); objective measures included the Timed Get Up and Go (TUG), Nine Hole Peg Test (9-HPT), Addenbrooke's Cognitive Examination (ACE-R) and Montreal Cognitive Assessment (MoCA) administered by trained staff.

**Results:** Ninety seven participants (mean age 70.5, range 45–94) were assessed. The Mobility and Hand Function domain scores of the SIS showed strong positive correlations with performance on the TUG ( $r = 0.69$ ,  $p < 0.05$ ) and 9-HPT (right hand;  $r = 0.22$ ,  $p < 0.05$ , left hand;  $r = 0.53$ ,  $p < 0.001$ ). The SIS Memory domain scores did not relate to performance on the ACE-R ( $r = 0.17$ ,  $p = 0.47$ ) or MoCA ( $r = 0.19$ ,  $p = 0.09$ ).

**Conclusions:** The SIS self-reported measures of physical functioning were reliable compared with objective measures, but poor correlation on cognitive tests may indicate lack of insight into cognitive difficulties possibly attributed to "getting older". Objective measures of cognitive functioning appear preferable in follow-up of patients with mild stroke.

## ESOC-1026

### 09. Rehabilitation and Recovery Changes in gait characteristics and walking ability after high-intensity aerobic interval treadmill training following stroke

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**Introduction:** High-intensity treadmill training following stroke has been shown to improve gait speed and endurance. However, the effect of such training on walking characteristics is scarcely investigated.

**Aim:** To assess changes in spatiotemporal gait characteristics and walking ability after a high-intensity aerobic interval training (AIT) program shown to improve cardiovascular fitness.

**Methods:** Single-group, interventional study consisting of 4x4-minute intervals at 85–95% of peak heart rate, interrupted by 3-minute active breaks, performed twice per week for 6 weeks, using treadmill with body-weight support. Spatiotemporal gait characteristics were assessed using an electronic mat before, immediately after and 6 and 12 weeks after the intervention. Walking ability was assessed with the self-report Walking Impairment Questionnaire (WIQ). All participants signed written informed consent.

**Results:** Fifteen independent walkers (10 men and five women, mean age 70.0 ± 7.7 years, 3–9 months post stroke), were included. At 12-weeks follow-up preferred walking speed had increased from 1.18–1.32 m/s ( $p = 0.021$ ) and fast walking speed had increased from 1.59–1.77 m/s ( $p = 0.020$ ). Step length increased and stance time decreased at both preferred and fast speeds over the same period (all  $p < 0.05$ ). Stance time asymmetry at preferred speed had reduced immediately after training ( $p < 0.05$ ), but the improvement was not sustained. Neither step length asymmetry nor stance time asymmetry improved. Walking duration sub-scale of WIQ improved ( $p < 0.05$ ), but there was no improvement in the total WIQ-score.

**Conclusion:** Improvement in walking speed, stride length, stance time and self-reported endurance, but not gait symmetry were maintained 12 weeks following high-intensity AIT on treadmill with body-weight support.

## ESOC-1323

### 09. Rehabilitation and Recovery The correlations between unstable angina pectoris (UAP), diabetes mellitus type 2 (DMT2), silent ischemic strokes at patients with first ever ischemic stroke. Early neurological rehabilitation

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**Background:** Patients with unstable angina pectoris (UAP) complicated with diabetes mellitus and silent strokes are characterized by poorer outcome in physical rehabilitation with varying risks of early and long-term rehabilitation events in first ever stroke.

**Methods:** The study included 215 patients after first ever major ischemic stroke with severe motor impairment who present on MRI older image infarcts as defined  $\geq 3$ –15 mm in diameter, UAP, DMT2. The subjects were evaluated at admission, after 1 month and after 1 year using a standard neurological exam, CT scan/MRI, blood tests, NIHSS scale, Rankin Modified Scale (mRS), and MMSE scale.

**Results:** Mean age was 68.2 ± 3.24 years and 143 (66%) were men. Diabetic patients were 74 (34.41%), UAP patients were 78 (36.27%). Abnormal ECG was found in 45 (20.93%) of the patients, including damaged left ventricular systolic and diastolic functions. In the subjects with DMT2

after 1 year NIHSS average score was significantly higher compared with admission score, with 3.68 points on the scale ( $p < 0.001$ , CI95%), and the average mRS score was 3.8 vs. 2.9 ( $p = 0.023$ , CI95%). At admission the mean MMSE score was 24.2 points and 19.7 after 1 year. The overall mortality rate was 17.67 % ( $n = 38$ ).

**Conclusions:** The prevalence of UAP and DMT2 is associated with a reduction in physical outcome for hemiplegia and also after the first year with severe cognitive impairment. Patients with abnormal ECG, cardiac enlargement and damage of cardiac function in echocardiography after first stroke present risk of myocardial infarction and death.

## ESOC-1033

### 09. Rehabilitation and Recovery

#### A detailed exploration of the longer-term unmet needs of stroke survivors

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**Introduction:** Stroke survivors and their carers experience continuing problems in the longer-term after stroke with nearly half of all survivors reporting one or more unmet need up to five years post-stroke. Prevalence studies commonly report practical and functional needs such as information provision, mobility issues and fatigue. However, qualitative research studies often emphasize social and emotional problems. In order to achieve a more complete understanding of longer-term unmet needs after stroke we have completed a large scale needs assessment.

**Method:** We used multiple methods to identify the longer-term needs of stroke survivors including interviews with survivors and their families, focus groups with community stroke services, a review of the unmet needs literature and analysis of the queries made to the Stroke Association helpline. The identified needs were then merged based on the categories of the International Classification of Functioning.

**Results:** A total of 25 longer-term needs were identified including a range of emotional, cognitive, physical, practical, social, instrumental, information and support needs.

**Conclusion:** These results indicate that the longer-term needs of stroke survivors can be complex. Longer-term support interventions for stroke survivors and their families need to be flexible and generic in order to address and resolve the individual needs of all survivors.

## ESOC-1038

### 09. Rehabilitation and Recovery

#### Questions people ask about stroke: Revisiting the UK Stroke Association helpline data

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**Introduction:** In 1993 Hanger and Mulley reported the type and frequency of questions made to the UK Stroke Association helpline in 1990. Since that time stroke care has been transformed with the introduction of stroke units and early supported discharge. The purpose of this paper is to compare the Stroke Association helpline data from 2013 to that reported

in 1990 to explore whether the types of inquiry have changed in line with the revolution in stroke care over the past two-decades.

**Methods:** Data on all of the inquiries received by the UK Stroke Association helpline between 1st April 2013 and 31st March 2014 were collated and compared to the data collected by the UK Stroke Association helpline between May 1990 and September 1990.

**Results:** In 1990 the most common inquiry was for more information about stroke (22.5% (429/1,908)) and in 2013 this remained the same, with 25.4% (2601/10,233) of all callers asking "what is a stroke?". Specific medical questions increased from 4.2% (80/1,908) in 1990 to 10.5% (1,074/10,233) in 2013. Queries about support with home care reduced from 9.4% (180/1,908) in 1990 to 2.6% (257/10,233) in 2013. Questions concerning recovery and rehabilitation were of similar frequency in 1990 (11.1% (212/1,908)) and in 2013 (13.2% (1354/10,233)).

**Conclusion:** Despite the developments in the stroke care pathway, many stroke-survivors and their families still struggle with understanding their condition and coping at home in the longer-term.

## ESOC-1331

### 09. Rehabilitation and Recovery

#### Application of neurofeedback in patients with frontal dysfunction

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**Background:** Conventional neurofeedback (NF) includes voluntary training and thus is impossible in frontal dysfunction. Infra-low frequency (ILF) NF implicates subconscious training at the frequencies of default mode networks, and thus does not require high level of voluntary cooperation.

**Aims:** To evaluate the adherence to ILF neurofeedback in patients with moderate to severe frontal dysfunction

**Methods:** 15 patients aged  $43 \pm 25.6$  with moderate to severe frontal dysfunction due to acquired brain injury (stroke, TBI) were included. NF was performed with the use of Cygnet HD ILF system at reward frequencies between 0.1 and 2.5 mHz at interhemispheric and frontal sites – 10 to 20 30-min sessions 5 days a week. Patients observed therapeutic "game", where the amplitude of EEG in the reward frequency was fed back as the speed of an object (e.g., a rocket) and/or volume of the music, brightness of images etc.

**Results:** Compliance to training was high in 14 patients. One patient was unable to tolerate 30-min session, so two 15-min sessions a day were performed. In one case due to absence of gaze fixation the feedback was entirely aural. The only side effects were transient headache (2 cases) and muscle tension (1 case). An increase in cognitive performance was observed by the end of the treatment (MoCa scale  $17.0 \pm 9.6$  vs.  $11.5 \pm 8$ ,  $p = 0.002$ ; Frontal Assessment Battery  $9.6 \pm 8.8$  vs.  $7.2 \pm 6.5$ ,  $p = 0.075$ ; Neuromental index  $75.0 \pm 13.3$  vs.  $52.9 \pm 24.8$ ,  $p = 0.002$ ).

**Conclusions:** ILF NF is a viable approach to rehabilitation of frontal systems functions after stroke and traumatic brain injury.



## ESOC-0726

## 09. Rehabilitation and Recovery

**Visual impairment after stroke: A review of the efficacy and functional outcomes of existing interventions**L Fergie<sup>1</sup>, N Sprigg<sup>2</sup>, A Drummond<sup>2</sup>, A Foss<sup>3</sup>, P Bath<sup>2</sup><sup>1</sup>*School of Health Sciences, University of Nottingham, Nottingham, United Kingdom*<sup>2</sup>*Faculty of Medicine & Health Sciences, University of Nottingham, Nottingham, United Kingdom*<sup>3</sup>*Ophthalmology, Nottingham University Hospitals Trust, Nottingham, United Kingdom*

**Background:** Visual problems are common after stroke and affect up to 60% of survivors. The resultant disability impacts on ability to perform everyday tasks and is present in 25% of survivors at 3 months (Ali, 2014). Existing interventions fall into three categories:

- Substitution (use of an external device e.g. prisms)
- Compensation (improvement in visual field e.g. technological scanning programs)
- Restitution (restoration of visual field e.g. computerized therapy)

**Methods:** We searched the Cochrane Database of Systematic Reviews, the Cochrane Central Register of Controlled Trials CENTRAL (MEDLINE and EMBASE) from 2008 to present date. We included all studies which incorporated one, or a combination of the three types of interventions for both homonymous hemianopia and unilateral spatial neglect.

**Results:** 13 studies involving 1122 participants were included. We identified a lack of robust RCT's, most studies had small sample sizes (ave n = 26), lengthy interventions (up to 15 weeks) and no or poorly matched control groups. One large scale observational study (n = 915) excluded restitution studies and found half (52%) of the participants showed no recovery. Prisms yielded some improvements but overall sufficient evidence was found to recommend the use of cognitive based and neuroplasticity promoting interventions (eg. The RehaCom "Exploration" task showed significant (p = .048) improvement).

**Conclusion:** Further research is needed to prioritize disabilities that arise from visual impairment and establish acceptability of new technology which will involve both compensation and restitution intervention types.

## ESOC-1142

## 09. Rehabilitation and Recovery

**A prospective longitudinal study assessing stroke patients' adherence to a long-term follow-up program applied in a randomized controlled trial**M Gunnes<sup>1</sup>, B Indredavik<sup>1</sup>, T Askim<sup>1</sup><sup>1</sup>*Department of Neuroscience, Norwegian University of Science and Technology, Trondheim, Norway*

**Background:** Adherence to rehabilitation programs is considered important in the wake of optimizing long-term participation in physical activities after stroke. The aim of this study was to investigate to what extent patients were adherent to a long-term follow-up program, applied in a randomized controlled trial.

**Method:** A prospective, longitudinal study followed patients for 18 consecutive months. The intervention consisted of monthly coaching by a coordinating physiotherapist, aiming to motivate patients to adhere to at least 30 minutes of daily physical activity and 45 minutes of weekly exercise. Patients' self-reports in training diaries, in addition to adherence reported by the physiotherapist reviewing these, were combined and assessed as the primary outcome measure. Borg's scale of perceived exertion and Goal attainment scaling were secondary measures.

**Results:** Forty-one informed consenting patients with mild to moderate stroke (mean age 75.2 years (SD 7.7)) were included three months after onset. Nine patients withdrew during the follow-up period. The overall median (IQR) amount of daily physical activity and weekly exercise was 30.0 minutes (15.7–48.4) and 90.0 minutes (15.6–173.1), respectively. There were no statistically significant changes in adherence to physical activity or exercise from the beginning to the end of the study. Further, most of the exercise was performed at levels of moderate to high intensity, while goals were poorly achieved over time.

**Conclusion:** Except for the nine participants who withdrew the study, our findings indicate that stroke patients who completed the intervention demonstrated good adherence to physical activity and exercise over time.

## ESOC-1296

## 09. Rehabilitation and Recovery

**Rehabilitation for visual field loss after stroke: A mixed methods exploration of the effect and feasibility of home-based scanning training**C Hazelton<sup>1</sup>, A Pollock<sup>1</sup>, G Walsh<sup>2</sup>, M Brady<sup>1</sup><sup>1</sup>*NMAHP Research Unit, Glasgow Caledonian University, Glasgow, United Kingdom*<sup>2</sup>*Department of Vision Sciences, Glasgow Caledonian University, Glasgow, United Kingdom*

**Background:** Visual field loss (VFL) persists in 20% of stroke survivors, reducing ability in activities of daily living (ADL) and quality of life (QoL). Scanning training is a promising rehabilitation method, with a range of interventions in use. We aimed to explore the effect and feasibility of home-based scanning training for rehabilitation of VFL.

**Methods:** Design: n-of-1 methodology.

Participants: visual field defects, more than 6-months post-stroke, living at home.

Interventions: Four interventions delivered in randomized order: paper-based (Rainbow Readers), computer software (VISIOcoach), web-based (Happy Neuron) and specialized (NeuroVision Training). Intervention choice reflected training modalities used in UK clinical practice.

Outcomes: Quantitative measures of visual search, reading, ADL and QoL. Diaries of adherence. Qualitative interviews to explore participant perspectives.

Analysis: Visual analysis of outcome measure plots. Framework analysis of interview transcripts.

NHS ethical approval was granted, requiring participant's signed written informed consent.

**Results:** Twelve participants were recruited (6–16 months post-stroke; 6 right-sided, 6 left-sided VFL) and with one dropout due to family circumstances. Quantitative measures demonstrated no treatment effect at individual patient level. Qualitatively, participants reported benefits due to improved visual skills and confidence. Intervention use varied from 0 to 300% of recommended timings; enjoyment and levels of cognitive challenge were key aspects affecting motivation and adherence.

**Conclusion:** Home-based VFL scanning training can be delivered in a range of formats: key factors relating to the delivery of acceptable training have been identified. This evidence can inform continuing intervention development, with a need for further clinical and cost effectiveness studies using randomized trial designs.

## ESOC-1368

## 09. Rehabilitation and Recovery

## Parietofrontal motor pathways and their association with motor function after stroke

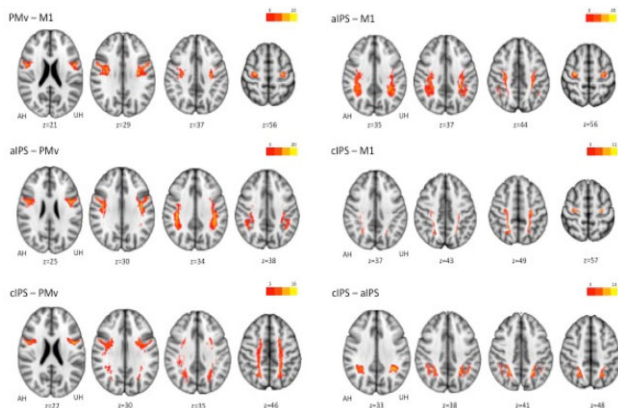
P Koch<sup>1</sup>, R Schulz<sup>1</sup>, M Zimmermann<sup>1</sup>, M Wessel<sup>1</sup>, M Bönstrup<sup>1</sup>, G Thomalla<sup>2</sup>, B Cheng<sup>2</sup>, C Gerloff<sup>1</sup>, F C Hummel<sup>1</sup>

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Corticocortical interactions between the primary motor cortex, the ventral premotor cortex and posterior parietal motor areas, such as the anterior and caudal intraparietal sulcus are relevant for skilled voluntary hand function. It remains unclear to what extent this network contributes to basic motor functions after stroke. We hypothesized that white matter integrity of the underlying parietofrontal motor pathways between these brain regions might relate to residual motor function after stroke. 25 chronic stroke patients were recruited (aged  $64 \pm 8.8$  years, range 46–75, 17 male, one left-handed) and evaluated 34 months after stroke (range 12–169 months).

Based on grip force, pinch force and the Fugl-Meyer assessment of the upper extremity, a motor function score was estimated applying a factor analysis with principal component extraction. Using diffusion tensor imaging and probabilistic tractography we reconstructed probable intra-hemispheric trajectories between the brain regions of interest in each patient. White matter integrity was estimated for each individual tract by means of fractional anisotropy. Generalized linear modeling was used to relate tract-related fractional anisotropy to the motor function. We found that the white matter integrity of the fiber tracts connecting the ventral premotor cortex and the primary motor cortex ( $p < 0.001$ ) and the anterior intraparietal sulcus and the ventral premotor cortex ( $p < 0.01$ ) positively correlated with motor function. Providing first structural connectivity data for parietofrontal connections in chronic stroke patients, the present results indicate that both the ventral premotor cortex and the posterior parietal cortex might play a relevant role in generating basic residual motor output after stroke.



## ESOC-0929

## 09. Rehabilitation and Recovery

## Energy cost of overground walking early after stroke

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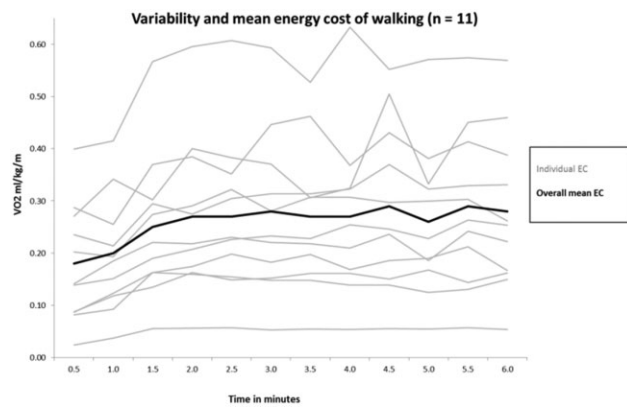
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**Background:** Physical impairments post-stroke affect the ability to perform daily activities, such as walking. Oxygen uptake during walking, i.e. energy cost (EC), provides an indirect estimate of energy expenditure. We know little about energy expenditure during walking in acute stroke. **Objectives:** To pilot measuring EC levels at <2 weeks post-stroke and determine test-retest reliability of EC using breath-by-breath analysis.

**Methods:** Ambulatory acute stroke survivors performed 2 bouts of 6-minute overground walking at a comfortable walking speed, separated by a 30-minute rest-period. EC was measured in ml/kg/m over 6-minutes and steady-state (final 3 minutes of each bout) walking. Intra-class and concordance correlation coefficients were calculated to estimate test-retest reliability. This study was approved by the local HREC.

**Results:** 11 participants (men/women 7/4; mean  $\pm$  SD age  $76 \pm 14$  years and time since stroke  $5 \pm 3$  days) completed the 1st bout of walking; average  $\pm$  SD EC was  $0.26 \pm 0.14$  ml/kg/m over 6 minutes (Fig. 1) and  $0.27 \pm 0.15$  ml/kg/m over steady-state walking. Eight participants completed both walking bouts; agreement between EC measures was high (all > 0.9).

**Conclusions:** We found high variability in EC between the participants early after stroke, but individual performance was consistent between tests. We showed that it is feasible to measure EC early after stroke. Future studies with larger samples can help to identify subgroups of people with high and low EC.



## ESOC-0793

## 09. Rehabilitation and Recovery

## Post-stroke checklist adaptation into Swedish

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The incidence of stroke in Sweden is 300 cases per 100 000 inhabitants a year. Of these, about 20% will die within the first month and about 1/3 of the survivors will remain significantly disabled after 6-12 months.

The post-stroke checklist was developed for follow-up (Philp I, Brainin M, et al, Global Stroke Community Advisory Panel; J Stroke and Cerebrovascular Disease). Eleven long-term post stroke problem areas were identified and rated along with stroke secondary prevention; activities of daily living, mobility, spasticity, pain, incontinence, communication, mood, cognition, life after stroke, relationship with caregiver. The checklist has been tried in the UK and in Singapore with positive responses reported. It is posted on the website of the World stroke organization and the Canadian stroke guidelines advocate its use.

The checklist was translated in to two independent Swedish versions and then back to English. Focus groups were used with persons with prior stroke as well as health care personnel for further validation. Some small modification was made which then needed to be translated back into English again. The final version is validated in a clinical setting with follow-up in specialized care as well as in a primary/community care center. Data from 20 patients from each level of health care (40 in all) with the specialized setting mainly seeing patients within the first 15 months post stroke and the primary/community care center mainly seeing patients more than 12 months post stroke is collected.

## ESOC-1416

### 09. Rehabilitation and Recovery

#### Early rehabilitation after acute stroke in older patients: Is it safe and effective?

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Early rehabilitation is a critical component of care in stroke unit. Our protocol provides out of bed sitting and walking within the first 36 h from admission when allowed by clinical and neurological conditions. Our retrospective analysis evaluated safety and effectiveness of early rehabilitation in patients older than 80 years.

**Methods:** Data regarding demographic, neurological, clinical and functional status had been prospectively collected in our stroke registry. Out of 410 patients admitted in 24 months, those with unstable or deteriorating clinical conditions, palliative care, fracture and pre-stroke mRankin score >3 were excluded. Patients with normal trunk control on admission (TCT score = 100) were excluded too. The 111 remaining patients with impaired trunk control were grouped according to age and their data compared (see Table 1).

	<80 y n44	≥80 y n67	
Age – female	70.4–43%	85.9–61%	p<00001
Ischemic	90.1%	88.0%	ns
Time to bed sitting (days)	1.43	1.43	ns
Prestroke mRankin	1.20	1.42	ns
NIHSS	8.07	9.35	ns
TCT admission	46.2	37.9	ns
LOS (days)	10.0	11.0	ns
Complications	38.6%	35.8%	ns
mRankin (discharge)	3.22	3.80	p.01
TCT (discharge)	65.6	50.7	p.04
TCT <36 (discharge)	22.7%	40.3%	p.0001
Barthel Index (discharge)	52.4	38.9	p.015

**Conclusion:** In older patients with impaired trunk control, early rehabilitation in Stroke Unit seems safe but less effective than in younger. Groups

didn't differ for complications but the older one had a poorer functional status at discharge. A greater proportion of older patients failed to reach a TCT score >36 that is predictive of good functional outcome in the following in-patient rehabilitation.

## ESOC-1170

### 09. Rehabilitation and Recovery

#### Consumer involvement in the design and development of clinical stroke research: Can models of consumer involvement in the UK be adopted in other countries?

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**Background:** Consumer (patient and carer) involvement is an established component of clinical stroke research with perceived benefits in the UK. However, this concept remains relatively undeveloped in other European countries. We set out to establish and evaluate the impact of including consumer involvement in a comprehensive stroke research center in Berlin, Germany.

**Methods:** We adapted an established consumer group model from a translational research center in King's College London. Recruitment strategies included: posters, website, purposive sampling from stroke out-patient clinics. Consumer group participants provide informed consent. The group meets regularly with various stroke researchers to ask and answer questions about ongoing research and proposals. Consumer involvement was reviewed using recognized categories (no involvement, 'consultation', 'collaboration', 'consumer-led' activity) in 9 established activities e.g. setting up project; designing project materials; dissemination of research findings.

**Results:** Since January 2012, over 200 consumers (age 29–78) were invited to the group of which 46 expressed interest and 19 (age 49–78) attend regularly. As of December 2014, the group has attracted less severely disabled stroke patients, but includes carers of more disabled patients. To date involvement only takes the form of consultation, including 4 large projects and a patient on one study board.

**Conclusion:** A stroke research consumer group based on a UK model was successfully established in Berlin, raising consumer involvement levels. This project is unique in Germany, but how increased consultation impacts on the quality, quantity or relevance of local clinical stroke research needs to be established before the model is more widely adopted.

## ESOC-1302

### 09. Rehabilitation and Recovery

#### Activity patterns during hospital stay after stroke

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**Background and Aim:** Early mobilization and reduced bed rest is recommended after stroke, and activity levels should preferably increase during the hospital stay. However, few studies have examined how physical activity changes from day to day while hospitalized. The aim of this study was

to investigate day-to-day changes in physical activity during the hospital stay.

**Method:** Physical activity was assessed by use of triaxial accelerometers, fixed on their unaffected sides' thigh for 4 consecutive days. Starting day was on average day 3 ( $\pm 2.7$ ) from stroke. Primary outcomes were time in upright (standing and walking) and number of upright transitions. Severity of stroke was assessed by use of National Institutes of Health Stroke Scale (NIHSS) and physical function by using the Short-Physical-Performance Battery (SPPB).

**Result:** Thirty-three, consenting, in-hospital stroke patients were included. Mean age was 76.3 ( $\pm 10.5$ ) years (51% women). Participants' severity of the stroke was moderate (NIHSS  $8.2 \pm 6.0$ ), they had a reduced physical function (SPPB  $3.5 \pm 3.3$ ), and slow walking speeds ( $0.6 \pm 0.35$  m/sec). Time in upright position had a median (interquartile range) of 0.44 (0.16–1.41), 0.32 (0.11–0.78), 0.28 (0.12–0.86), and 0.40 (0.09–1.13) on day 1, day 2, day 3, and day 4, respectively. Number of transitions had a median (interquartile range) of 20 (10.5–48.0), 16 (8.0–29.5), 17 (11.5–31.5), and 21 (11.50–34.50) one the four days. No significant changes were found.

**Conclusion:** Patients undergoing stroke only have small changes in physical activity, and tends to maintain a low level of activity during their hospital stay.

## ESOC-1195

### 09. Rehabilitation and Recovery Identifying expressed need for social support in stroke recovery

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**Background:** Previous studies examining social work interventions often lack information on content, methods and timing over the different phases of care (acute hospital, rehabilitation clinic, and ambulant after-care). We aimed to address this information gap by describing and quantifying expressed need for social work in people with stroke and their carers in terms of the timing and the content of social work contact and how this varied over different phases.

**Methods:** We evaluated data from a descriptive cross sectional study (March 2010 to April 2012) of a "Stroke-Servicepoint", a "drop in" center for non-medical stroke assistance staffed by trained social workers in Berlin, Germany, handling enquiries in person, by phone and website.

**Results:** 257 subjects (patients (28%) and carers (61%)) provided informed consent. Stroke had occurred within six month in 45% of the all cases and 56% of patients were 65 years and older. Total interest in support in one or more subtopics associated with therapeutic options was 55% and 30% in further medical topics. Interest in some subtopics associated with long term recovery and outcome such as secondary prevention differed depending on patients' location e.g. hospital, rehabilitation clinic or ambulant setting, while others, such as further therapeutic options did not show relevant changes with the phases of stroke care.

**Conclusion:** Expressed need for social work related support after stroke varied across the course of the disease. Future high quality studies should

characterize social work interventions over all stroke care phases to inform developments in social work services.

## ESOC-1421

### 09. Rehabilitation and Recovery Methods for modeling stroke outcome data over time

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**Introduction:** After a stroke, it is important to determine the nature and duration of the recovery process. We are conducting a longitudinal analysis using data from 8003 patients enrolled in the Stroke Oxygen Study using the modified Rankin Scale (mRS) at 90, 180, and 365 days, to predict recovery using statistical modeling techniques.

**Challenges:** The mRS is a 6-point ordinal scale assessing disability, with scores ranging from 0 (no disability) to 5 (severely dependent, requiring 24-hour care). A score of 6 is commonly added to include death, but this may affect the ordinality of the scale, as severe disability may be deemed a worse outcome than death – hence, treating the scale as ordinal could provide misleading results. The challenge is to justify the inclusion of death as a point on the scale and apply appropriate longitudinal methods, as these subjects would drop out of follow-up assessments.

**Methods:** A proportional odds model can be used for modeling longitudinal ordinal data, or the ordinal structure could be ignored and a multinomial model applied, thus comparing the scores to a reference category. Alternatively, latent class growth analysis could be used to classify patients into groups with similar recovery profiles. If mRS values are treated as separate states, death can be accommodated using multi-state models, or a time-to-event analysis using Cox regression.

**Conclusion:** Modeling stroke recovery poses significant challenges, especially when including death into the scale. Issues determining the most appropriate modeling strategy for these extreme values in the scale will be discussed.

## ESOC-1036

### 09. Rehabilitation and Recovery Bone mineral density in patients with stroke

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**Aim:** The aim of this research is to define the bone mineral density in patients, with stroke.

**Methods:** We examined 26 women with stroke and 26 healthy women of appropriate age; 27 men with stroke and 27 healthy men of appropriate age.

**Results:** BMD of women after stroke was significantly lower compared with BMD of women of control group on the level of total body (Z-score =  $-0.02 \pm 0.21$  vs.  $0.67 \pm 0.21$ ,  $F = 5.92$ ,  $p = 0.018$ ) and at the distal forearm (Z-score =  $-0.65 \pm 0.24$  vs.  $0.45 \pm 0.25$ ,  $F = 9.7$ ,  $p = 0.003$ ). In men with moderate and severe it was obtained significant differences in BMD at total body (Z-score =  $-0.35 \pm 0.25$  vs.  $0.59 \pm 0.23$ ,  $F = 7.4$ ,  $p = 0.09$ ), lumbar spine (Z-score =  $-0.48 \pm 0.42$  vs.  $0.68 \pm 0.26$ ,  $F = 6.0$ ,  $p = 0.02$ ), total hip (Z-score =  $-0.16 \pm 0.27$  vs.  $0.51 \pm 0.15$ ,  $F = 5.4$ ,  $p = 0.03$ ), distal forearm (Z-score =  $-0.03 \pm 0.33$  vs.  $0.99 \pm 0.30$ ,  $F = 4.7$ ,  $p = 0.04$ ).

**Conclusion:** BMD in patients with stroke was significantly lower than in healthy people of the same age. In women the difference was significant at

the level of the total body and distal forearm. In men, the difference was significant only in the group of the patients with moderate and severe paresis.

## ESOC-1127

### 09. Rehabilitation and Recovery

#### What factors inhibit and enable English community stroke teams from meeting the needs of longer-term stroke survivors? Findings from a focus group study

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**Introduction:** A national survey of community stroke teams revealed that longer-term support for survivors is variable across England. Most teams provided a service for up to 12 months, yet less than half commissioned an annual review. Strategies for developing longer-term stroke care need to recognize barriers and enablers confronting service providers.

**Method:** A purposive sample of eight English community stroke teams selected from the national survey hosted focus group discussions as part of a wider study into developing and implementing a longer-term stroke strategy for survivors and their families. Six of the teams provided support for up to 12 months; one for up to 6 months, and one for up to 3 years. Group discussions were facilitated and audio-recorded, then transcribed and subjected to qualitative thematic analysis.

**Results:** Several interconnecting themes were identified that inhibited and enabled support.

Inhibitors included shortage of psychologist input, a target-driven culture based on managing survivor throughput, limitations of commissioning processes, weak multi-agency partnerships involving NHS, Social Services and Voluntary organizations, shortfalls in training within primary care and in care home settings, poor information provision, inadequate public transportation, and limited retraining/employment opportunities for survivors.

Enablers included annual reviews, open door referral systems, interdisciplinary team learning and practice across professional boundaries in clinical settings, innovative in-house training programs, peer support schemes and the delivery of group self-management programs for survivors.

**Discussion:** A number of barriers and enablers were identified. Managerial, operational and cultural shifts in practice are required to produce longer-term wraparound support for survivors.

## ESOC-0900

### 09. Rehabilitation and Recovery

#### Proportion of patients with acute ischemic stroke who presented dysphagia in Clínica Alemana Temuco, Chile, during the period from October 2013 to October 2014

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**Background:** Hospital-acquired pneumonia (HAP) is often the result or aspiration of oral secretion and is reported to occur in 3.9%–21.4% of acute ischemic stroke (AIS) patients overall. Since the presence of dyspha-

gia has been associated with increased risk of pulmonary complications and mortality. Our national guidelines recommend swallow evaluation be performed in at-risk patients before any oral intake.

**Aim:** To determine the proportion of patients with AIS who presented dysphagia in Clínica Alemana Temuco (CAT) from October 2013 to October 2014.

**Methods:** All patients with AIS hospitalized in (CAT) were evaluated. The variables of age, sex, realization and form of swallowing evaluation. Dysphagia was considered with a positive swallowing evaluation according our national guide (MINSAL, 2013) made by physicians and speech therapist and a positive nasofibrolaryngoscopy (FEES). All patients signed informed consent.

**Results:** Of 73 patients, 11 were excluded for having a TIA. Of the total 62, 22 presented dysphagia (35.5%). Of the patients with dysphagia, 16 were male (72.8%), 6 women (27.2%). The median age: 66.4 years ( $\pm 14.2$ ). Only a 48.4% was formally written by the physician in the medical record the form of swallowing evaluation in the first 24 hours. 4 (6.5%) had an aspiration pneumonia and none had a nosocomial pneumonia. 1 patient died (1.6%).

**Conclusion:** The proportion of dysphagia in AIS in our clinic is similar to other studies. However we should improve the screenings and diagnostics protocols especially the formally written evaluation. Because this complication can be serious.

## ESOC-1574

### 09. Rehabilitation and Recovery

#### Effectiveness of modified constraint induced movement therapy on the quality and quantity of upper extremity movement recovery after stroke

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**Introduction:** Constraint-Induced Therapy (CIT) is a therapeutic strategy that has been shown to improve the function of the upper limb affected by stroke. Although an extensive body of literature supports the positive impact of CIT on neuroplasticity and the recovery of function, most research has evaluated an individual mode of delivery. However, evidence is limited for the application of CIT protocol in a group setting.

**Objective:** To determine the effectiveness of a modified version of CIT in a group setting as compared to individual, one-on-one basis on the quantity and quality of movement of the paretic upper limb.

**Methods:** Forty participants, 6–60 months post stroke, were randomized into either a group or individual application of CIT. The hemiparetic upper extremity quantity and quality of movement was evaluated using the self-reported, Motor Activity Log and each participant's clinical record at baseline, pre-treatment and post-treatment. The data were analyzed through an analysis of variance with a mixed factorial design 2x2. All patients signed informed consent.

**Results:** Both groups tended to improve their scores between baseline and pre-treatment measurement, however, no significant effect was found between groups for this time period ( $p > 0.05$ ). Conversely, group differences were seen between pre and post treatment evaluations ( $p < 0.05$ ).

**Conclusion:** This clinical trial provides evidence supporting the application of CIT delivered in a group mode for 3 hours, to improve the performance of the paretic upper limb in daily activities. However the evidence is still limited in relation to this mode CIT version.

## ESOC-1481

## 09. Rehabilitation and Recovery

## Study design and preliminary results of the study SMARTS: Studying markers of angiogenesis during rehabilitation therapy after stroke

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Experimental studies in stroke have shown the importance of angiogenesis in functional recovery, but its role during rehabilitation therapy is unknown. The SMARTS study was designed to identify biological markers of angiogenesis (molecular/cellular) associated with recovery during rehabilitation after stroke. First-ever ischemic strokes enrolled to intensive neurorehabilitation therapy (>3 h a day/5 days a week) were included as SMARTS cases. The protocol consisted in a battery of neurological/functional tests (FMA, FAC, MRC, CAHAI, among others) performed by an experienced neuro-rehabilitator before therapy (baseline, 11 ± 4.7 days after stroke) and at one, three and six months together with a blood extraction to collect serum/plasma and to count endothelial progenitor cells (EPCs, as CD34+/KDR+ within CD45+ population). Part of the cohort also underwent an MRI study (baseline/three months). For non-ischemic controls, blood was collected to obtain serum/plasma and EPCs counts. The stroke group consisted in 10 men and 3 women, mean age of 54.5 ± 10.6 years; whereas 6 men and 8 women, mean age of 65 ± 6 years, formed the control group. The number of EPCs was significantly higher at baseline in strokes vs. controls ( $p = 0.026$ ) and decreased over time with less circulating EPCs at 3/6 months vs. baseline ( $p = 0.068$ ). Stroke severity (NIHSS) trended to be associated with the number of baseline EPCs ( $p = 0.089$ ). Patients with improved neurological function (decrease of NIHSS ≥ 4 points) presented higher levels of EPCs than patients who did not improve ( $p = 0.064$ ). In conclusion, the results of the SMARTS study could contribute to determine the role of angiogenesis in neurorehabilitation therapy after stroke.

## ESOC-0988

## 09. Rehabilitation and Recovery

## Effectiveness of post-stroke rehabilitation in elderly

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**Background and Purpose:** The stroke impact on the population health is rising steadily with gradual changes in demographic indicators (lengthening the life). There is only little data about the benefit from post-stroke rehabilitation in older population. We aimed to evaluate effectiveness of early post-stroke rehabilitation in patients older than 75 years as compare to younger population.

**Methods:** The study included 1754 consecutive post-stroke patients admitted to the neurorehabilitation unit in 2006–2013. We evaluated changes in: the degree of disability using the modified Rankin scale (mRs), functional state – Barthel index (BI), neurological state – NIH Stroke Scale (NIHSS), weekly increase in BI and the frequency of complications.

**Results:** Our study group consists of: 787 (44.9%) women and 967 (55.1%) men; 315 patients (18%) were over 75. The functional state and

disability at admission (0) and at discharge (1) were worse in group older than 75 (consecutively: BI\_0: 8.9 vs. 10.64; mRs\_0: 3.81 vs. 3.56; BI\_1: 13.0 vs. 15.11; mRs\_1: 3.02 vs. 2.64), even if the neurological state was similar (NIHSS\_0: 7.18 vs. 7.81; NIHSS\_1: 5.54 vs. 5.52). Weekly improvement in BI was similar in both groups (0.67/week vs. 0.78/week). Complication rates was higher in group older than 75 (80.2% vs. 72.8%).

**Conclusions:** Rehabilitation in older patients may bring functional improvement and should be investigated. Older patients should not be a priori disqualified from post-stroke rehabilitation, even those that have higher risk of complications during therapy.

## ESOC-0677

## 09. Rehabilitation and Recovery

## Association between BDNF-196 G&gt;A and BDNF-270 C&gt;T polymorphisms, BDNF concentration, and cerebrolysin treatment outcome after ischemic stroke

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Annual mortality from ischemic stroke (IS) in Russia – one of the highest in the world. Morbidity and mortality from IS among persons of working age in Russia increased over the past 10 years, more than 30% IS is the leading cause of disability in the population, one third of patients undergoing its need assistance, another 20% cannot walk alone, only one in five could return to work. The efficacy of rehabilitation in ischemic stroke patients likely varies because of brain plasticity. One of the main neurotrophins in the central nervous system is brain-derived neurotrophic factor (BDNF).

**Objectives:** This study aimed to determine allelic and genotypic distribution of BDNF-196 G>A and -270 C>T polymorphisms, and to assess the impact of Cerebrolysin treatment on serum BDNF concentrations measured before rehabilitation and after 4 weeks of rehabilitation.

**Methods:** 60 patients with hand paresis and 60 with aphasia were randomly assigned to treatment with Cerebrolysin (25 ml/daily) or placebo group (which received saline infusions).

**Results:** In patients with aphasia in Cerebrolysin group after the 4 weeks rehabilitation, BDNF concentration was increased than placebo-treated patients. A similar difference was observed in patients with hand paresis after 4 weeks of rehabilitation. No significant differences in serum BDNF concentration were observed in patients with different BDNF-196 G>A or -270 C>T genotypes.

The positive dynamics of speech rehabilitation was observed, the regress of aphasic disturbances being more significant for daily Cerebrolysin dosage of 25 ml than placebo-treated patients.

## ESOC-1034

## 09. Rehabilitation and Recovery

## The effect of ankle foot orthosis on postural control in patients with post-stroke hemiplegia

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**Objectives:** Ankle foot orthosis (AFO) is a useful orthosis to improve gait pattern, but lack of study on the static balance in hemiplegic patients. This study was to investigate the changes of postural control and the effect of AFO on the static balance in patients with post-stroke hemiplegia.

**Materials and Method:** Fourteen hemiplegic stroke patients with independent ambulation more than 10 m were included. Severe cognitive impairment, severe visual spatial disturbance and musculoskeletal

problem unrelated to stroke were excluded. The movement of center of gravity (COG) during static postural control was measured with Biodex Balance System SD® (Biodex Medical System, New York, USA) at three different conditions (barefoot, shoes and AFO) randomly for three times on same condition. Percent (%) time in quadrant (anterior, posterior, left and right), overall, anterior-posterior and medio-lateral movement index were measured.

**Results:** COG were distributed to the right and posterior quadrant during static standing for maintaining postural stability in patients with post-stroke hemiplegia, and this patterns were not changed with shoes or AFO application. There was tendency of weight shift to the sound side for maintaining postural stability in hemiplegic patients, but not statistically significant. Overall, anterior-posterior and medio-lateral movement index were increased in hemiplegic patients compared to control ( $p < 0.05$ ), and decreased by application of AFO ( $p < 0.05$ ).

**Conclusion:** The impaired static postural control in patients with post-stroke hemiplegia was improved with AFO application.

## ESOC-1037

### 09. Rehabilitation and Recovery

#### The effect of shoulder sling on postural control in hemiplegic stroke patients

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**Purpose:** Balance impairment is a common problem caused by multiple factors in patients with hemiplegia. The shoulder sling commonly used for hemiplegic shoulder subluxation may affect the postural control. So, this study investigate the effect of various shoulder slings on balance in patients with hemiplegia. **Subjects and Methods:** Twenty-seven hemiplegic stroke patients were enrolled in this study. The Fugl-Meyer score of upper arm and Functional ambulation category were measured. Balance test were performed with simple arm sling and with Bobath sling and without sling in random serial order. Static and dynamic balance was assessed by using BALANCE SYSTEM SD (SD950-302, Biodex Medical System Inc, USA). The summation of distance from the center of the platform to the reference position for 20 s is measured and a score named the Balance Index (BI). Static and dynamic balance testing during eye open was carried out 3 times. Functional balance was evaluated using the Berg balance test and Trunk impairment scale.

**Results:** The Fugl-Meyer score of upper arm and Functional ambulation category were correlated with all balance tests. Static and dynamic overall BI score was lower with simple arm sling compared with that score with Bobath sling and without sling, but the difference was not statistically significant. Likewise, Berg balance score and Trunk impairment scale were also no significant difference in each comparison.

**Conclusion:** There was no significant effect of shoulder sling on balance in hemiplegic stroke patients regardless of sling type.

## ESOC-1261

### 09. Rehabilitation and Recovery

#### Phospholipids in neurorehabilitation ischemic stroke

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**Objective:** To evaluate effectiveness of ion-reflex phonophoresis session using hypothalamus phospholipids in rehabilitation of patients with ischemic stroke in the early recovery period.

**Materials and Methods:** 158 patients were supervised with ischemic stroke. There were use Mini Mental State Examination (MMSE), The Montreal Cognitive Assessment Scale (MoCA), and Barthel ADL Index. Under observation were 3 groups: 1st- 65 patients received intramuscular injections of hypothalamus phospholipids; 2nd- 63 patients who received an extra ion-reflex phonophoresis sessions using hypothalamus phospholipids by applying head's frontooccipital longitudinal galvanization techniques were conducted; 3rd- 30 patients treated with protocol formed a control group. **Results:** Additional use of phospholipids hypothalamus significantly improves cognitive function and the degree of self-service in both groups, sessions of ion-reflex phonophoresis hypothalamus phospholipids using longitudinal methods fronto-occipital head galvanizing can achieve more significant results. Observed positive dynamics of cognitive functions according to MoCA test in both groups ( $23,23 \pm 1,3$  and  $25,75 \pm 1,3$  points;  $20,6 \pm 1,1$ -control). The MMSE was not informative. Barthel index rose by 4 and 8 points, respectively, in the control without dynamic.

**Conclusions:** The research's indicators' dynamics shows positive impact of ion-reflex phonophoresis sessions using hypothalamus phospholipids by applying head's frontooccipital longitudinal galvanization techniques in rehabilitation of patients with ischemic stroke in the early recovery period.

## ESOC-1582

### 09. Rehabilitation and Recovery

#### The rationale for and methods of dose selection in trials of intensity of physical therapy to enhance recovery after stroke

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**Background:** The optimum therapeutic "dose" of physical therapy to enhance motor recovery after stroke remains unclear. We aimed to investigate the rationale for and methods of dose selection reported in randomized controlled trials (RCTs) of intensity of physical therapy after stroke which were included in recent systematic reviews.

**Methods:** Narrative review of a convenience sample of primary RCTs (English language) included in a comprehensive systematic review and meta-analysis of physical therapy after stroke (Veerbeek et al.2014). Two reviewers (PH, IW) extracted data on pre-defined methodological features including: (1) rationale for dose selection (2) dose components (length, frequency, duration) and (3) development of intervention. Data were synthesized for rationale and method of dose selection.

**Results:** We reviewed 31 RCTs (2518 participants). One was a feasibility trial. No other studies reported or referred to previous dose selection investigations (e.g. dose ranging / safety / tolerance).

29 trials did not report the rationale for dose selection. 2 trials reported basing dose on available literature. One reported discussions with stroke survivors to develop the intervention. Most doses were selected by pragmatic or arbitrary increases over standard care (range from a few hours to 1 year longer “on treatment”) with dose adjusted according to therapists’ judgment of patients’ tolerance or response.

**Conclusion:** The rationale and methods of dose selection of physical therapy were poorly described in this sample of trials comparing different intensities. Future trials of physical therapy to enhance recovery after stroke should investigate the optimum therapeutic dose before undertaking a subsequent definite trial.

## ESOC-1510

### 09. Rehabilitation and Recovery Early psychosocial risk factors for depression after stroke

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Depression is among the most frequent long-term complications after stroke, affecting about 30% of stroke survivors. Post-stroke depression is associated with prolonged recovery, reduced quality of life, and increased mortality. Longitudinal research on risk factors for post-stroke depression is complicated by the diversity of stroke-related impairments, and the long periods in which depression can emerge. We recently proposed a two-phase pathogenetic model of depression after stroke, with premorbid, neurobiological and psychosocial factors predicting early-onset depressiveness, and psychosocial integration predicting late-onset and persisting depression. The model is currently tested in a prospective longitudinal study involving 302 patients in two different neurological rehabilitation clinics. The study involves assessment of demographic neurological, stroke-related, and psychosocial risk factors one, six, and twelve months after stroke. Results of the baseline and six months follow-up assessment show that psychosocial factors such as self-efficacy, perceived social support and self-reported depressive symptoms one month after stroke strongly impact the risk of later depressive disorders. However, stroke localization in the left or right hemisphere, cognitive status or functional impairment did in our rather mildly affected sample not significantly influence the future risk of depression. We conclude that psychosocial factors represent important early predictors of later depressive disorders and should be targeted by prevention programs.

## ESOC-0366

### 09. Rehabilitation and Recovery Time to recovery to pre-intervention functioning and return-to-work, and long-term life satisfaction after treatment of unruptured aneurysms

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**Background:** The eventual goal of preventive treatment of unruptured intracranial aneurysms is to increase the number of life years with high life satisfaction. Insight in the time with reduced functioning, working capac-

ity and life satisfaction after aneurysm treatment is pivotal to balance the pros and cons of preventive aneurysm occlusion.

**Methods:** We sent a questionnaire on time-to-recovery to pre-intervention functioning and return-to-work and life satisfaction to patients treated for an unruptured aneurysm between 2000 and 2013. Changes in life satisfaction before treatment, during recovery and at follow-up were assessed with Wilcoxon signed-rank tests.

**Results:** The questionnaire was sent to 159 patients of whom 110 (69%) responded. The mean follow-up time after aneurysm treatment was 6 years (SD 4). Fifty-four patients had endovascular and 56 had microsurgical occlusion. Complete recovery to pre-intervention functioning was reported by 81% (95% CI: 74–88) of patients, with a median time-to-recovery of 3 months (range 0–48). Complete work recovery was reported by 78% (95% CI: 66–87) of patients. The proportion of patients with high life satisfaction reduced from 76% [95% CI: 67–84] before treatment to 52% (95% CI: 43–61) during the period of recovery ( $p < 0.01$ ), and restored largely at long-term follow-up (67% [95% CI: 59–76],  $p = 0.08$ ). **Conclusion:** Life satisfaction is significantly reduced during the period of recovery after treatment of unruptured aneurysms. In the long-term, approximately one out of five patients reports incomplete recovery. These treatment effects should be kept in mind when considering preventive aneurysm treatment. Prospective studies are needed to better compare these losses in patients treated for unruptured aneurysms with those who had subarachnoid hemorrhage.

## ESOC-0470

### 09. Rehabilitation and Recovery Acupuncture for post-stroke neurogenic bladder: A systematic review and meta-analysis of randomized controlled trials

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**Introduction:** This study is aimed to review the randomized controlled trials (RCTs) systematically to evaluate the effectiveness of acupuncture or electro-acupuncture for the patients with post-stroke neurogenic bladder.

**Methods:** After searching Medline, EMBASE and Cochrane Central Register, KoreaMed and Oasis in Korean, and China Integrated Knowledge Resources Database in Chinese, we selected any eligible RCTs with placebo or conventional control groups. The two investigators assessed the risk of bias. And the meta-analysis was performed with Maximum Cystometric Capacity (MCC), Post-void Residual urine (PVR), and Clinical Effective Rate (CER), using the Reviewer Manager Software 5.3 (Cochrane Collaboration, Oxford, UK).

**Results:** One RCT in English and 12 in Chinese were included. Meta-analysis showed that acupuncture or electro-acupuncture significantly increased MCC (weighted mean difference=25.34, 95% CI = 4.56-46.11, I<sup>2</sup> = 38%, n = 312, random effect model) and CER (risk ratio = 1.73, 95% CI = 1.44-2.08, I<sup>2</sup> = 68%, n = 1151, random effect model) of the patients with post-stroke neurogenic bladder. In sub-analysis, PVR in post-stroke urinary incontinence patients significantly decreased. Heterogeneity could be explained by the differences of control groups, acupoints selection, and the stroke onset between studies.

**Conclusions:** Acupuncture could be very effective to increase MCC and to decrease PVR of the patients with neurogenic bladder after stroke, but



further studies are needed to be designed to figure out the long-term effects of the acupuncture for the disease.

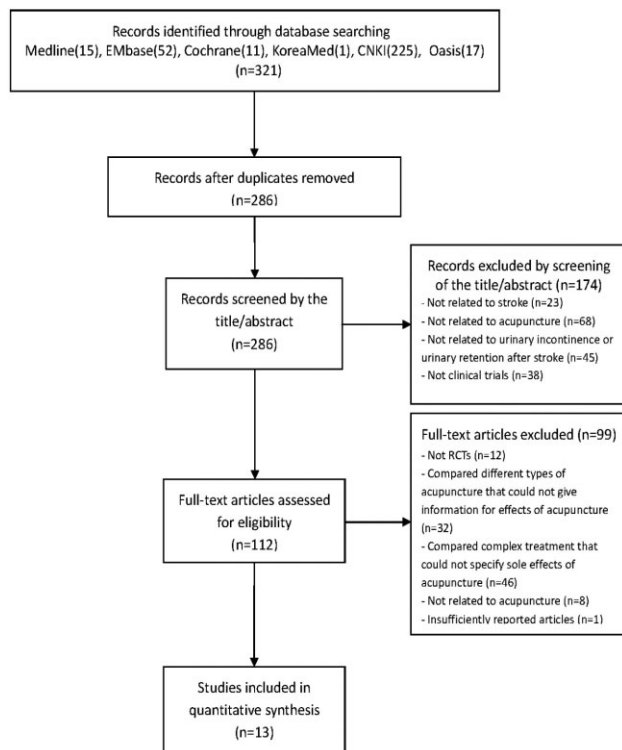


Fig. 1 Flow chart.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Chen 2000	?	-	-	?	+	?	-
Chu 2012	?	-	-	-	+	+	?
Feng 2011	+	-	-	?	?	?	?
Gong 2003	?	-	-	?	+	?	?
Kou 2012	?	-	-	?	+	?	?
Liu 2013	?	+	+	+	-	+	?
Wang 2009	?	-	-	?	+	?	-
Wang 2011	?	-	-	?	+	?	?
Xu 2009	?	-	-	?	+	+	-
Zeng 2012	?	-	-	?	+	+	?
Zhang 2012	?	-	-	?	+	+	?
Zheng 2006	?	-	-	?	+	?	-
Zhu 2012	+	-	-	?	+	?	?

Fig. 2

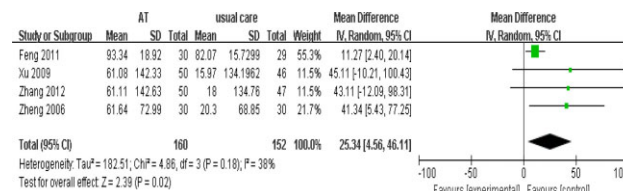


Fig. 3 AT vs usual care, changes of maximum cystometric capacity.

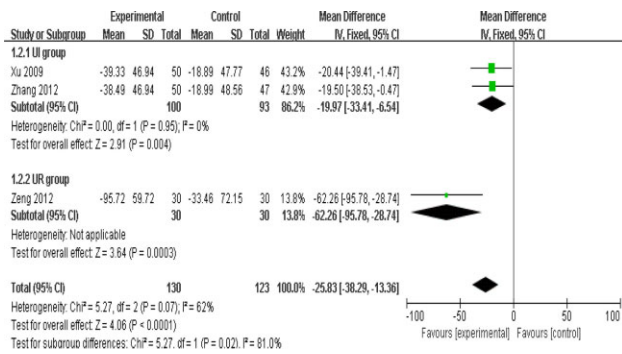


Fig. 4 AT vs usual care, changes of post-void residual urine.

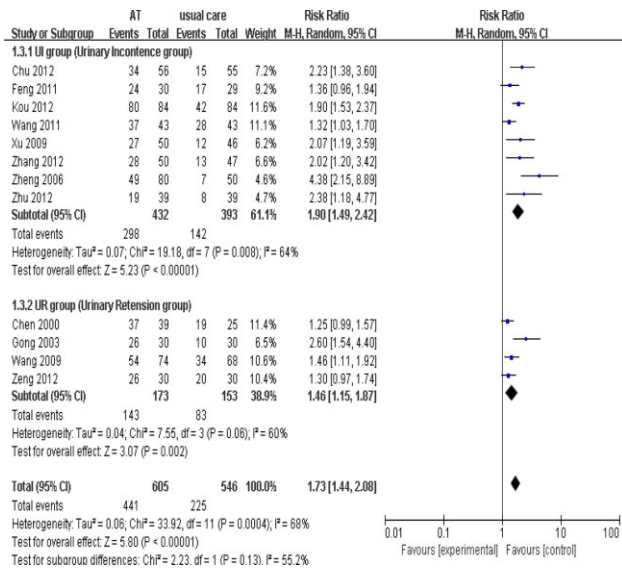


Fig. 5 AT vs usual care, clinical effective rate.

ESOC-0373

09. Rehabilitation and Recovery

Family-led rehabilitation after stroke in India: The ATTEND trial

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**Background:** Western models of stroke rehabilitation are currently unaffordable for the majority of the global stroke population but evidence from The Completed Stroke Unit and Early Supported Discharge Rehabilitation Trials suggest that components of these interventions may be effective in a low-cost model. We have designed a randomized controlled trial (RCT) based in India to test this hypothesis.

**Methods:** The ATTEND trial is a RCT with secure randomization and blinded outcome assessment. The intervention is protocol-based, with an emphasis of repetition of task-specific activities, patient-centered goals

and begins in hospital within 7 days of admission (< 1 month of stroke) and includes post-discharge home visits by the stroke coordinator. The primary outcome is the modified Rankin Score, six months after randomization; secondary outcomes include care giver burden scale, quality of life.

**Results:** By 5 January 2015, 482 out of a planned sample size of 1,200 had been recruited from 13 active sites across India. The average age of recruited patients is 57.3 years, mean NIHSS 10, caregivers were the spouse (43%) daughters/daughter-in-law (27%) or sons/sons-in-law (26%). A quarter of recruited patients had hemorrhagic stroke. At 6-months 53% of participants were independent (mRS0-2).

**Conclusions:** Recruitment is on target to complete final follow-up in 2016. The younger age of stroke and a greater prevalence of hemorrhagic stroke is characteristic of stroke in India. Nearly half the trial participants were dead or disabled six months after stroke, confirming the poor prognosis for stroke in India.

Universal Trial Number (UTN): U1111-1138-6707

ESOC-0386

09. Rehabilitation and Recovery

Socioeconomic status predicts return to work after first stroke in younger adults

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**Background:** Stroke is a leading cause of disabilities among young adults. This can result in an inability to return to work after stroke. We studied socioeconomic status and other possible predictors of work return one year after stroke in a nationwide population in Sweden.

**Methods:** Employed patients aged 25–55 with first stroke between 2008 and 2011 were included. Data on sequelae and employment were retrieved from the Swedish national stroke register, Riksstroke, and socioeconomic data (income, education and country of birth) from Statistics Sweden. Multiple logistic regression analyses were used to calculate odds ratios for return to work between pre-specified patient subgroups and to adjust for confounders.

**Results:** The study included 2370 stroke patients. Physical and mental disabilities after stroke were observed to be major independent predictors for decreased chance of work return, especially if the patient had need of help with ADL (activities of daily living) (OR 0.02; 95% CI 0.006–0.04), were depressed (OR 0.46; 95% CI 0.35–0.61) or experienced pain (OR 0.45; 95% CI 0.35–0.594). Highest income tertile (OR 1.40; 95% CI 1.06–1.86) and ages of 35–44 (OR 1.88; 95% CI 1.18–3.00) and 45–55 (OR 1.74; 95% CI 1.14–2.68) were after adjustment for confounders observed to be predictive factors of work return after stroke.

**Conclusion:** This study demonstrates that socioeconomic status predicts return to work in Swedish younger adults within one year after first stroke. Positive predictors for work return were high income and not belonging to the youngest age group.

## ESOC-0203

## 09. Rehabilitation and Recovery

**What is the role of the home environment during rehabilitation? The experience of STRENGTH (Stroke Rehabilitation Enhancing and Guiding Transition Home)**L Gustafsson<sup>1</sup>, P Cornwell<sup>2</sup>, S Kuys<sup>2</sup>, J Fleming<sup>1</sup><sup>1</sup>School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Australia<sup>2</sup>Behavioural Basis of Health Program, Griffith Health Institute & Metro North (Northern) Health Services District, Gold Coast, Australia

**Background:** Research has explored the impact of an enriched hospital environment on activity levels during rehabilitation. Acknowledging the contrived nature of an enriched hospital environment, it is important to recognize that the home environment may be an equally important mediator of client motivation, client-centered goal setting, therapy, and activity levels. STRENGTH is a model of inpatient rehabilitation that is enhanced by therapy within the home environment for one day of every week.

**Objective:** To explore the impact of STRENGTH on client-centered goal setting, therapy, and activity levels.

**Method:** STRENGTH was piloted for six months and semi-structured interviews were conducted with clients (n = 7), carers (n = 3), and the therapy team (n = 9). Interviews were completed with clients and carers at discharge and four to six week follow-up. Therapy staff participated in a focus group at the conclusion of the pilot. Inductive analysis of each participant group has been reported previously. This presentation reports a meta-synthesis of the qualitative results from all participants.

**Results:** The meta-synthesis identified three key themes: the restricted nature of the hospital environment, home as a mediator of change to goals and therapy, and home was central to preparation for discharge.

**Discussion:** The results support that the home environment is an important mediator of the therapeutic alliance and process, and may prove essential to ensuring client-centered practices within rehabilitation. Further studies are required to understand the role of the home environment and evaluate the impact of STRENGTH on key outcomes and activity levels.

## ESOC-0204

## 09. Rehabilitation and Recovery

**Fact or fiction? Compression management for post-stroke edema of the upper limb**L Gustafsson<sup>1</sup>, K Bower<sup>2</sup>, K Marshall<sup>2</sup>, A Slaughter<sup>2</sup>, A Walter<sup>1</sup>, J Cavaye<sup>1</sup>, E Patterson<sup>1</sup>, M Hoyle<sup>1</sup><sup>1</sup>School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Australia<sup>2</sup>Occupational Therapy, Princess Alexandra Hospital, Brisbane, Australia

**Background:** Research evidence supports compression management for many forms of edema but the effectiveness has not yet been established for post-stroke edema. The purpose of this program of research was to address this gap and explore the effectiveness of compression management for post-stroke upper limb edema.

**Method:** Three single case design studies explored the effectiveness of:

1. Low (n = 4) versus high (n = 4) stretch bandaging of the hand.
2. Bandaging of the hand (n = 6) versus hand to axilla (n = 6).
3. Compression gloves (n = 4) to maintain reductions in edema.

Circumferential measurements were taken at five points along the participants' hand and arm during baseline and intervention phases. Analysis of data included visual analysis of graphs for slope trends and calculated acceleration lines.

**Results:** Post-stroke edema levels fluctuated during all baseline and intervention phases. All studies demonstrated an intervention effect with increasing edema during baseline phases followed by a decrease during the bandaging (intervention) phases. There was no difference in effectiveness between high and low stretch bandaging of the hand. There was a trend to suggest that bandaging from the hand to the axilla was more effective than bandaging of the hand alone. A compression glove applied after bandaging did not maintain reductions.

**Conclusions:** This preliminary evidence supports the clinical application of compression management for the stroke-affected upper limb. Further research should seek to understand the mechanism of the edema, refine the management protocols, and conduct further empirical testing.

## ESOC-0516

## 09. Rehabilitation and Recovery

**Is serum vascular endothelial growth factor expression in combination with physiotherapy along with repetitive transcranial magnetic stimulation plays a role in acute stroke recovery?**H Sharma<sup>1</sup>, A Bhasin<sup>1</sup>, R Sharma<sup>1</sup>, N Kumar<sup>2</sup>, R Moganty<sup>3</sup>, M V Padma Srivastava<sup>1</sup><sup>1</sup>Neurology, All India Institute Of Medical Sciences, New Delhi, India<sup>2</sup>Psychiatry, All India Institute Of Medical Sciences, New Delhi, India<sup>3</sup>Biochemistry, All India Institute Of Medical Sciences, New Delhi, India

**Background and Objective:** Low frequency repetitive transcranial magnetic stimulation to the contralateral (M1) along with physical therapy enhances serum VEGF level in acute ischemic stroke (AIS). This study aimed to compare serum VEGF levels in AIS using low frequency rTMS with physiotherapy compared to physiotherapy alone.

**Methods:** Patients diagnosed with AIS onset within 7–15 days with NIHSS score 4–20 were recruited. Active group was administered with low frequency (1Hz), 750 pulses, inter train stimulus interval~45 seconds @ 110% resting motor threshold (RMT) given at 10th week for 2 weeks (10 days). Physical therapy was administered to all patients for 12 weeks. Venous blood sample was collected at baseline, 10th week and 12th week for serum VEGF along with clinical assessment.

**Results:** Fifty five subjects were randomized into real group (n = 28) and sham group (n = 27) with mean age 51.72 ± 13.55. Significant increase in serum VEGF was observed in real group (P = 0.04) with recovery as measured on FMA (P = 0.01) (Table 1).

**Conclusion:** Low frequency rTMS along with physiotherapy elevates VEGF level in AIS patients causing restoration of neurological function.

Table 1

Variable	Time period (12th week)		P<0.05
	Real group Mean ± S.D. N = 28	Sham group Mean ± S.D. N = 27	
NIHSS (0–42)	2.79 ± 1.41	5.82 ± 2.52	<b>0.001</b>
FMA Upper (0–66)	57.05 ± 10.23	50.03 ± 15.72	<b>0.01</b>
VEGF (pg/ml)	592.50 ± 190.03	450.93 ± 221.30	<b>0.04</b>
RMT affected hand (%) (n = 18)	57.83 ± 15.51	68.18 ± 10.25 (n = 17)	0.07

## ESOC-0094

### 09. Rehabilitation and Recovery

#### Daily life consequences, cognitive impairment and fatigue after transient ischemic attack (TIA)

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**Background:** After transient ischemic attack (TIA) fatigue and cognitive impairment may be present as suggested in several studies, but little is known about consequences in daily life.

**Aims:** The aim was to explore performance in daily life, presence of cognitive impairment and fatigue at 1 and 9 months after a TIA event.

**Methods:** Data regarding cognition, fatigue and activities of daily life was used from 46 patients, assessed at discharge from hospital and at 1 and 9 months after TIA. The assessments served as a basis for interviews focusing on changes related to the TIA.

**Results:** Analyses showed that 16 patients had remaining problems in complex activities of daily life after 9 months. Mental fatigue was experienced by 11 after one month and by 7 after 9 months. Cognitive impairment was present in 18/44 patients after one month and 7/23 after nine months. Difficulty with communication in daily life was the most commonly reported problem and increased from 7 patients to 14 between the two time-points. Decrease in performance at work was experienced by 6/15 at 9 months.

**Conclusions:** A third of the patients discharged after TIA had residual problems in performance of complex activities in daily life, particularly concerning communication, within the first 9 months. Some patients needed to change working-tasks or could not work fulltime, one explanation could be the cognitive impairments and the mental fatigue. The risk of consequences in daily life and at work indicates the need for systematic multi-professional evaluation and support after TIA.

## ESOC-0048

### 09. Rehabilitation and Recovery

#### Depression, anxiety, and cognitive functioning after intracerebral hemorrhage

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**Background and Purpose:** Poststroke depression (PSD) is an important complication of stroke. We studied long-term PSD after intracerebral hemorrhage (ICH) at young age, as well as anxiety, and cognitive functioning of the survivors.

**Methods:** We gathered clinical and imaging data of 336 young ICH patients between age 16 and 49 treated in the Helsinki University Central Hospital. After a median follow-up of 9.7 (7.0–12.0) years, we interviewed 130 survivors with structural questionnaires including Beck Depression Inventory II (BDI-II), Hospital Anxiety and Depression Scale (HADS), Pain Anxiety Symptoms Scale (PASS), Brief Pain Inventory (BPI), and Montreal Cognitive Assessment (MoCA). Univariate and multivariate analysis was performed to identify factors associated with PSD (BDI-II score > 13). Degree of disability was measured by modified Rankin Scale score (mRS).

**Results:** PSD was present among 30 (23.1%) and anxiety among 52 (40.0%) patients (HADS score >6). Higher degree of disability was associated with symptoms of depression (higher BDI-II scores,  $p = 0.001$ ), emotional distress (higher HADS scores,  $p = 0.004$ ), and pain (higher PASS scores,  $p = 0.008$ , and higher BPI scores,  $p = 0.003$ ). The only baseline factor identified to associate with PSD was hydrocephalus ( $p = 0.014$ ). Median PASS score was 9 (IQR 0–25), median BPI score was 5 (0–23), and

median MoCA score was 26 (22–28) hinting to normal or mild cognitive dysfunction. Antidepressants were used by 9.2%.

**Conclusions:** One out of four survivors of ICH at young age suffers long-term PSD. Higher degree of disability predicted occurrence of PSD. Treatment of depression appears as an unmet need in young ICH survivors.

## ESOC-0189

### 09. Rehabilitation and Recovery

#### Walking ability, independence and health-related quality of life

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**Background:** Stroke patients, indifferent of disability, have the same possibility to improve with training, it is argued. The aim of the study was to follow and register functional improvements in two groups with different ambulatory ability at baseline for a period of 48 months.

**Methods:** Stroke patients were recruited and divided into groups according to functional ambulatory capacity (FAC) at baseline: FAC 0-2 ( $n = 36$ ) and FAC 3-5 ( $n = 39$ ). During the acute rehabilitation both groups received functional task-oriented training, followed by regular self- or therapeutic driven training the first year post stroke and varied exercise patterns the following months. The participants were tested on admission, discharge, at three, six, twelve and forty-eight months after the onset of stroke with Motor Assessment Scale (MAS), Barthel Index (BI), Timed-Up-and-Go (TUG), Berg Balance Scale (BBS), 6 Minute Walk Test (6MWT) and Nottingham Health Profile (NHP).

**Results:** There were significant differences between the groups in MAS, BI, TUG, BBS and 6MWT. Change scores indicate a greater potential for rehabilitation in  $FAC \leq 2$  in relation to  $FAC \geq 3$ , although the functional capacity was higher in the latter. HRQoL was perceived worse in the  $FAC \leq 2$  compared to  $FAC \geq 3$  in total score, and for sub scores physical mobility, pain and energy. However there were no significant differences in perceptions of emotional, sleep and social functions.

**Conclusion:** The results indicate the importance of maintaining exercise and training for all persons post stroke. Furthermore, the results underline the importance of ambulation as a prerequisite for independence and for HRQoL.

## ESOC-0515

### 09. Rehabilitation and Recovery

#### Post-stroke pain: Is it being under-reported?

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Post stroke pain (PSP) refers to a broad range of clinical conditions, including central post stroke pain (CPSP) and tension type headaches. The prevalence of PSP is reported at 11–55% following a stroke, with the average duration of the pain lasting 5.73 years. CPSP can exhibit a latent period of up to 18 months, meaning that the incidence of PSP is generally underestimated. Pregabalin and gabapentin are used as first line agents to manage this pain; however, there is currently no recommendation for providing preventative treatment.

Our aim was to estimate the prevalence of PSP, and investigate whether it is under-reported or misdiagnosed. Patients attending the Royal Liverpool and Broadgreen University Hospital Trust outpatient stroke clinics were

interviewed after their appointment and completed a modified McGill Pain Questionnaire.

In total, 100 participants were included. 45 (45.0%) reported having pain following their stroke; of which, 20 (44.4%) did not report this pain to the doctor. The main reason for not reporting the pain was that the doctor didn't ask about pain, which occurred in nine (45.0%) participants. The pain presented during the first three months after the stroke in 39 (86.7%) participants. Nine (20.0%) participants reported the pain as severe, 23 (51.1%) reported the pain to be moderate and 13 (28.9%) reported only mild pain.

The presence of PSP is common within our trust but is commonly under-reported due to the lack of diagnostic criteria, because of this PSP should be included in the stroke follow up proforma.

## ESOC-0436

### 09. Rehabilitation and Recovery

#### Feasibility of cognitive assessment in post-stroke rehabilitation settings

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**Introduction:** Cognitive screening using a multi-domain assessment tool is recommended in stroke rehabilitation guidelines, however there is no

guidance on the preferred instrument. Choice of assessment should be guided by test properties. We aimed to describe feasibility of commonly used cognitive assessment tools.

**Methods:** We approached sequential medically stable stroke-survivors in two teaching hospital stroke rehabilitation units. Two researchers administered Folstein's Mini-Mental State Examination (MMSE); Montreal Cognitive Assessment (MoCA); Addenbrooke's Cognitive Examination (ACE-III) and the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). We recorded numbers completing tests; time to complete tests and where assistance was required.

**Results:** Over three months recruitment, of n = 55 suitable, n = 34 (62%) agreed to testing and completed at least part of the cognitive test battery. Median age 72 years (IQR: 62–84); n = 14 (41%) male. Of this group around half were able to fully complete the assessments with no assistance (Table 1). Completion time was lowest for MMSE. Partial completion of tests predominantly related to drawing and writing tasks (ACE-III n = 5; MMSE n = 6 participants; MoCA n = 9). Only 7 (21%) IQCODE assessments were completed.

**Conclusions:** Many stroke-survivors in rehabilitation struggle with traditional multi-domain cognitive assessments, gaining informant based data is also difficult. Recommendations for universal cognitive assessment need to be mindful of limited feasibility in a rehabilitation setting.

Assessment (range, threshold)	Median score (IQR)	Median time (minutes) to complete (IQR)	Below threshold for "impairment" n (%)	Partially completed n (%recruited)	Fully completed n (%recruited)
ACE-III (0–100, 88)	55 (41–70)	21 (15–25)	28 (97%)	29 (85%)	15 (44%)
MoCA (0–30, 26)	14 (7–16)	10 (8–11)	25 (100%)	25 (76%)	16 (47%)
MMSE (0–30, 24)	21 (18–25)	5 (5–6)	13 (54%)	23 (68%)	17 (50%)

## ESOC-0087

### 09. Rehabilitation and Recovery

#### Stroke survivors' experience of stroke rehabilitation: What are we missing?

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**Background:** The voices of patients recovering from stroke are not well represented in the evidence currently guiding rehabilitation research and service development.

**Objective:** To synthesize the best available evidence on the perspectives and preferences of stroke survivors undertaking physical rehabilitation in inpatient settings.

**Methods:** MEDLINE, CINAHL, Embase, and PsycINFO databases were searched, with no language or time constraints applied. Independent pro-

cesses were used throughout by two or more reviewers, and final decisions made by consensus. Qualitative studies reporting the experiences of inpatient stroke rehabilitation were selected. The search yielded 3039 records, 95 documents went to full text review. Quality of reporting was assessed using the COREQ framework. A thematic synthesis approach was used, where all text reported in studies' results sections were entered into NVivo software for coding and analysis.

**Results:** 31 studies met inclusion criteria and had an acceptable level of bias. Nine interrelated analytical themes, with descriptive subthemes, were identified that related to issues of importance to stroke survivors: physical activity is valued; bored and alone; patient-centered therapy; recreation is also rehabilitation; dependency and lack of control; fostering autonomy; power of communication and information; motivation needs nurturing; fatigue can overwhelm. Negative experiences were reported in all studies and include disempowerment, boredom, and frustration.

**Conclusions:** Rehabilitation could be improved by increasing activity within formal therapy and in free time, fostering patients' autonomy through genuinely patient-centered care, and more effective communication and information. Future stroke rehabilitation research should take into account the experiences and preferences of stroke survivors.

**ESOC-0166****09. Rehabilitation and Recovery****Why aren't all patients with stroke on Australian acute stroke units considered for rehabilitation?**E Lynch<sup>1</sup>, J A Luker<sup>1</sup>, D A Cadilhac<sup>2</sup>, C E Fryer<sup>1</sup>, S L Hillier<sup>1</sup><sup>1</sup>International Centre for Allied Health Evidence, University of South Australia, Adelaide, Australia<sup>2</sup>Department of Medicine, Monash University, Melbourne, Australia

*Background:* In 2013, less than half of the patients with stroke in Australian hospitals were assessed by rehabilitation specialists.

*Aims:* To explore how clinicians working in acute stroke units (ASU) determine which patients to refer to rehabilitation services.

*Methods:* Mixed qualitative methods design. Team meetings were observed and medical records reviewed over 4 weeks at two Australian ASUs. Detailed field notes were taken during and after each observed meeting. Focus groups were also conducted with staff from 8 ASUs in two states of Australia. Focus groups were audio-taped and transcribed. Data were coded and content analyzed.

*Results:* Rehabilitation was mentioned in team meetings for 50/64 patients (78%) during the observation period. Rehabilitation referrals were organized for 47 patients (94%) for whom rehabilitation was discussed (74% of the sample); and for no patients when rehabilitation was not discussed. Factors identified from both the observations and the focus groups that influenced whether rehabilitation referrals were organized included the anticipated discharge destination; severity of stroke; staff expectations of the patient's recovery trajectory; and if there was advocacy by families about rehabilitation. Clinicians tended to refer the patients they considered might be accepted by the rehabilitation service. Staff at two ASUs expressed concern that referring all patients with stroke-related deficits to rehabilitation would be unfavorable with rehabilitation providers.

*Conclusions:* Decisions made by ASU staff regarding who to refer to rehabilitation after stroke are often not solely based on patients rehabilitation requirements. Further research is underway to clarify how to improve assessment and referral processes.

**ESOC-0343****09. Rehabilitation and Recovery****Improving rehabilitation assessment and referral practices for patients with stroke in Australia. A mixed methods cluster-randomized implementation trial**E Lynch<sup>1</sup>, J A Luker<sup>1</sup>, D A Cadilhac<sup>2</sup>, C E Fryer<sup>1</sup>, S L Hillier<sup>1</sup><sup>1</sup>International Centre for Allied Health Evidence, University of South Australia, Adelaide, Australia<sup>2</sup>Department of Medicine, Monash University, Melbourne, Australia

*Background:* In 2013, one third of patients with acute stroke in Australian hospitals were not assessed for ongoing rehabilitation requirements.

*Aims:* To evaluate the effectiveness of 2 implementation programs for a clinical decision-making tool, the Assessment for Rehabilitation Tool (ART), on rehabilitation assessments and access to rehabilitation for patients with stroke.

*Methods:* Ten hospitals in 2 Australian states were randomly assigned to receive either education-only or multi-faceted ART implementation interventions. Medical records were audited before and after the implementation period and relevant staff participated in focus groups and individual interviews. Qualitative data were independently coded by two researchers, and thematically analyzed.

*Results:* Data from 705 patients (333 pre-intervention; 372 post-intervention; median age 77 years; 56% male) showed that proportions of patients assessed for rehabilitation increased significantly post-ART inter-

ventions ( $\chi^2 = 3.81, p = 0.05$ ). Despite a strong association between being assessed for rehabilitation and accessing rehabilitation (OR 22.13 [CI 11.27–43.47,  $p = 0.00$ ]), rehabilitation access did not change post-ART interventions ( $\chi^2 = 0.25, p = 0.62$ ). The difference in absolute change in proportions of patients assessed for rehabilitation was not significantly affected by intervention type (5% [CI –20% to 10%,  $p = 0.48$ ]).

Following the ART interventions, health professionals at 7 sites (3 education; 4 multi-faceted intervention) reported focusing on patient requirements when conducting rehabilitation assessments. Five of these sites reported that pre-ART, assessments were based on rehabilitation service availability and admission criteria.

*Conclusion:* The 2 ART interventions were equally effective in improving rehabilitation assessment documentation and reported patient-centered assessment practices, but interventions did not improve access to rehabilitation.

**ESOC-0671****09. Rehabilitation and Recovery****Outcome prediction of early recovery period of the cerebral ischemic hemispheric stroke**S Medvedkova<sup>1</sup>, O Lisovaya<sup>2</sup><sup>1</sup>Department of Nervous Diseases, Zaporizhzhia State Medical University, Zaporozhye, Ukraine<sup>2</sup>Department of Cardiology, City Clinical Hospital #6, Zaporozhye, Ukraine

*Aim:* Of the research was to investigate the predictive value of circulating vascular endothelial growth factor-1 level for recurrent cardiovascular events by the cerebral ischemic hemispheric stroke patients.

*Methods:* 102 cerebral ischemic hemispheric stroke patients of the early recovery period were included in the study. Follow-up was 12 months. The circulating peak VEGF-1 level was assessed at baseline. Clinical interviews were conducted every 3 months for 1 year after receiving blood samples.

*Results:* We found that circulating VEGF-1 levels in patients with one, two, three and more recurrent cardiovascular events were 373.80 pg/ml (95% CI=342.90–479.70 pg/ml), 539.96 pg/ml (95% CI = 444.28–865.56 pg/ml) and 724.66 pg/ml (95% CI = 558.72–890.66 pg/ml) respectively. Peak VEGF-1 level for these subjects were significantly higher than patients of free events (Me=289.28 pg/ml; 95% CI = 279.71–345.88 pg/ml) ( $P = 0.001$ ). The most optimal cutoff-point of circulating peak VEGF-1 in hypertensive patients was 403.57 pg/ml (sensitivity and specificity were 78.6% and 70.0%). Area under ROC curve (AUC) was 0.76 (95% CI = 0.602–0.917;  $P = 0.001$ ). Kaplan-Meier curves revealed an accumulation of cardiovascular events was superior in patients with peak VEGF-1 level more 403.57 pg/ml when compared with subjects with VEGF-1 level less this cutoff point ( $P = 0.001$ ).

*Conclusions:* We found that peak vascular endothelial growth factor-1 level was an independent predictor of one-year cumulative cardiovascular events by the cerebral ischemic hemispheric stroke patients.

## ESOC-0429

## 09. Rehabilitation and Recovery

**Intra-arterial bone marrow mononuclear cells (BM-MNCS) transplantation in acute ischemic stroke (IBIS trial). Protocol of a phase II randomized, dose-finding, controlled multicenter trial**

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*Rationale:* No neuroprotective or neurorestorative therapies have been approved for ischemic stroke. Bone marrow mononuclear cell (BM-MNC) intra-arterial transplantation improves recovery in experimental models of ischemic stroke.

*Aims:* This trial aims to test safety and efficacy of intra-arterial injection of autologous BM-MNC in ischemic stroke patients.

*Design:* Multicenter prospective phase II, randomized, controlled (non-treated group as control), assessor-blinded clinical trial. Seventy-six stroke patients will be enrolled. Patients fulfilling clinical and radiological criteria (e.g. age between 18-80 years, middle cerebral artery ischemic stroke with a National Institutes of Health Stroke Scale [NIHSS] score of 6–20 within 1–7 days from stroke onset and no lacunar stroke) will be randomized to intervention or control group (1:1). Bone marrow harvest and intra-arterial injection of autologous BM-MNC will be done in the intervention group with two different doses (2x10<sup>6</sup>/kg or 5x10<sup>6</sup>/kg in 1:1 proportion). Patients will be stratified at randomization by NIHSS score. Patients will be followed-up for 2 years.

*Study Outcomes:* The primary outcome is the proportion of patients with modified Rankin Scale scores of 0–2 at 180 days. Secondary outcomes include NIHSS and Barthel scores at 6 months, infarct volume, mortality, and seizures.

*Discussion:* This is the first trial to explore efficacy of different doses of intra-arterial BM-MNC in moderate-severe acute ischemic stroke patients. The trial is registered as NCT02178657.

## ESOC-0186

## 09. Rehabilitation and Recovery

**Physical activity, sedentary behavior and metabolic control following stroke: A cross-sectional and longitudinal study**

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*Background:* Physical activity and sedentary behavior are key moderators of cardiovascular disease risk and metabolic control. Despite the importance of a physically active lifestyle, little is known about the effects of stroke on physical activity. We assessed physical activity and sedentary

behavior at three time points following stroke compared to a healthy control group.

*Methods:* Physical activity and sedentary behavior were objectively measured using a portable multi-sensor array in 31 stroke participants (73 ± 9 years, National Institute of Health Stroke Scale 2 ± 2, mobile 10 meters with/without aid) within seven days and at three and six months. Stroke data were compared with an age, sex and body mass index matched healthy control group (n = 31).

*Results:* Within seven days of stroke, total energy expenditure and physical activity were significantly lower and sedentary time higher in the stroke group compared to controls (total energy expenditure 1840 ± 354 vs. 2220 ± 489 kcal, physical activity 28 ± 32 vs. 79 ± 46 min/day, steps 3111 ± 2290 vs. 7996 ± 2649, sedentary time 1383 ± 42 vs. 1339 ± 44 min/day, p < 0.01). At three months physical activity levels had increased (64 ± 58 min/day) but plateaued by six months (66 ± 68 min/day).

*Conclusions:* Physical activity levels are reduced immediately post-stroke and remain below recommended levels for health and well-being at the three and six month time points. Clinicians should explore methods to increase physical activity and reduce sedentary behavior in both the acute and later stages following stroke.

## ESOC-0605

## 09. Rehabilitation and Recovery

**Quantitative analysis of the perceived barriers and motivators to physical activity post-stroke**

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*Background:* Physical activity after stroke is low. To understand the reasons for this, we explored stroke survivors' perceived barriers and motivators to physical activity, including self-efficacy and the intention to be physical active.

*Methods:* Fifty independently mobile stroke survivors [(29/50) 58% female] were recruited prior to hospital discharge. Participant average age was 72.4 years (standard deviation: 12.3 years). After completing two walking tests (6 minute walk test and a short walk) participants rated nine possible motivators and four possible barriers to physical activity based on The Mutrie Scale, as having either "no influence", "some influence" or "a major influence" on physical activity. To determine the influence of the walking tests on self-efficacy and intention to increasing walking, participants were asked to rate their confidence and their intention to increase walking in the next month on two separate five-point rating scales.

*Results:* The most common motivating factor was "physical activity is good for health" [34(68%)]. The most common barrier was "feeling too tired" [24(48%)]. After the walks, intention and self-efficacy were high. Self-efficacy was graded as either 4 or 5 (highly confident) on the five-point scale by 34 (68%) participants, whilst 42 (84%) participants "strongly agreed" or "agreed" that they intended to increase their walking in the next month.

*Conclusions:* Participants felt capable of increasing physical activity after their stroke but fatigue was perceived as a common barrier to physical activity. These results need to be incorporated into interventions to increase physical activity in stroke survivors.

## ESOC-0014

### 09. Rehabilitation and Recovery

#### Effortful swallow with resistive electrical stimulation training improved pharyngeal propulsion in post-stroke dysphagia

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**Introduction:** To evaluate that effortful swallow combined with surface electrical stimulation used as a form of resistance training affect on pharyngeal constriction function in post-stroke patients with dysphagia.

**Materials and Methods:** Nineteen post-stroke dysphagia patients received 20 minutes effortful swallow training with resistive electrical stimulation during every weekday for 4 weeks. Electrical stimulation was applied on infrahyoid area as a resistance against hyolaryngeal elevation. Stimulation intensity was daily adjusted till the patients could endure electrical stimulation and raise their hyolaryngeal complex. Blinded biomechanical measurements of the extent of hyolaryngeal excursion and the pharyngeal constriction ratio (PCR) before and after training were performed. The change of the PCR and the relationship between hyolaryngeal elevation and the PCR were evaluated.

**Results:** The PCR was significantly decreased after training ( $p < 0.05$ ). There was a high inverse correlation between the hyoid elevation and the PCR ( $-0.62$ ).

**Discussion:** Effortful swallow with resistive electrical stimulation training increased pharyngeal strength. It can be used as a treatment to improve pharyngeal propulsion in dysphagia patients.

## ESOC-0205

### 09. Rehabilitation and Recovery

#### The increased bolus volume effects on delayed swallowing reflex in stroke patients

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**Purpose:** This study examined whether the method 'increasing fluid bolus volume' might be applied as a treatment option for stroke dysphagic patients.

**Methods:** Ten stroke patients who had a problem of delayed swallowing reflex confirmed by video fluoroscopic swallowing study (VFSS) were enrolled. Each subjects completed two swallows each of 2 mL, 5 mL, and 10 mL of barium liquid thinned with water. Pharyngeal delay time and penetration-aspiration scale (PAS) were measured and the changes among different volume swallows were analyzed.

**Results:** The pharyngeal delay time were shortened significantly when 5 mL and 10 mL thin barium were swallowed compared to 2 mL. However, there was no significant difference in PAS as bolus volume increased.

**Conclusion:** The increased fluid bolus volume reduced pharyngeal delay time, but did not affect penetration and aspiration status. This method is not proper as a treatment for stroke dysphagic patients.

## ESOC-0121

### 09. Rehabilitation and Recovery

#### Discharge destination of stroke survivors at Bradford Royal Infirmary, Bradford, UK

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**Background:** Reducing length of stay (LoS) for stroke patients is viewed as a good quality marker. However, this might be confounded by stroke survivors been discharge to a long-term care institutions. We aimed to determine the discharge destination (DD) for stroke survivors in our hospital (23 acute stroke beds), which serves a catchment population of 273,327 adult inhabitants.

**Method:** We prospectively studied consecutive acute stroke presentations (TIA excluded), aged  $\geq 18$  years from 01/05/2013 to 30/04/2014 referred to our single center.

**Results:** A total of 664 acute strokes were diagnosed in 652 individuals, of whom: 18.3% (122) died in hospital; 6.4% (43) were not admitted to hospital; 0.9% (6) had second stroke during same admission; and in 0.6% (4) DD was not known. The average LoS among the remaining 495 stroke survivors was 20.2 (SD 23.7) days; of those 84.6% (419) were discharged to their own home (OH), 9% (45) went from OH to nursing home (NH), 2% (10) went from OH to residential home (RH), 2.2% (11) and 0.8% (4) discharged back to their own NH and RH respectively, and 1% (5) went from RH to NH. The average LoS in those discharged from OH to NH was  $>3$  times longer (52 days) than those discharged to OH (17 days).

**Conclusions:** The average LoS among stroke survivors was 20.2 days. 12% of patients were discharged to long term care institutions. DD needs to be considered when LoS is measured.

## ESOC-0552

### 09. Rehabilitation and Recovery

#### The cardiac autonomic nervous system state and response to different stimuli among stroke patients and age-matched controls

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Autonomic nervous system instability, reflecting hyper-stimulation of the sympathetic system, is a common phenomenon among patients post stroke. Heart rate variability (HRV) refers to beat-to-beat alterations in the heart rate, measured non-invasively in the assessment of cardiac autonomic control. The purpose of the current study is to describe the response of the cardiac autonomic nervous system to different physical and cognitive stimuli, among patients post stroke and age matched healthy controls.

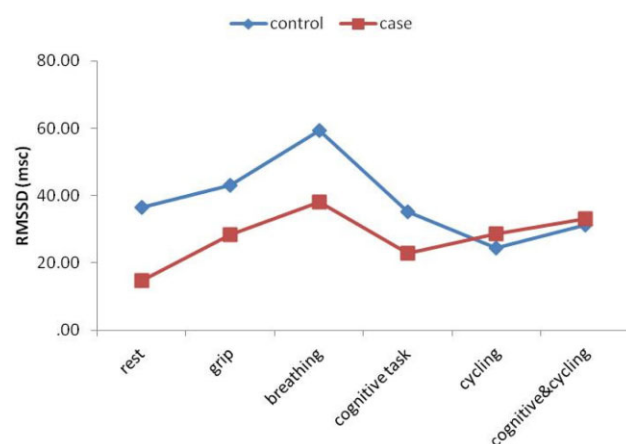
**Study Population:** Four patients in the sub-acute stage post first-ever ischemic stroke, with preserved cognitive capacity, without severe vision or hearing impairment, and four age-matched healthy controls.



**Method:** HRV recorded in several conditions: (1) rest, (2) a grip task, (3) a breathing task, (4) cycling, (5) a cognitive task, (6) cycling combined with a cognitive task. Each condition followed by a rest period.

**Results:** Mean heart rate values were similar in both groups at rest and throughout the different study conditions. In contrast, the HRV was lower among individuals post stroke, both at rest and during performance of the different tasks, except for cycling, alone or combined with a cognitive task (4, 6), where healthy controls showed a decline in HRV.

**Discussion:** The findings highlight the fact that the cardiac autonomic nervous systems, as measured by the HRV, react in an abnormal manner in the sub-acute period after stroke onset.



**Fig. 1** HRV in stroke patients and matched controls in different conditions. RMSSD = root mean square standard deviation.

## ESOC-0259

### 09. Rehabilitation and Recovery Stroke patients in an acute stroke unit show little physical, social and cognitive activity

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**Background and Purpose:** Stroke survivors who are in an Acute Stroke Unit (ASU) have been found to spend the majority of their day inactive and alone, with little information available regarding cognitive or social engagement. Since these studies, growing evidence indicates that stroke survivors should be active as early and frequently as possible. The aim of this study was to characterize the physical, social and cognitive activity levels of people with a stroke in a contemporary ASU.

**Methods:** Thirty adults with stroke admitted to an ASU in Australia were observed every 10 minutes from 7.30am to 7.30pm across three days during their first week in the ASU by staff trained in behavioral mapping. The location, body position, people present, physical, social and cognitive activity occurring was recorded at each observation.

**Results:** The mean age of participants was 76 (SD13) years, who were classified to have a mild (n = 17), moderate (n = 9) or severe (n = 4)

stroke. Participants spent 91% of their time in their room, 65% in supine position, and were alone 57% of the time. Physical, social, and cognitive activity was observed in 21%, 28% and 42% of the day, with the severe group having lowest activity levels across all areas.

**Conclusion:** Despite growing evidence recommending early activity, stroke survivors continue to spend the majority of the day inactive in the first week after stroke. An upcoming study will determine if an enriched environment can increase activity levels and reduce secondary complications in an ASU.

## ESOC-0057

### 09. Rehabilitation and Recovery Effects of motor learning through motor imagery on motor performance and functional cerebral reorganization

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In this study, 35 healthy subjects were asked to perform and to imagine the same motor task before and after a training period through mental practice with motor imagery. The protocol was approved by the ULB-Erasme Ethics Committee and all subjects gave their written informed consent before participating. The motor task consisted of different repetitive left ankle movements executed in a predetermined order. The training consisted in five times a week of mental practice comprising 10 blocks of 10 sequences in the kinesthetic imagined condition. Subjects were divided in 2 groups: first group imagined foot movements at regular velocity, second group imagined fast foot movements. They underwent brain functional MRI (fMRI) before and after training.

Mental training induced improvement in motor performance and a concomitant functional cerebral reorganization. First, time for the imagination and the execution of the motor sequence before and after mental training in both group showed that mental training led to a significant improvement (picture1). Second, mental training induced significant recruitment with a left-side predominance of the dorsomedial prefrontal, anterior paracingulate, posterior cingulate and precuneate cortices, left putamen and left head of the caudate nucleus. Our results also revealed training-related differences in the attentional network comprising specific cerebellar (crus I and II) and anterior paracingulate activations during the post-training task (picture2).

In conclusion, the present fMRI study show that mental practice is an efficient training method to improve motor performance and the shift of differential and coupled recruitment of cognitive networks can constitute neural marker of training effects.

## ESOC-0197

### 09. Rehabilitation and Recovery Intensive CIMT (Constraint Induced Motor Therapy) in chronic stroke- feasible in outpatient settings

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**Background:** CIMT (Constraint Induced Motor Therapy) is an effective method in the treatment of post-stroke- patients. Due to cost restrictions

it is important to test whether this therapy can also be delivered in a day clinic setting.

**Methods:** 11 chronic stroke outpatients were treated six hours daily in a group therapy setting over two weeks. Motor hand function was evaluated using the WMFT (Wolf Motor Function Test), and MAL (Motor Activity Log) at therapy onset, after two weeks of therapy, and in a 6-month-follow-up.

Functionally relevant individual task movements were shaped into sequential modules for a repetitive training program. The training was performed by two occupational therapists.

**Results:** In the Wilcoxon analyses, comparison to baseline scores showed that 6 out of 7 items of the WMFT improved significantly (lift pencil  $p < 0,004$ , pick up paper clip  $p < 0,01$ , flip card  $p < 0,017$ , turn key in lock  $p < 0,021$ , fold towel  $p < 0,003$ , lift basket  $p < 0,023$ ) after two weeks of therapy. In 6 out of 7 test items in the WMFT, there were significant improvements in the re-evaluation after 6 months (lift pencil  $p < 0,041$ , pick up paper clip  $p < 0,006$ , stack checkers  $p < 0,01$ , flip cards  $p < 0,003$ , turn key in lock  $p < 0,003$ , fold towel  $p < 0,01$ ). The MAL showed a significant improvement after six months. Three patients even reported a "normal spontaneous use" of their paretic hand and arm.

Shoulder pain or increased spasticity were not reported.

**Conclusion:** CIMT in chronic stroke patients can be performed in a day clinic setting and shows impressive and sustainable gains in motor function.

## ESOC-0132

### 09. Rehabilitation and Recovery Efficacy of CIMT with RTMS on upper extremity recovery in chronic stroke

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**Background and Purpose:** Constraint-induced movement therapy (CIMT) has been documented to improve motor function in the upper extremity following stroke. Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive and effective therapeutic stimulation to modulate cortical excitability of motor area and has the potential to improve dexterity of affected hand post stroke. The purpose of the study was to investigate the effect of rTMS with CIMT in chronic stroke patients with upper extremity motor deficits.

**Methods:** A randomized controlled study was undertaken with 25 chronic stroke patients between 3 to 18 months of index event with preserved at least 10° of wrist extension, 10° of thumb abduction and 10° of any two digit extension, and NIHSS score of (4–20). Group A (n = 13) was given CIMT alone and Group B (n = 12) were given rTMS with CIMT. All patients were subjected to Fugl Meyer Assessment (FMS), Barthel Index (BI) and Modified Rankin Scales (MRS). Resting motor threshold (RMT) and motor evoked potentials (MEP) were assessed before and after rTMS.

**Results:** Significant improvement was seen in patients treated with rTMS and CIMT on FMS of Upper extremity ( $p = 0.006$ ) and non-significant on MRS ( $p = 0.3$ ) and BI ( $p = 0.9$ ). Follow up MEP mean was  $109.78 \pm 157.27$  and RMT mean was  $80.08 \pm 23.24$  with no significant changes between the baseline and follow up MEP and RMT.

**Conclusion:** rTMS with CIMT resulted in significant improvement on FMS scale for upper extremity motor deficits.

## ESOC-0218

### 09. Rehabilitation and Recovery Repeated sessions of motor skill learning under dual-tDCS in chronic stroke patients

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**Background:** We previously showed that dual transcranial direct current stimulation (dual-tDCS) improves motor skill learning and long-term retention in stroke patients.

**Objective:** To prospectively follow-up 7 chronic hemiparetic stroke patients during repeated sessions. Among the 39 patients who participated in the RCT, 7 individuals spontaneously reported improvements beyond those formally assessed with the outcome measures; they requested additional sessions.

**Methods:** We provided additional sessions of motor skill learning combined with dual-tDCS every 4–8 weeks depending on the patient's needs and requests. During the repeated sessions, dual-tDCS (1 mA) was delivered to both primary motor cortices during 30 minutes.

**Results:** The baseline characteristics of these 7 patients were similar to those of the others. They reported lasting benefits of the repeated intervention ("somehow regained more control over the paretic upper limb"; "spasticity attenuated"; "more benefit from the usual physical/occupational therapy sessions"). Within-session, the Learning Index (LI) kept improving during most of the repeated sessions (LI:  $23.97\% \pm 14.45\%$  (mean  $\pm$  SD); slope:  $0.56 \pm 0.65$ ). Between-session, there was also a constant, cumulative performance improvement (slope:  $0.12 \pm 0.23$ ).

**Conclusion:** Beyond the enhancements formally assessed in our previous RCT, 7/39 patients spontaneously reported enhancement of motor function in everyday life, exclusively after the real dual-tDCS session (applied in a randomized, double-blind, sham-controlled, cross-over design). They benefited from additional, repeated real sessions, suggesting that motor skill learning combined with dual-tDCS could be applied repetitively. It would be surprising that the continuous between-sessions enhancements were driven exclusively by a placebo effect.

## ESOC-0145

### 09. Rehabilitation and Recovery Relaxation techniques for stroke survivors: Findings from a patient and public involvement project in the UK

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About 2/3 stroke patients report psychological problems such as depression, anxiety and poor confidence. Relaxation techniques have been reported as effective interventions in non-stroke people with anxiety issues. Little is known whether and how these techniques might work for stroke survivors.

This project aimed to consult with stroke patients about: 1) the suitability of relaxation techniques for improving psychological health; 2) determin-

ing preference in applying them and 3) how they can be tailored to meet stroke patients' needs, especially those with aphasia.

Four focus groups were conducted in the UK with 13 stroke survivors (aphasic = 7, median age = 61 years). Patients watched a 15-minute film of relaxation techniques and practiced each one (counting, word repetition, body movement, breathing, positive emotions, thinking of a nice place and body relaxation). They feedback how these techniques could be tailored to meet their needs, their preferences for different techniques and reasons for likes and dislikes. They also rated each technique in order of preference.

The mean rating showed that nice place comes out top, followed by breathing, and positive emotions. Counting and word repetition were the least favorable. Correlation analysis suggested that if people like positive emotions, they also like breathing. A strong relationship also existed between those who like the nice place and those who like body relaxation. All top 3 techniques should be selected for use in further studies; however tailoring is necessary for stroke survivors, e.g., choosing specific wording for the instructions and a slower pace for aphasic patients.

### ESOC-0339

#### 09. Rehabilitation and Recovery Investigation of body schema in adults post-stroke

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**Background:** The mechanisms underpinning unilateral spatial neglect are not well understood. There is some evidence to suggest that it may be associated with an impairment of an individual's body schema. However, little is known about distortions of body schema in the first two weeks following stroke, nor any associations with somatosensory deficits.

**Methods:** Fifteen participants with a hemispheric stroke were assessed within the first two weeks of their stroke and then again three weeks later. The primary outcome was body schema, assessed using an online left/right hand judgment task with the Recognise™ app (noigroup). Secondary outcomes included assessing personal neglect with the Vest Test, spatial neglect with the Bells Test and Line Bisection Task, light touch sensation of the arm with the Semmes-Weinstein monofilaments and proprioception with the Distal Proprioception Test. Contralateral and ipsilesional hand judgment accuracy and reaction time was compared at both time points to determine if body schema was distorted and if it changed over time. Associations between somatosensory deficits, unilateral neglect and distorted body schema were explored.

**Results:** There was no significant difference in body schema between contralateral and ipsilesional sides of the body or from the acute to subacute period following a stroke. Quantile regression analysis identified a significant association with impairment of proprioception and a distorted body schema ( $p = 0.03$ ).

**Conclusion:** A distorted body schema was associated with impaired proprioception in adults post stroke.

### ESOC-0289

#### 09. Rehabilitation and Recovery A prospective study of the psychological determinants of walking among community-based, ambulatory stroke survivors

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**Background:** Many stroke survivors have low levels of physical activity. In order to develop a novel physical activity intervention, focused on walking, for stroke survivors able to walk outdoors following rehabilitation, knowledge of the psychological factors affecting how much stroke survivors walk is required. Therefore, we tested whether psychological beliefs, taken from the well-known Theory of Planned Behavior, and participants' self-reported use of planning strategies, predicted intentions for, and actual, walking more.

**Methods:** Prospective survey. At time 1, 70 South London Stroke Register participants, able to walk outdoors, completed measures of weekly walking time, intentions to walk more, attitudes towards walking more, perceived norms for walking more, perceived behavioral control over walking more and use of spontaneous planning strategies for walking more. One week later, weekly time walked was assessed again.

**Results:** Intentions to walk more were significantly predicted by perceived positive norms for walking more ( $\beta = 0.41$ ,  $p < 0.001$ ) and higher perceived control over walking more ( $\beta = 0.38$ ,  $p = 0.01$ ) while attitudes' effect ( $\beta = 0.20$ ,  $p = 0.08$ ) was not significant,  $R^2 = 0.50$ . Walking more was not significantly predicted by either intentions ( $OR = 1.09$ ,  $p = 0.20$ ) or perceived control over walking more ( $OR = 0.99$ ,  $p = 0.99$ ), contrary to what was expected. Use of planning strategies also did not significantly influence whether participants walked more ( $OR = 0.93$ ,  $p = 0.33$ ).

**Discussion:** Greater perceived behavioral control and perceived positive subjective norms are associated with increased intentions to walk more and could be targeted by walking interventions for stroke survivors. However, any intervention will also require additional strategies to turn this positive motivation into action.

### ESOC-0199

#### 09. Rehabilitation and Recovery Continuous activity monitoring in cryptogenic stroke patients with insertable cardiac monitors and the impact of newly detected atrial fibrillation

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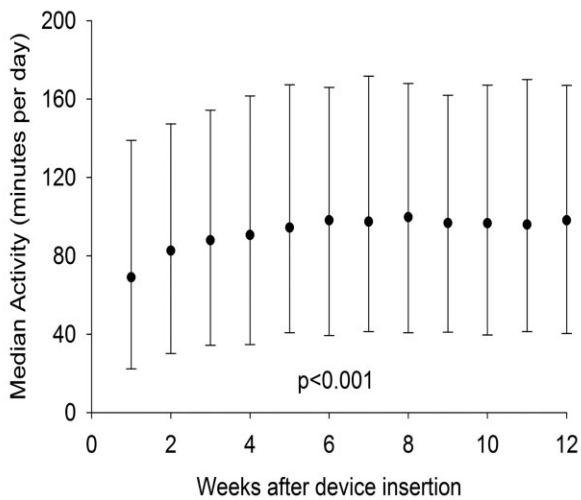
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**Introduction:** Comprehensive activity data following cryptogenic stroke (CS) and the subsequent impact of atrial fibrillation (AF) are limited. We investigated activity stabilization and AF's impact on activity among a large cohort with insertable cardiac monitors (ICM) placed following CS.

**Methods:** Patients in the Medtronic Discovery™Link database with ≥12 weeks of data who received an ICM (Reveal LINQ™) following CS were included. The ICM continuously monitors activity and AF. Activity stabilization was defined as the time required to attain ≥95% of the average weekly activity between weeks 9–12. For patients with AF detected, activity was compared between weeks 1, 2, and 4 prior vs. after detection of the first adjudicated episode.

**Results:** 1069 patients (age 65.1 ± 13.1, 52% male) were included. Median activity in the initial week following ICM placement was low (69.0 [IQR 22.3–138.9] minutes/day) but increased over 5 weeks and stabilized (Fig. 1). Among patients with sufficient data, daily activity did not change significantly in the week(s) before vs. after initial AF detection (p=NS).

**Conclusion:** Activity following CS was low but significantly improved over the initial 5 weeks following ICM placement. The presence of AF did not impact weekly activity levels, suggesting that most AF was asymptomatic. Consequently, ICMs could aid in both monitoring functional recovery as well as identifying asymptomatic AF in CS patients who would benefit from oral anticoagulation.



## Language and Cognition

### ESOC-1172

#### 10. Language and Cognition

##### Phenomenology and neuropsychology of delirium in the 14 days after stroke: A prospective cohort study

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**Background:** Delirium affects ~25% of patients after stroke, has adverse consequences, and yet is poorly understood. Here we examined the phenomenology and neuropsychology of delirium after acute stroke.

**Methods:** We consecutively recruited 95 participants (aged >60) hospitalized with acute stroke. Diagnosis of delirium was made using DSM-IV criteria. Features of delirium were assessed by the Confusion Assessment Method-ICU (CAM-ICU), Delirium Rating Scale-Revised-98 (DRS-R98) and retrospective Chart-CAM, administered on alternate days over week one (first assessment median 5 days post-stroke) and at day 14. National Institutes for Health Stroke Scale (NIHSS) was scored at baseline.

**Results:** Twenty-six participants (27%) developed delirium.

Characteristic	Median (inter-quartile range)
Age, years	83.5 (79–85.3)
NIHSS score	8.5 (5.0–12.8)
Day of delirium onset	5 (4–7)
Duration of delirium, days	2 (1.3–9)
Maximum severity score (DRS-R98)	22 (15.8–25.5)
Delirium subtype, n (%)	14 (54)
Hypoactive	4 (15)
Hyperactive	8 (31)
Mixed	

The median time of delirium onset was day 5, and the median duration was 2 days. The majority (14/26) had a hypoactive delirium. The median DRS-R98 score was 22 out of 48 and the most common abnormalities were short and long-term memory deficits (23/26 and 25/26 respectively), sleep-wake cycle disturbance (22/26) and moderate to severe inattention (20/26). Fourteen (54%) patients had detectable psychotic features.

**Discussion:** Delirium affected more than 25% of patients. It was most often hypoactive. Sleep-wake cycle disturbance and significant memory and attentional deficits were common. Psychotic features affected more than 50% of delirious patients. Stroke physicians should be aware of the high prevalence of the frequently undetected hypoactive subtype of delirium post-stroke.

### ESOC-0452

#### 10. Language and Cognition

##### The role of the amygdala in the perception of positive emotions: An "intensity detector"

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Although the development of functional imaging techniques has established the implication of the amygdala in the emotional process, its specific role remains controversial. The aim of this study was to highlight the sensitivity of the amygdala to emotional intensity (arousal). We conducted

an analysis of the modulation of amygdala activation according to variation in emotional intensity via an fMRI event-related protocol. Monitoring of electrodermal activity, a marker of psychophysiological emotional perception and which reflects the activation of the autonomic nervous system, was carried out concurrently. Eighteen subjects (10 men; aged from 22 to 29 years) looked at emotionally positive photographs. We demonstrated that the left and right amygdalae were sensitive to changes in emotional intensity, activating more in response to stimuli with higher arousal. Furthermore, electrodermal responses were more frequent for the most intense stimuli, demonstrating the concomitant activation of the autonomic nervous system. These results highlight the sensitivity of the amygdala to the intensity of positive emotions, and in conjunction with results in the literature on negative emotions, prove the role of the amygdala in the perception of intensity.

### ESOC-0925

#### 10. Language and Cognition

##### The AVERT MoCA data: Cognitive assessment in a large-scale, multi-center stroke trial

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**Background:** The Montreal Cognitive Assessment (MoCA) is now one of the most widely used cognitive screening tools in stroke. Scoring the visuospatial/executive items of the MoCA involves subjective judgment. The aim of this study was to examine scoring accuracy in the context of a multi-center trial.

**Methods:** A Very Early Rehabilitation Trial (AVERT) is a Phase III RCT of early mobilization after stroke that included the MoCA as a 3-month outcome measure. Once completed, MoCA score sheets were scanned and sent from the 53 participating hospital sites to a central repository for data checking. For the 3 visuospatial/executive items (Trail-making, Cube copy, Clock drawing), we compared the original scoring of the assessors at each site (trained to administer the MoCA) to blind scoring of the data by a second, independent and experienced rater.

**Results:** In a sub-sample of 910 score sheets (originally completed by 99 different assessors), we found reasonable agreement. The match between original and blind scoring was: Trail-making 97%, Cube 90%, Clock contour 91%, Clock numbers 87%, Clock hands 72%. For all items except Clock contour, independent scoring was stricter than original scoring. Most of the discrepancies were errors in original scoring, rather than being attributable to gray areas in subjective judgment.

**Conclusions:** In trials that include the MoCA, researchers should emphasize the scoring rules to assessors and implement some form of independent data checking, especially for the Clock hands item, to maximize accuracy.

## ESOC-1050

### 10. Language and Cognition

#### Metacognition versus global cognition determining mood symptoms post-stroke

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**Introduction:** The association between global cognition and depression after stroke has been recognized. Although the link between metacognition and mood has been well established, particularly in other conditions with psychological comorbidity, there is limited evidence regarding this association in the area of stroke.

**Aims:** The aim of the study was to examine correlates and potential predictors of mood symptoms after stroke including global and metacognition in a Middle Eastern cohort.

**Methods:** A prospective stroke sample of n = 50 patients have been recruited to date from the largest Medical Complex in Bahrain. A neuropsychological battery of cognitive assessments including measures the Mini-mental State Examination (MMSE), the Montreal Cognitive Assessment (MOCA) for global cognition and the Meta-cognition Questionnaire 30 (MCQ-30) for meta-cognition. The Hospital Anxiety and Depression Scale assessed mood symptoms and stroke severity was measured using the National Institute of Health Stroke Severity Scale (NIH-SS).

**Results:** Total MCQ-30 scores highly correlated with anxiety ( $r = .54$ ,  $p < .0001$ ) and depression ( $r = .47$ ,  $p = .001$ ). The MCQ-30 subscales cognitive confidence ( $p < .05$ ), cognitive self-consciousness ( $p < .05$ ) and uncontrollability/danger ( $p < .0001$ ) were the specific domains to be associated with anxiety and depression. There were no statistical significant correlations found for the MMSE or MOCA scores with the MCQ-30. Metacognition remained a statistically significant correlate with anxiety ( $\beta = .53$ ,  $p < .0001$ ) and depression ( $\beta = .52$ ,  $p < .0001$ ), after controlling for age and stroke severity.

**Conclusions:** Metacognition appears to be a better estimator of mood symptoms after stroke in comparison to global cognition.

## ESOC-1479

### 10. Language and Cognition

#### The relationship between cognitive and emotional symptoms one week and three months post-stroke

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**Background:** Cognitive and emotional symptoms are common in stroke patients. The aim of the present study was to explore the relationship between emotional and cognitive symptoms one week and three months post-stroke.

**Method:** 36 patients with cortical and 49 patients with lacunar supratentorial ischemic infarctions, recruited from a university-hospital based stroke unit, were followed-up for 3 months (age =  $64.4 \pm 9.2$ ; education =  $11.0 \pm 2.9$ ; men = 68%; Mini Mental State Examination =  $28.4 \pm 1.7$ ; the National Institute of Health Stroke Scale-day 2 =  $2.7 \pm 2.6$ ). All patients were assessed for emotional and cognitive symptoms one week and three months post-stroke. Emotional symptoms were evaluated using the Hospital Anxiety and Depression Scale (HADS). Working memory, processing speed/attention, divided attention, response

inhibition and inhibition/switching were assessed using the following neuropsychological measures: the Letter-Number Sequencing task, the Trail Making Test (TMT) A/B and the Color-Word Interference Test. Correlation analyses were performed in order to test the association between cognitive and emotional symptoms.

**Results:** One week post-stroke, higher emotional morbidity (HADS depression and anxiety subscales) was significantly associated with worse working memory performance (Pearson's  $r = -0.27$  for anxiety subscale and  $r = -0.30$  for depression subscale;  $p < 0.05$ ). In addition, higher depressive symptoms (HADS depression subscale) were significantly associated with reduced divided attention one week post-stroke ( $r = 0.22$ ;  $p < 0.05$ ). Three months post-stroke, higher depressive symptoms (HADS depression, but not anxiety subscale) were significantly associated with worse performance on measures of processing speed/attention, divided attention and response inhibition/switching ( $r \geq 0.23$ ;  $p < 0.05$ ).

**Conclusion:** The findings indicate an association between depressive symptoms and performance on neuropsychological measures of executive function one week and three months post-stroke.

## ESOC-0571

### 10. Language and Cognition

#### Lesions in the left precentral gyrus were associated with apraxia of speech in patients with acute stroke in the MCA territory

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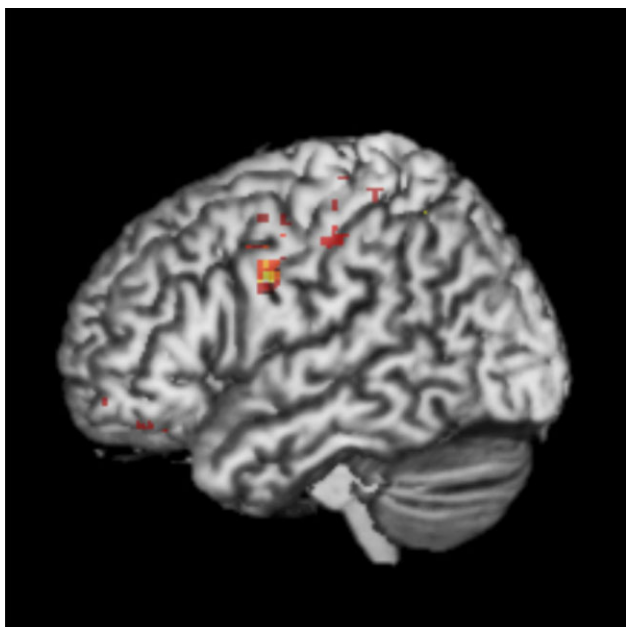
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**Background:** Accumulated case reports of pure apraxia of speech (AOS) suggested that the left precentral gyrus is the responsible lesion, while the left anterior insula or posterior part of the inferior frontal gyrus has been implicated in speech articulation in stroke patients. The aim of this study is to address this issue in consecutive acute stroke patients.

**Methods:** We retrospectively studied consecutive 2146 ischemic stroke patients who were admitted within 7 days after onset. According to the inclusion criteria of first-ever stroke onset, right-handed, isolated non-lacunar infarcts in the left MCA territory, and evaluation by speech-language pathologists, consecutive 136 patients were enrolled in this study. Lesions were delineated on T2-weighted images or fluid-attenuated inversion recovery images obtained during hospital stay. We generated a statistic map of lesions contribution related to AOS using voxel-based lesion symptom mapping (VLSM).

**Results:** The median interval between onset and speech evaluation was 7 days [5–10, interquartile range]. Of the 136 patients, 22 patients (16 %) showed AOS including 7 patients with pure AOS. The median time from onset to imaging was 9 days [7–12.75]. The VLSM analysis revealed areas associated with AOS in regions centered at the posterior bank of the left precentral gyrus.

**Conclusion:** Lesions in the left precentral gyrus are the most likely site causing AOS in acute stroke patients.



## ESOC-0590

## 10. Language and Cognition

**Cerebrolysin adjuvant treatment in Broca's aphasics following first acute ischemic stroke of the left middle cerebral artery**

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**Objective:** To assess the efficacy of Cerebrolysin in Broca's aphasics with acute ischemic stroke of left middle cerebral artery (MCA).

**Methods:** Language was evaluated with the Romanian version of the Western Aphasia Battery (WAB). Inclusion criteria: age 20–75 years, admission in the hospital within 12 hours from the onset of the symptoms, diagnosis of first acute left MCA ischemic stroke, presence of large artery disease stroke, a NIHSS score of 5–22 points, and a therapeutic time window within 72 h. 52 patients were treated with Cerebrolysin (Cerebrolysin group) as an adjunctive treatment. A placebo group, which received adjunctive saline infusions (104) were matched to the NIHSS and WAB scores, gender and age of the Cerebrolysin group at baseline. We assessed spontaneous speech (SS), comprehension (C), repetition (R), naming (N), and Aphasia Quotient (AQ) scores of the two groups in an open label design, over 90 days, the mRS scores and mortality.

**Results:** The two groups had similar age ( $66 \pm 8$  versus  $65 \pm 8$  years) and sex ratio (14/38 versus 30/74). The mean AQ scores and the mean sub-scores for SS, R, N were similar at baseline and improved in the Cerebrolysin group significantly ( $p < 0.05$ ) over placebo group at all study time points. The mRS score at 90 days was also lower in the Cerebrolysin group than in the placebo group. Cerebrolysin and placebo were both tolerated

and safe, and no difference in the mortality rate was seen (3.8% in each group).

**Conclusion:** Cerebrolysin is effective for the treatment of such Broca's aphasics.

## ESOC-1496

## 10. Language and Cognition

**Blood brain barrier permeability predicts cognition one year post-lacunar stroke**

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**Background:** Blood brain barrier permeability (BBBP) is linked to lacunar stroke sub-type, and dementia. Little data exists on the relationship between BBBP and post-stroke cognition.

**Methods:** We recruited patients with a lacunar or cortical non-disabling ischemic stroke. At 1–3 months and 1 year post-stroke we measured cognition with Addenbrookes Cognitive Examination (ACE-R) and pre-morbid intelligence quotient (IQ) with the National Adult Reading Test (NART). We obtained BBBP measurements on white matter hyperintensities (WMH) and normal tissues at 1–3 months from dynamic contrast enhanced MRI. We used multiple linear regression to investigate the link between BBBP and ACE-R.

**Results:** A total of 147 patients (92 lacunar stroke, 109 cortical) had DCE MRI and cognitive tests at 1–3 months post-stroke and 139 returned for one year follow-up. In lacunar stroke only patients there was a significant association between increased BBBP in WMH and lower ACE-R at 1–3 and 12 months post-stroke (adjusted for age, sex, NART, diabetes, and alcohol)  $p = 0.03$  in lacunar and  $0.07$  in cortical stroke. The difference between subtypes was more pronounced at 1 year ( $p < 0.001$  lacunar and  $0.45$  cortical). There was no other consistent association with BBBP elsewhere in the brain, or between BBBP and NART.

**Conclusion:** In lacunar, but not cortical, stroke increased BBBP in white matter lesions was associated with post-stroke cognition. The mechanism of post-stroke cognitive impairment may be different in lacunar stroke, perhaps due to the involvement of diffuse small vessel disease which may be mediated by BBBP.

## ESOC-0286

## 10. Language and Cognition

**Methodological factors in determining rates of dementia and cognitive impairment in TIA and stroke: Applicability of short cognitive tests**

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**Introduction:** Cognitive assessment is recommended after stroke but there are few data on the applicability of short cognitive tests to the full spectrum of patients. We therefore determined rates and causes of untestability in a population-based study of all TIA and stroke.

**Methods:** Patients with TIA or stroke prospectively recruited (2002–2007) into the Oxford Vascular Study had  $\geq 1$  of mini-mental-state examination

(MMSE), telephone interview of cognitive status (TICSM), Montreal cognitive assessment (MOCA), and abbreviated mental test score (AMTS) with follow-up to 5-years.

**Results:** Among 1097 consecutive assessed survivors (mean age/sd 74.8/12.1 years, 378 TIA), numbers testable with a short cognitive test at baseline, 1, 6, 12 and 60 months were 819/1097 (75%), 760/947 (80%), 671/825 (81%), 612/762 (80%) and 381/544 (70%). Untestability was associated with older age, greater severity of index event and premorbid dependency. Over 90% (343/378) of TIA patients were testable at baseline compared to only 41% (120/290) of major stroke. Untestability was commonly caused by dysphasia (18%) and being too unwell (13%) at baseline whereas moving out of study area was common at 5 years (26%). Testing difficulties (eg dysphasia, poor vision) in otherwise testable patients were more prevalent at baseline (120/819 (15%)) than thereafter: 57/760 (8%), 16/671 (2%), 7/612 (<1%) and 12/381 (3%) at 1, 6, 12 and 60 months.

**Conclusions:** Requiring completion of a cognitive test excludes those most at risk of cognitive impairment after TIA and stroke. Future studies should report data on untestable patients and on those with testing difficulties.

## ESOC-1053

### 10. Language and Cognition

#### New IPAD-based cognitive test for stroke patients

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**Introduction:** Cognitive testing is important in sub-acute stroke for research, prognostication and planning. However, the very diverse symptoms poses challenges for a test battery suitable for all patients, and the testing has to be carried out in a limited time as stroke patients are prone to fatigue.

**Method:** We developed and validated an iPad-based battery of tests for aphasia, neglect, episodic memory, attention span, executive function, working memory, mental speed, anosognosia, manual speed and depression. Sub-acute stroke patients and age-matched controls were tested twice within one month.

**Results:** 44 healthy controls and 51 stroke patients were included. Mean age 67 years (range 33–90). Mental speed by coding: patients 29.3 and controls 45.7; mean difference 16.4, 95% CI (10.3–22.4)  $p < 0.001$ . Test re-test reliability in healthy controls by intra-class correlation coefficients (ICC) 0.925. Mean verbal fluency correct in 1st session: patients 29.2 and controls 45.3; Mean difference 16.03, 95% CI (10.1–22.0)  $p < 0.001$ . Mean change in patients from 1st to 2nd session: 6.2, 95%CI (1.2–11.2)  $p = 0.017$ . Test-retest reliability in healthy controls by ICC 0.935. Similar analyses of memory, attention span, and executive function showed significant differences between control and patient groups as well as in patients from 1st to 2nd session.

**Conclusion:** It is feasible to employ the test battery with the majority of sub-acute stroke patients. It can be performed in a relatively short time-span. It is sensitive to the common neuropsychological symptoms and to the remission of the symptoms.



## Experimental/Translational Medicine

### ESOC-1551

#### 11. Experimental/Translational Medicine

#### Inflammatory biomarkers associated with acute symptomatic carotid atherosclerosis in the Dublin Carotid Atherosclerosis and Stroke Study (DUCASS)

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**Introduction:** In recently-symptomatic carotid stenosis, circulating inflammatory biomarkers may predict recurrent stroke but may be confounded by inflammation secondary to cerebral ischemia. We investigated the relationship between clinical syndrome (DWI-negative, DWI-positive TIA, mild stroke) and inflammatory markers in the DUCASS Study.

**Methods:** DUCASS is a prospective study of biomarkers of recurrent stroke in consecutive patients with retinal embolism, TIA and mild-moderate stroke (Rankin <3), with ipsilateral carotid stenosis ≥50%. Plasma C-reactive protein (CRP), interleukin-6 (IL-6), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) and IL-1 $\beta$  were analyzed by mass spectrometry and ELISA, and compared with non-stroke controls.

**Results:** 97 patients were included (60.8% retinal embolism/TIA (40.7% DWI-positive), 39.2% stroke).

In patients with DWI-positive TIA (n = 24) CRP, TNF- $\alpha$  and IL-6 but not IL-1 $\beta$  (8.96 vs. 1.88, p = 0.002), 4.97 vs. 3.61, p = 0.002) and (7.42 vs. 3.43, p = 0.002) and for stroke (n = 38), CRP, TNF- $\alpha$  and IL-6 but not IL-1 $\beta$  (3.58 vs. 1.88, p = 0.03), (6.03 vs. 3.61, p = 0.002) and (6.85 vs. 3.43, p = 0.0002) were higher in carotid stenosis than controls.

Similar relationships were found in DWI-negative TIA (n = 23) compared with controls, for CRP and TNF- $\alpha$ , but not IL-6 and IL-1 $\beta$  (0.82 vs. 1.88 mg/ml, p = 0.047) and (4.40 vs. 3.61 pg/ml, p = 0.028).

**Conclusion:** CRP, TNF- $\alpha$  and IL-6 but not IL-1 $\beta$  were associated with acute symptomatic carotid atherosclerosis, including CRP and TNF- $\alpha$  in DWI-negative TIA, suggesting a contribution from plaque inflammation. Further study is required to determine the prognostic utility of inflammatory biomarkers in cranio-cervical atherosclerosis.

### ESOC-0799

#### 11. Experimental/Translational Medicine

#### Early ischemic changes on CT are associated with MMP-3 and TIMP-1 balance after thrombolysis in patients with acute ischemic stroke

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**Background and Purpose:** Substantial experimental and clinical evidence suggest that matrix metalloproteinases (MMPs) and their tissue inhibitors (TIMPs) play a relevant pathophysiologic role in early phases of acute ischemic stroke. In acute clinical setting, early ischemic damage on baseline CT scan is often evaluated by using the Alberta Stroke Program Early Computed Tomography Score (ASPECTS). We aimed to establish whether an association between ASPECTS and MMPs and TIMPs exists in patients treated with i.v. thrombolysis.

**Methods:** Data were obtained from the MAGIC study. We performed centralized assessment of ASPECTS dichotomized into two groups (0–7 vs 8–10). Circulating levels of MMPs and TIMPs were taken before and 24 hours after t-PA treatment. Baseline values, delta median values ([24 hours post t-PA – pre t-PA]/pre t-PA), and delta median ratio values between MMPs and their inhibitors [(MMP/TIMP 24 hours post t-PA – MMP/TIMP pre t-PA)/(MMP/TIMP 24 hours)] were analyzed among the two ASPECTS groups. We used multiple logistic regression to study independent associations.

**Results:** 230 patients were assessed for ASPECTS rating and blood biomarkers levels. After adjustment for major clinical determinants, MMP-3 delta median value showed a trend towards lower ASPECTS (OR = 1.25; 95% CI: 0.97–1.61). Higher MMP-3/TIMP-1 delta median ratio proved to be independently associated with lower ASPECTS (OR = 1.27; 95% CI: 1.01–1.58).

**Conclusions:** In patients with acute ischemic stroke treated with intravenous thrombolysis the extent of ischemic changes on baseline CT is associated with balance between MMP-3 and TIMP-1. Further studies are needed to validate this finding.

## ESOC-1355

### 11. Experimental/Translational Medicine

#### Peripheral frequency of CD4+CD28-cells in acute ischemic stroke: Relationship with stroke subtype and severity markers

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**Background:** CD28 null cells have been reported as increased in acute coronary syndrome. Only two studies analyzed peripheral frequency of CD28 null cells in acute ischemic stroke but, peripheral frequency of CD28-cells in each TOAST subtype has never been evaluated. We hypothesized that the CD4+CD28- subset could show a different degree of peripheral percentage in subjects with acute ischemic stroke in relation to clinical subtype and severity of stroke.

**Objectives:** To analyze peripheral frequency of CD4CD28-cells in subjects with acute ischemic stroke in relation to TOAST diagnostic subtype, relationship with scores of clinical severity of acute ischemic stroke, and their predictive role in the diagnosis.

**Methods:** We enrolled 98 consecutive subjects with ischemic stroke. As controls we enrolled 66 patients without acute ischemic stroke. Peripheral frequency of CD4+ and CD28-T cells has been evaluated by a FACS Calibur flow cytometer.

**Results:** Subjects with acute ischemic stroke had a significantly higher peripheral frequency of CD4+ cells and CD4+CD28-cells compared to controls without acute ischemic stroke. Subjects with cardio-embolic stroke had a significantly higher peripheral frequency of CD4+cells and CD28-cells compared to subjects with other TOAST subtypes. We observed a significant relationship between CD4CD28-cells and Scandinavian Stroke Scale and NIHSS scores. ROC curve analysis showed that CD28-cell percentage was predictive of stroke and LAAS and cardio-embolic subtype.

**Conclusions:** These findings suggest a possible role for a T-cell component also in acute ischemic stroke clinical setting showing a different CD28-cell peripheral frequency in relation of each TOAST subtype of stroke.

## ESOC-0064

### 11. Experimental/Translational Medicine

#### Delayed administration of perlecan domain V significantly increases neurogenesis and improves functional outcome after experimental ischemic stroke

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Stroke, a major cause of morbidity and death, has limited therapeutic options. In our efforts to develop novel stroke therapies, we have discovered that the domain V (DV) bioactive protein fragment of the brain vascular matrix proteoglycan perlecan is both neuroprotective and pro-angiogenic. Furthermore, functional outcome can be significantly improved in rodents by administering DV 6–24 hours after experimental

transient (distal MCA occlusion) or permanent (photothrombosis) stroke. Here we studied the potential of delayed DV administration (initiated 7 days post-stroke) to increase neurogenesis and improve functional outcome as well as a possible mechanism of action through the alpha 2 integrin receptor. After two doses of DV, 3-month old male C57BL6 mice subjected to transient distal MCA occlusion had significant functional improvement as measured by rotor rod. Brain immunohistochemistry 21 days after stroke demonstrated that DV treated mice had significantly more BrdU (a marker of cell division), doublecortin (DCX, immature neuron marker), and NeuN (neuronal marker) positive cells in the infarct area. Furthermore, DV's neurogenic effects could be blocked by treatment with alpha 2 function blocking antibody after photothrombosis. These results suggest that delayed DV treatment after experimental stroke increases neurogenesis, increases the number of new neurons that reach stroked brain regions and survive there, and improves functional outcome through an alpha 2 integrin dependent mechanism. Importantly, as we are unaware of any other delayed stroke monotherapy that significantly improves functional outcome after stroke, our data further support the promise of DV as a novel stroke therapy.

## ESOC-0056

### 11. Experimental/Translational Medicine

#### Prognostic value of sST2 in patients with acute ischemic stroke – Results of the Linz Stroke Unit (LISU) study. A prospective cohort study

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**Aim:** To evaluate whether plasma concentrations of sST2 were independently associated with death and disability after stroke.

Concentrations were measured in consecutive patients with acute ischemic stroke.

The NIHSS and plasma concentrations of C-reactive protein (CRP) and amino-terminal pro-B-type natriuretic peptide (NT-proBNP) were also assessed at baseline. Primary outcome measure was all-cause mortality at 90 days; secondary outcome measure was functional outcome at 90 days. The median sST2 plasma concentration was 35 U/mL. The median sST2 plasma concentration was higher in decedents than survivors (55 U/mL vs. 34 U/mL;  $p < 0.001$ ). A clear threshold effect at an sST2 plasma concentration of 35 U/mL was established. Univariate Cox proportional-hazard regression analysis, using the threshold of 35 U/mL to dichotomize sST2, revealed a 7.5 fold increased risk of death in stroke patients with increased sST2 plasma concentrations (risk ratio 7.57, 95% confidence interval 2.65–21.57;  $p < 0.001$ ). In multivariate analysis, sST2 remained an independent predictor of mortality (risk ratio 3.07, 95% confidence interval 1.02–9.20;  $p = 0.046$ ). With respect to the secondary outcome, median sST2 plasma concentrations were significantly higher in stroke patients with unfavorable vs. favorable outcome at 90 days (41 U/mL vs. 32 U/mL;  $p < 0.001$ ). After adjustment for NIHSS, CRP and NT-proBNP sST2 lost its predictive value for unfavorable outcome at 90 days (odds ratio 1.50, 95% confidence interval 0.90–2.51;  $p = 0.199$ ).

**Conclusion:** sST2 was an independent predictor of 90-day all-cause mortality but not of 90-day functional outcome. The biomarker sST2 added prognostic information to the NIHSS with respect to mortality at 90 days.

## ESOC-0952

### 11. Experimental/Translational Medicine

#### Bone structure and density were reduced in non-paretic but not in paretic hindlimbs in an animal model of stroke: A pilot investigation

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**Background and Aim:** In humans, inactivity after stroke is associated with accelerated bone loss. The aim of this study was to investigate skeletal effects of brain infarct, using a proven animal model.

**Hypothesis:** Post-stroke, skeletal parameters of left and right femurs would be compromised, but physical activity unaffected, to suggest a skeletal effect of brain infarct.

**Methods:** Spontaneously-hypertensive male rats, aged 15 weeks, randomized to stroke (right middle cerebral artery occlusion, n = 12) or sham surgery (n = 8). Impairment testing (stroke behaviors, ladder walk) and activity monitoring (proportion of time active) were undertaken prior to cull at four weeks. Trabecular and cortical parameters of distal regions of both femurs were determined by Micro-CT (10.5 µm resolution). Study was approved and managed according to Austin Health Animal Ethics Committee.

**Results:** Stroke animals displayed impaired left hindlimbs, but activity did not differ between groups. Non-parametric analyses showed no between-group differences in trabecular (primary outcome) or cortical parameters of left femurs. However, between-group differences were observed in right femurs: stroke animals had lower trabecular connective density (median 194.1 (IQR 182.9, 230.0) v 206.0 (195.9, 226.2), p = 0.03), cortical bone volume fraction (85.8% (83.6, 86.0) v 88.1 (86.4, 89.1) p = 0.02) and material density (951.8 mgHA/mm<sup>3</sup> (943.3, 958.1) v 973.4 (969.2, 981.7), p = 0.01). Stroke impairments were not associated with these parameters.

**Conclusion:** Stroke animals had compromised bone parameters of non-paretic legs, but not paretic legs compared to shams, despite no observed differences in activity or associations with impairments. Investigation of limb use and weightbearing symmetry using this model is warranted to better understand drivers of post-stroke bone loss.

## ESOC-1491

### 11. Experimental/Translational Medicine

#### Use of metabolomics and genomics to find biomarkers of TIA and to study mechanisms of ischemic conditioning on mice

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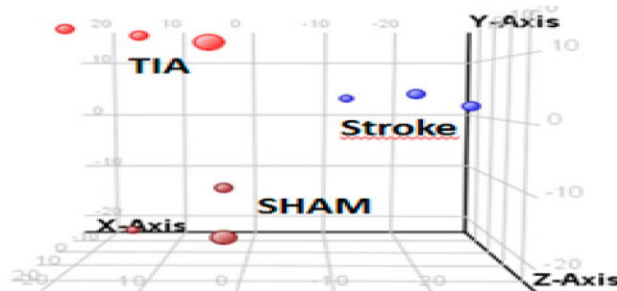
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**Introduction:** Clinical diagnosis of patients with transient ischemic attack (TIA) is a difficult endeavor and metabolomics on patient cohorts is often jeopardized due to intrinsic variability of sampling patients on the clinical setup. To circumvent this, we used a mice model to identify TIA biomarkers and we develop as well an ischemic conditioning (IC) system for molecular characterization of this phenomenon.

**Methods:** Mice were submitted to surgery only (SHAM), 7 minutes or 25 minutes occlusion (TIA and Stroke), and plasma was collected at 6, 12, 24 and 48 h after. For IC, mice got 5x2 min occlusion (not on SHAM), let recover 24 h and a 60 min occlusion (Stroke) was performed. Just before stroke (basal) and 0, 1, 3, 6, 12 and 24 h post Stroke ischemic cortical brain tissue and plasma were obtained for mRNA and metabolomics assay.

**Results:** Multivariate statistics allowed us to separate between different times on same treatment (except for SHAM) and SHAM vs TIA vs Stroke. Further, one way ANOVA after Benjamini-Hochberg correction identified 38 metabolites that separate SHAM-TIA-Stroke.

**Conclusion:** The use of mice model to identify metabolites for clinical diagnosis of TIA allows the use of very stringent statistics. This allows proposing candidate biomarkers to distinguish between TIA and Stroke, providing an excellent platform for biomarker development to be validated on human cohorts.



## ESOC-1095

### 11. Experimental/Translational Medicine

#### Distinct specificity patterns of anti-beta amyloid peptide antibodies in hemorrhagic and inflammatory cerebral amyloid angiopathy and Alzheimer's disease

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**Context:** Cerebral amyloid angiopathy is a frequent cause of microvascular stroke and lobar cerebral hemorrhage (CAA-h). CAA related inflammation (CAA-i) is a rare cause of subacute steroid responsive focal white matter edema with superficial hemorrhages. Deposits of aggregated  $\beta$ -amyloid peptide (A $\beta$ ) are found in the brain parenchyma and/or vessel walls of CAA-h, CAA-i and Alzheimer's disease (AD) patients. Natural anti-A $\beta$  antibodies are produced spontaneously by both healthy subjects and patients. We hypothesize that a specific immune reaction induced against fibrillar A $\beta$  deposits might play a key role in the pathophysiology of CAA-h and CAA-i.

**Objective:** To compare concentrations of serum anti-A $\beta$  antibodies and their specificity against polystyrene-coated monomeric, oligomeric and fibrillary forms of A $\beta$ , in a cohort of CAA-h, CAA-i, AD and age-matched healthy controls.

**Methods:** Purity of *in vitro* generated monomeric, oligomeric and fibrillar A $\beta$  was evaluated by cryoTEM. Using these antigenic preparations, indirect ELISAs were performed for measuring the serum levels of anti-A $\beta$  IgG and IgM specific for the corresponding conformers.

**Results:** Preliminary studies revealed that CAA-i is associated to lower levels of anti-A $\beta$  IgG than CAA-h, AD and healthy controls. CAA-i is also associated to higher ratios of anti-fibrillar A $\beta$  / anti-soluble (monomeric and oligomeric) A $\beta$  antibodies. This repertoire shift was observed in a lesser extent in CAA-h.

**Conclusion:** Results suggest a specific role of anti-A $\beta$  antibodies in CAA-i and CAA-h, along with the development of an immune response against fibrillar A $\beta$  deposits.

## ESOC-1577

### 11. Experimental/Translational Medicine

#### Cerebrolysin dose-dependently improves neurological outcome in male and female rats after acute stroke

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Cerebrolysin is a peptide preparation indicated for the use in stroke, traumatic brain lesions and dementias including Alzheimers disease. The current study was conducted with the aim to examine the dose response of Cerebrolysin on behavior and histology parameters in a clinical relevant treatment scheme. The present study was carried out as a prospective, randomized, double-blind, placebo-controlled study of Cerebrolysin in both male and female ischemic rats. Wistar rats (51 male and 51 female) were subjected to embolic middle cerebral artery occlusion (MCAO). Rats were randomized to treatment with Cerebrolysin or saline at 0.8, 2.5, 5.0,

and 7.5 ml/kg with treatment initiated at 4 h after MCAO and continued daily for 9 consecutive days. An array of behavioral tests to detect somatosensory functions was measured. All rats were sacrificed 28 days after MCAO and infarct volume was measured. There was a significant ( $p < 0.01$ ) dose effect of Cerebrolysin on neurological outcome versus saline in both genders 28 days after MCAO. Doses  $\geq 2.5$  ml/kg significantly ( $p < 0.01$ ) improved functional recovery starting 14 days post stroke. Cerebrolysin at doses of  $\geq 2.5$  ml/kg also significantly ( $p < 0.05$ ) reduced infarct volume. For the first time a preclinical Cerebrolysin study with a rigorous double-blind clinical trial design and analyses has been implemented under good laboratory practice (GLP) conditions. Thus, preclinical data performed under rigorous conditions of a clinical trial, strongly support the clinical translation of Cerebrolysin as a treatment for stroke.

## ESOC-0161

### 11. EXPERIMENTAL/TRANSLATIONAL MEDICINE

#### Assessment L-theanine neuroprotective efficiency using neurological and behavioural tests in different terms after focal cerebral ischemia in rats

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Among broad spectrum of neuroprotective drugs new natural origin neuroprotective factors start to draw investigator's attention. L-theanine (gamma-glutamylethylamide) is the green tea (*Camellia sinensis*) amino acid. Present study is aimed to evaluate L-theanine neuroprotective efficiency in experimental brain ischemic damage in rats on late terms (till 4 weeks) of postischemic period using several neurological and behavioral tests (Garcia Score Test, Modified Sticky-Tape Test, Tongue Protrusion Test, Open Field Test). Also we compare the sensitivity of noticed tests in different terms after ischemia to produce optimal postischemic impairment assessment criteria. L-Theanine was administered intraperitoneally 1 mg/kg 30 minutes before middle cerebral artery occlusion in Koidzumi model of focal transient cerebral ischemia. Tests were managed before and on the 2, 7, 14, 21, 28 days after the ischemia. According to Garcia Score Test significant difference in neurological deficiency between control and experimental groups was revealed only on the second day after ischemia. Modified Sticky-Tape Test shows significant somatosensory sensitivity diminution on the second week after ischemia. Significant tongue motion activity diminution was observed on the first, second and third weeks after MCA occlusion. Significant difference in behavioral disorders was fixed only since fourth week after ischemia. Thereby L-theanine introduction decrease an intensity of neurological deficiency and behavioral disorders in rats during the whole observed postischemic period. On early terms after ischemia it's more appropriate to use neurological tests for functional disorders evaluation, as well as behavioral tests are more sensible on late terms (3–5 weeks) after ischemia.

## ESOC-1379

### 11. Experimental/Translational Medicine

#### Systemically injected IGF-I is transported to the brain and exerts neuroprotective effects via central IGF-I receptors in a rat model for ischemic stroke

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The pleiotropic peptide insulin-like growth factor (IGF)-I is a neuroprotective agent in animal models of focal cerebral ischemia, but only a few studies demonstrated these effects following systemic IGF-I administration. It remains unknown whether systemic injection of IGF-I exerts its neuroprotective effects through interaction with IGF-I receptors in the brain after passage of the blood-brain barrier or more indirectly via peripheral effects.

To separate the central action component of IGF-I from its systemic component in stroke, conscious male Wistar Kyoto rats received IGF-I systemically and the IGF-I receptor antagonist JB-1 centrally in the lateral cerebral ventricle. Stroke was induced through injection of endothelin-1 in the right hemisphere next to the middle cerebral artery.

Intravenous administration of IGF-I reduced the infarct size with 50% and central administration of JB-1 reverted the neuroprotective effects of IGF-I. These results suggest that systemically injected IGF-I exerts neuroprotective effects via binding to IGF-I receptors in the brain. We also measured the transport to the brain of systemically administered recombinant human IGF-I after induction of ischemic stroke with an ELISA specifically detecting human IGF-I. Human IGF-I was detected in both hemispheres. Remarkably, induction of stroke induced transport of systemically injected IGF-I to the left hemisphere in which no opening of the blood-brain barrier could be detected, indicating that stroke stimulates IGF-I transport to the brain through a genuine transport mechanism across the blood-brain barrier. This evidence provides strong arguments for testing systemic IGF-I administration together with protocols enhancing transport of IGF-I to the brain.

## ESOC-1347

### 11. Experimental/Translational Medicine

#### Moderate forced exercise improves sensorimotor and cognitive function following stroke in mice

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**Introduction:** Stroke is one of the leading causes of death and the most common cause of adult disability in the western industrial countries. Whereas thrombolysis with tissue plasminogen activator (tPA) is an approved neuroprotective therapy, neurorestorative pharmacological interventions targeting post-acute treatment of stroke are still elusive. The aim of this study was to investigate neurorehabilitative effects of moderate forced exercise on functional recovery and on the generation and survival of neural cells following photothrombotic stroke in mice.

**Methods:** A total of twenty-four C57BL/6 mice were subjected to photothrombotic cortical ischemia, a subset of twelve animals underwent moderate forced training in motorized running wheels starting at day 3 following ischemia until the end of the experiment on day 28. Extensive sensorimotor and cognitive testing was applied to quantify the animals' deficit and recovery process. To birth-date newly generated neurons, the thymidine analogues 5-Chloro-2'-deoxyuridine (CldU) and iododeoxyuridine (IdU) were administered at days 1 and 2 (CldU) and twice weekly until day 28 (IdU) after ischemia.

**Results:** Forced rehabilitative training improved recovery from sensorimotor and cognitive deficits following cortical ischemia. Immunohisto-

chemical analysis revealed significantly increased generation and survival of newly born neurons in both the dentate gyrus and the subventricular zone.

**Conclusion:** Moderate forced exercise improved the recovery of sensorimotor and cognitive function following stroke and increased both the generation and survival of neural cells. Effectiveness even after delayed initiation 48 hours after onset of ischemia opens up promising possibilities for successful rehabilitation following stroke.

## ESOC-0110

### 11. Experimental/Translational Medicine

#### Spreading depolarization in patients with cardiac arrest

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**Background:** Spreading depolarization (SD) is characterized by massive ion translocation. Dependent on energy, SD is either preceded by non-spreading electrical silence (depression) due to neuronal hyperpolarization, or it causes spreading depression of electrical activity due to a depolarization block. Nonspreading depression seems to translate into the initial symptoms of ischemic stroke and spreading depression into migraine aura. SDs facilitate neuron death when they invade metabolically compromised tissue while they are innocuous in healthy tissue. SDs are abundant in patients with aneurysmal subarachnoid hemorrhage (aSAH) and malignant hemispheric stroke (MHS). The sequence of nonspreading depression followed by SD has however not been observed in patients.

**Methods:** In 2 aSAH patients, we performed subdural electrocorticography (ECoG) of SDs in order to detect delayed cerebral ischemia. Clinical and research consents were obtained according to our Institutional Review Board.

**Results:** In both cases, ECoG electrodes were in place when a medical decision of the treating intensivists was reached to withdraw life support. Cardiac failure induced acute cerebral hypoxia-ischemia. Spontaneous electrical activity was present at baseline and the series of events associated with death were similar: first, decline in cardiac output developed together with progressive depression of spontaneous activity. Then, complete depression of activity was documented to occur synchronously in a non-spreading manner across the array of the 6 electrodes, spanning 5 cm. Seventy-five respectively 222 seconds later, terminal SD started to run in the cortex with amplitudes of 4.7 respectively 9.2 mV.

**Conclusion:** Similar to animal experiments, cardiac arrest induces non-spreading depression followed by SD.

## ESOC-0393

### 11. Experimental/Translational Medicine

#### The role of Ghrelin in neuroregeneration following experimental stroke

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**Introduction:** The discovery that Ghrelin receptors are expressed in the CNS led to the view that ghrelin may affect higher brain functions, besides its regulatory impact on feeding and metabolism. Ghrelin exerts multifaceted actions in the CNS and possesses vital functions in neuroregeneration.

The aim of this study is to investigate effects and the underlying mechanisms of Ghrelin on functional and structural regeneration in the post-ischemic brain.

**Methods:** Male adult rats were given a photothrombotic infarct and divided into the following intervention groups:

- Photothrombosis and Ghrelin for 28 days (50 µg/kg, i.p.)
- Photothrombosis and NaCl for 28 days (i.p.)
- Photothrombosis and Ghrelin receptor antagonist D-Lys3-GHRP-6 (i.p.)

To birth-date newly generated neurons, the thymidine analogues Chloro-deoxyuridine (CldU) and Iodo-deoxyuridine (IdU) were administered at days 1–4 (CldU) and at days 25–27 (IdU) after ischemia. Functional recovery was assessed using the *adhesive tape removal test* and the *cylinder test*, cognitive function was measured via the *water maze test*.

To quantify neurogenesis in the dentate gyrus and the subventricular zone, immunohistochemical co-staining of CldU and NeuN was performed.

**Results:** Ghrelin treatment led to increased sensorimotor recovery after stroke, whereas blocking of the Ghrelin receptor interfered with the recovery. Concordantly, cognitive performance was improved within the Ghrelin-treated group.

Immunohistochemical analysis revealed an increased survival of newly born neurons in both the dentate gyrus and the subventricular zone.

**Conclusions:** The ameliorated functional recovery and its structural correlate, adult neurogenesis, strongly undermines the role of Ghrelin as a promising agent for the sub-acute treatment of ischemic stroke.

## ESOC-0898

### 11. Experimental/Translational Medicine Selective intra-arterial verapamil after reperfusion in experimental ischemic stroke is neuroprotective and improves motor function

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Large vessel ischemic stroke is a major cause of morbidity and mortality. Despite improving treatments and techniques to promote acute cerebrovascular recanalization, progress in clinical outcomes continues to lag. In this setting, we previously created and optimized a mouse model to study concurrent large vessel recanalization (1 hour transient middle cerebral artery occlusion) with intra-arterial drug administration. Using this model, we aimed to study verapamil, an FDA-approved calcium-channel blocker already administered to the brain for cerebral vasospasm. Verapamil or saline (n = 10) was given intra-arterially to the common carotid artery after reperfusion. We noted that mice treated with verapamil had significantly (p < 0.05) better functional recovery as assessed by the rotor rod. Mean stroke volumes were also significantly smaller as measured by TTC and cresyl violet stain. Verapamil treatment also resulted in significant reduction in apoptosis by TUNEL stain, and significantly more mature neurons were noted by NeuN stain. Finally, verapamil treatment resulted in reduced astrogliosis, as evaluated by GFAP staining. These results suggest that IA administration of verapamil immediately following experimental large vessel stroke represents a novel therapeutic approach that may be directly neuroprotective and improve functional recovery.

## ESOC-0870

### 11. Experimental/Translational Medicine Spreading depolarizations increase delayed brain injury in a rat model of subarachnoid hemorrhage

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Spreading depolarizations (SDs) may contribute to delayed cerebral ischemia after subarachnoid hemorrhage (SAH), but their effect on post-SAH lesion progression has not yet been assessed directly. In a rat SAH model, we measured brain tissue damage with MRI, before and two days after cortical KCl (SD group, n = 16) or NaCl application (no-SD group, n = 15) at day 1 post-SAH. Histology confirmed neuronal damage in areas of early and delayed injury. Lesion growth was significantly larger in the SD group (243 ± 233 mm<sup>3</sup>) than in the no-SD group (30 ± 55 mm<sup>3</sup>) (p = 0.001). Our study demonstrates that SDs advance delayed brain injury after SAH.

## ESOC-0524

### 11. Experimental/Translational Medicine Successive synaptic and membrane failure depend on depth and duration of hypoxia in an vitro model of the ischemic penumbra

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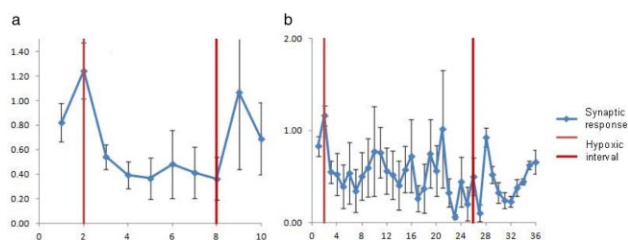
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There is limited understanding of the nature of dynamic neuronal processes leading to either secondary irreversible damage or recovery in the ischemic penumbra. We use cultured neuronal networks to study neuronal dynamics during partial hypoxia, focusing on changes of synaptic transmission and membrane integrity.

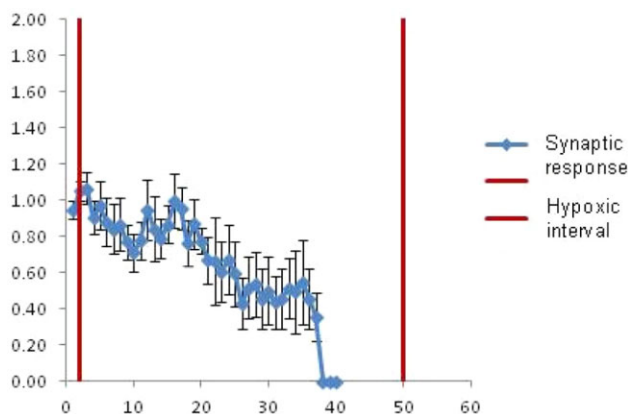
Twenty-two cultured networks of rat cortical neurons grown over multi electrode arrays were exposed to hypoxia of various depth and duration (pO<sub>2</sub> of 160 mmHg lowered to 90 or 30 mmHg, during 6–48 hours). Synaptic functioning was assessed before, during, and after hypoxia by the amount of spontaneous network activity and network responses to electrical stimulation. Action potential shapes and direct (non-synaptic) stimulus responses were used as measures of neuronal integrity.

During pO<sub>2</sub> = 30 mmHg, synaptic transmission failed within an hour. Isolated synaptic failure was reversible after 6–12 hours of hypoxia, but partly irreversible after 24 hours (Figure 1). Irreversible membrane failure occurred between 24 and 48 hours (Figure 2), but later with pO<sub>2</sub> = 90 mmHg.

The cascade of neuronal pathophysiological events in the ischemic penumbra includes reversible synaptic failure, irreversible synaptic failure, and membrane failure, respectively. The timescale of this cascade depends on remaining perfusion levels.



**Fig. 1** Reversible (a) and partly irreversible (b) decrease of synaptic stimulus response during hypoxia of 6 (a) and 24 (b) hours.



**Fig. 2** Irreversible decrease of non-synaptic stimulus response after hypoxia of 48 hours.

## ESOC-1226

### 11. Experimental/Translational Medicine

#### Magnetic resonance spectroscopy pattern-recognition techniques to metabolically differentiate brain regions in a rat stroke model: A biomarker discovery tool

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**Introduction:** Magnetic resonance spectroscopy (MRS) assesses the metabolic pattern of a brain region. SpectraClassifier is a pattern-recognition software that uses the metabolites that vary among different regions to objectively classify them in additional subjects. Our purpose was to determine those metabolites for normal-tissue, subventricular zones (SVZ) and infarct in a rat stroke model.

**Methods:** A total of 164 proton MR spectra were obtained at 7T at an echo time of 12 ms from Sprague-Dawley rats subjected to 90-minutes MCAO. MRS was acquired from normal-tissue (n = 48), SVZ (n = 82) and infarct (at 1 and 7 +/- 1 days post-MCAO; n = 34). Spectra were assigned to the training set (n = 108) to determine the discriminant features and to the independent test set (n = 56) to evaluate the classification robustness, using SpectraClassifier v3.0 (<http://gabrmn.uab.es/sc>). Statistical analysis of the individual metabolic changes among regions was performed with the Kruskal-Wallis test using SPSS.

**Results:** The training set showed that spectral features coherent with myoinositol (Myo, 3.62 ppm) and total creatine (TCr, 3.04 ppm) distinguished amongst normal-tissue (AUC: 0.90 ± 0.06), SVZ (AUC: 0.92 ± 0.04) and infarct (AUC: 1.00 ± 0.00), with a 83.5 ± 3.6% of cor-

rectly classified cases. The Balanced Error Rate in the independent test set was 7.2%. When the discriminative spectral features were analyzed individually, a diminished TCr allowed the differentiation of the infarct compared to the other brain regions (p < 0.01). Furthermore, Myo was increased in the SVZ and decreased in the infarct, in relation with the normal-tissue (p < 0.01).

**Conclusion:** SpectraClassifier robustly identifies different brain regions with good accuracy based on metabolite feature analysis.

## ESOC-0054

### 11. Experimental/Translational Medicine

#### p75 neurotrophin receptor and its novel interaction partner, NIX, are involved in neuronal apoptosis after intracerebral hemorrhage

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Recently, NIX, a pro-apoptotic BH3-only protein, was found a novel p75 neurotrophin receptor (p75NTR) binding protein by screening a human fetal brain two-hybrid library in our laboratory. Here, we further study the interaction of these two proteins and the possible roles for p75NTR and NIX in intracerebral hemorrhage (ICH)-induced neuronal death. Co-immunoprecipitation and *in vitro* binding assays demonstrated a direct interaction between p75NTR and NIX. Based on this interaction, NIX protein was stabilized by p75NTR at posttranslational levels. In addition, p75NTR could work together with NIX to promote apoptosis and affected NIX-induced JNK-p53-Bax pathway in neuronal PC12 cells. Previous work indicated that p75NTR and NIX are induced in neurons in human ICH and rat ICH model, respectively. In this study, we confirmed that both p75NTR and NIX levels were up-regulated in glutamate treated primary cortical neurons, a cellular *in vitro* model for ICH and in rat ICH model. Also, glutamate exposure increased the association between p75NTR and NIX and elevated the activation of JNK-p53-Bax pathway and neuronal apoptosis, all of these observations are similar in rat ICH model. Importantly, p75NTR and NIX appeared to be involved in cortical neuronal apoptosis because knockdown of p75NTR or NIX not only inhibited JNK pathway, but also impaired neuronal apoptosis. Our study suggests that p75NTR and NIX may play critical roles in ICH-induced neuronal apoptosis *in vitro* and *in vivo*.

## ESOC-0938

### 11. Experimental/Translational Medicine

#### Stem cell therapy in stroke – human dental pulp stem cells from basic science to a clinical trial

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Stroke is the leading cause of disability in many countries. The global burden of stroke is estimated at 33 million people who are chronically disabled post-stroke. There is no clinically proven drug or biological agent that will enhance neurological recovery as an adjunctive therapy with rehabilitation. We propose – TOOTH (The Open study Of dental pulp stem cells (DPSC) Therapy in Humans) Stroke Clinical Trial – to investigate the safety, feasibility and parameters of efficacy of autologous human adult stem cell therapy in participants with chronic stable disability. TOOTH will provide the first-in-human evidence of the potential of human DPSC as an active biological therapy. We will utilize autologous DPSCs, which are a neural-type of human adult stem cell. We first isolated human DPSCs from the dental pulp tissue of a human tooth in 2000.

DPSCs are clinically easy to access and have unique neurogenic potential due to their neural crest ontogeny. We have published a series of studies that demonstrated DPSCs differentiate into functional neurons, interact with the host nervous system inducing neural plasticity, and enhance neurological recovery following intracerebral injection into a rodent stroke brain. To date, we do not know which stem cell type will be best for neural regeneration or repair but one assumption is that neural stem cells or like cells will have a greater propensity for benefit. This presentation will demonstrate our path from basic stem cell and neuroscience discovery to translation into a future clinical trial.

## ESOC-1303

### 11. Experimental/Translational Medicine Development of long-circulating liposomes for thrombus imaging by CT

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**Introduction:** Liposomes represent advanced nanodelivery systems capable loading contrast CT agents as well as targeting of desired tissue (e.g. thrombus). Targeted CT liposomes represent novel approach for rapid thrombus imaging. The surface modification by polymer of these liposomes prolongs their biologic circulation. It also improves selective thrombus accumulation to enhance contrast over the surrounding tissue. **Aims:** The aim of this study was development of post-forming procedure for preparation of long-circulating liposomes.

**Methods:** Preformed liposomes prepared by freeze-thaw extrusion (100 nm) were modified by addition (5 mol %) of micellar lipid polymer (distearoyl phosphatidyl choline – polyethylene glycol 2000, DSPE-mPEG 2000). Preformed liposomes were composed of distearoyl phosphatidyl choline and cholesterol (molar ratio, 55/45). The size of micelles, preformed and long-circulating liposomes was monitored by dynamic light scattering. The formation of micelles was fluorimetrically detected.

**Results:** Formation of micelles was initiated from 8 µM of DSPE-mPEG 2000. Further, transfer of DSPE-mPEG2000 from micelles to preformed liposomes was completed during 30 min at 65°C. Corresponding to this phenomenon, the original liposome size increased from 94 nm to 107 nm. Micelles had size of 12 nm.

**Conclusions:** The post-forming was eligible for preparation of long-circulating liposomes. Using this procedure, only the external liposomal surface was modified. These liposomes will be further developed for loading of CT contrast agents as well as for thrombus imaging such as targeted long-circulating CT liposomes.

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## ESOC-0077

### 11. Experimental/Translational Medicine Activation of the HMGB1-RAGE signaling pathway in rats during neurogenesis after intracerebral hemorrhage

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**Background and Purpose:** Following intracerebral hemorrhage (ICH), high-mobility group box 1 protein (HMGB1) may promote neurogenesis that supports functional recovery. How HMGB1 regulates or participates in this process is unclear, as are the pattern recognition receptors and signaling pathways involved.

**Methods:** ICH was induced by injection of collagenase in Sprague-Dawley rats, which were treated 3 days later with saline, with the HMGB1 inhibitor ethyl pyruvate (EP) or with FPS-ZM1, an antagonist of the receptor for advanced glycation end-products (RAGE). A Sham group was treated with saline solution instead of collagenase and then treated 3 days later with saline again or with EP or FPS-ZM1. Expression of the following proteins was measured by Western blot, immunohistochemistry, or immunofluorescence: HMGB1, RAGE, toll-like receptor (TLR)-2, TLR4, brain-derived neurotrophic factor (BDNF) and matrix metalloproteinase-9 (MMP-9). Numbers of cells positive for 5-bromo-2-deoxyuridine (BrdU) or doublecortin (DCX) were determined by immunohistochemistry and immunofluorescence.

**Results:** Levels of HMGB1, RAGE, TLR4, TLR2, BDNF, and MMP-9 were significantly higher 14 days after ICH than at baseline, as were the numbers of BrdU- or DCX-positive cells. At the same time, HMGB1 moved from the nucleus into the cytoplasm. Administering EP significantly reduced all these ICH-induced increases, except the increase in TLR4 and TLR2. Administering FPS-ZM1 reduced the ICH-induced increases in the expression of BDNF and MMP-9, and in the numbers of BrdU- or DCX-positive cells.

**Conclusions:** These findings suggest that HMGB1 acts via the RAGE signaling pathway to promote neurogenesis in later phases of ICH.

## ESOC-0353

### 11. Experimental/Translational Medicine Matrix metalloproteinase-13 (MMP-13) modulates neuroprotection and neurorepair after cerebral cortical ischemia

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**Background and objective:** Neurorepair and neuroprotective therapies for stroke diseases can be modulated by some proteases of the extracellular matrix which participate in cell death and neurovascular remodeling. Our aim was to investigate the dual role of matrix metalloproteinase-13 (MMP-13), a central proteinase in the matrix metalloproteinase activation, in acute and subacute phases of stroke.

**Methods and results:** Transient focal cerebral ischemia was induced by distal middle cerebral artery occlusion (tdMCAo) in MMP-13 knockout (KO) and wild-type (WT) mice. tdMCAo led to significant smaller infarct size ( $p < 0.01$ ) acutely (24 hours after ischemia) and less neurological deficits in MMP-13 deficient mice, whereas extensive corrected tissue atrophy ( $p < 0.01$ ) was seen at 14 days post-ischemia. Immunohistochemistry at 14 d post-ischemia showed that ischemia induced neuroblasts migration from subventricular zone (SVZ) to peri-infarct areas, as expected. No difference was found in neuroblast density; however, less newborn proliferating neuroblasts were found in peri-infarct areas in MMP-13 KO mice ( $p < 0.01$ ). Regarding angiogenesis, peri-infarct cortical



vessel density was increased after ischemia in WT ( $p < 0.01$ ) but not in MMP-13 KO mice, whereas KO mice presented lower vessel density than WT ( $p < 0.05$ ), indicating an MMP-13-dependence for post-stroke angiogenesis. In agreement with these results, MMP-13 gene-silencing in endothelial progenitor cells (EPCs, key progenitor populations involved in endogenous post-stroke angio-vasculogenesis) resulted in deficient abilities to build vascular networks ( $p < 0.05$ ) in Matrigel®.

**Conclusion:** MMP-13 plays an important role in both infarct development and cortical neurorepair during the recovery phase being critical for optimal angio-neurogenic responses during stroke recovery.

## ESOC-0065

### 11. Experimental/Translational Medicine

#### Influence of mitochondrin (M2) on system disorders of glial homeostasis of sensorimotor cerebral cortex of rats under experimental acute hemorrhagic stroke

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**Background:** M2 is a complex of trophic regulatory oligopeptides with a molecular weight of 250–500 Da, polypeptides with a molecular weight up to 7000 Da, and the number of dominating amino acids.

**Methods:** The experiment was conducted with 3 groups of rats – “A” (control), “B” and “C” (with the simulated acute HS against the additional use of calcium gluconate within 10 days in a dose of 10 mg/kg). The rats of “C” group were injected M2 in a dose of 10 mg/kg every day. For the analysis of changes in the glial system were used a glial formula and glial quantitative index.

**Results:** Quantitative changes of cellular elements of the cerebral cortex of the experimental rats after modeling of primary acute HS and M2 application are given. The rats of group “C” were observed show the ratio of astrocytes to microgliaocytes – 0,693, oligodendrocytes to microgliaocytes-0,573, astrocytes to oligodendrocytes – 1,212. Positive changes were retraced also among ependymocytes and pyramidal neurons of 3 and 5 layers of the sensorimotor zone of the cerebral cortex.

**Conclusions:** On application of M2 one noted astrocyte restoration to the lower standard bound, index ratio restoration of the sum of astrocytes to microgliaocytes, an essential ratio decrease in the sum of oligodendrocytes to microgliaocytes and a ratio increase of the sum of astrocytes to oligodendrocytes. However, restoration among oligodendrocytes and microgliaocytes was not revealed.

## ESOC-0107

### 11. Experimental/Translational Medicine

#### Brain vascular pericytes acquire stemness following ischemic insult

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Brain vascular pericytes (PCs) are a key component of the blood–brain barrier (BBB)/neurovascular unit. Besides their crucial role in maintain-

ing the BBB, their multipotency has not been considered in the brain injury such as ischemic stroke. Here using the pericytes derived from the post-stroke mouse brain and the human brain pericytes cultured under oxygen glucose deprivation (OGD), we examined whether ischemia-stimulated PCs (iPC) acquire the stem cell activity and differentiate into neural and other lineage cells to reconstruct the neurovascular unit.

The iPCs were extracted from post-stroke CB-17 mice as described previously (Eur J Neurosci 2009;29:1842, Stem Cells Dev 2011;20:2037). Adhered iPCs were reincubated with floating cultures in neural-conditioned medium (NCM) (DMEM/F12, EGF, FGF-2, N2) or endothelial-conditioned medium (ECM) (DMEM, FGF-2, 10% FBS, N2). In another experiment, primary human brain PCs (hPCs; ACBRI-499, Cell Systems, Kirkland, WA) were incubated under OGD (1%O<sub>2</sub>/glucose-free) using a hypoxia-inducing system (Bionix, SUGIYAMA-GEN, Tokyo, Japan). Cell clusters formed were subjected to immunohistochemistry or reverse transcriptase-polymerase chain reaction (RT-PCR) analysis.

The iPCs revealed a complex phenotype of angioblasts, in addition to their original mesenchymal properties, and multi-differentiated into cells from both a neural and vascular lineage including endothelial cells. In addition iPCs cultured under NCM differentiated into functional microglia. These data indicate that under ischemic/hypoxic conditions, PCs can acquire multipotential stem cell activity and can differentiate into all components of the BBB/neurovascular unit. Thus, these findings support the novel concept that iPCs can contribute to CNS repair after stroke.

## ESOC-0370

### 11. Experimental/Translational Medicine

#### Antenatal inflammation attenuates blood-brain barrier disruption after stroke in young adult mice

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**Aim:** Maternal infection is associated with increased risk of preterm birth, lung diseases and neurologic disorders in the offspring. In this study, we aimed to elucidate the effects of antenatal maternal inflammation on stroke outcome in young, adult mice.

**Methods:** Pregnant mice were subjected to antenatal LPS i.p. injection on day E13 and the offspring underwent transient middle cerebral artery occlusion (tMCAO) at the age of 12-weeks. Several parameters including ischemic damage, edema formation, blood-brain barrier (BBB) impairment and behavior were measured 24 h or 72 h after stroke surgery.

**Results:** Antenatal LPS treatment significantly attenuated BBB disruption and subsequent edema formation 24 h after tMCAO and this was accompanied by an improved neurological status. Three days after tMCAO the BBB was still less permeable to Evans Blue and the infarcted brain area was significantly smaller in the offspring from LPS treated mice. Molecular analysis of the tight junction proteins occludin, claudin-3, claudin-5 and ZO-1 supported the findings of a tighter BBB after tMCAO in antenatal LPS-treated mice in comparison to controls.

**Conclusion:** Antenatal LPS treatment of pregnant mice ameliorates BBB damage and functional impairment after focal cerebral ischemia in the (adult) offspring.

## ESOC-0101

### 11. Experimental/Translational Medicine

#### The Quality in Acute Stroke Care (QASC) implementation project: State-wide evidence to practice translation

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**Introduction:** The Quality in Acute Stroke Care (QASC) Trial (Lancet 2011) proved supported implementation of clinical protocols to manage fever, hyperglycaemia and swallowing (FeSS protocols) following acute stroke decreased death and dependency by 16% ( $p = 0.002$ ); reduced temperatures ( $p = 0.001$ ); glucose ( $p = 0.02$ ); and improved swallowing management ( $p < 0.001$ ).

**Aim:** This project aimed to implement the QASC FeSS protocols in all 36 Stroke Services in New South Wales (NSW) Australia.

**Method:** All 36 NSW stroke services were eligible to participate. The project team mirrored the implementation strategy from the QASC trial that consisted of barrier identification, reinforcement of multidisciplinary teamwork, local adaptation and use of site champions. Evaluation was undertaken in collaboration with the National Stroke Foundation using their already established national audit data collection tool and processes.

**Primary outcome measures:** Proportion of patients that received care according to the FeSS clinical protocols pre to post-implementation.

**Results:** All 36 (100%) NSW stroke services agreed to participate. One hundred clinicians attended the one-day educational workshops. All ( $n = 36$ , 100%) sites participated in the medical record audit providing data for a total of 2144 patients (pre-implementation:  $n = 1062$ ; post-implementation:  $n = 1082$ ). Significantly increased proportions of patients received care according to the fever (pre: 69%; post: 78%;  $P = 0.0031$ ), hyperglycaemia (pre: 23%; post: 34%;  $P = 0.0085$ ), and swallowing (pre: 42%; post: 51%;  $P = 0.0331$ ) protocols post-implementation.

**Conclusion:** While there was further room for improvement in the proportion of patients receiving care according to these protocols, we demonstrated that scale-up and spread of proven interventions to achieve evidence based clinical practice is possible.

## ESOC-1487

### 11. Experimental/Translational Medicine

#### Cytokine expression in circulating monocytes during the acute phase of ischemic stroke

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**Background:** In cerebrovascular diseases complex interactions occur between the CNS and the peripheral immune system. Circulating mono-

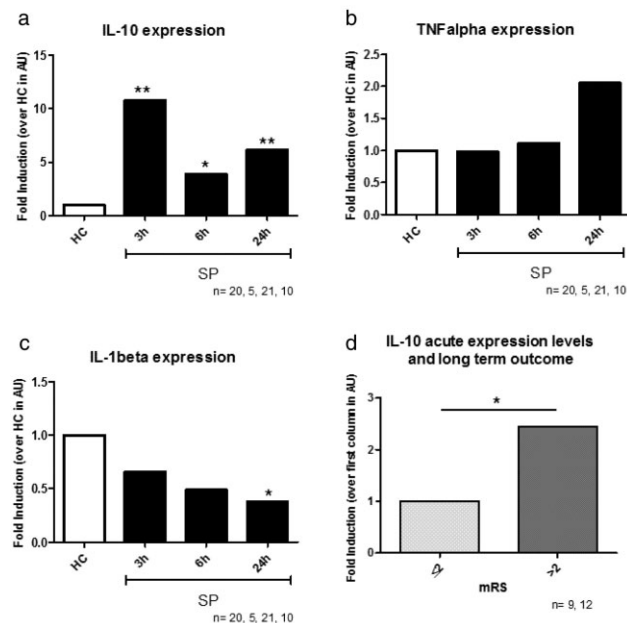
cytes rapidly increase in peripheral blood after stroke and their activity is related to the prognosis after stroke and the risk of infections.

**Aim:** We aimed to examine the cytokine expression profile of circulating monocytes in acute ischemic stroke and its correlation with the patient outcome.

**Methods:** We collected blood samples from 21 stroke patients (SP) at 3, 6 and 24 hours after symptom onset and from 20 healthy controls (HC). From each sample we measured the mRNA levels of IL-10, TNFalpha and IL-1beta expressed by circulating monocytes.

**Results:** Compared to HC, in SP the IL-10 expression significantly increased at 3 h after symptom onset ( $p < 0.01$ ) and high levels persisted at 6 h ( $p < 0.05$ ) and 24 h ( $p < 0.01$ ). IL-1beta was reduced ( $p < 0.05$ ) whereas TNFalpha was increased within the first 24 h after stroke, though last finding was not statistically significant. High levels of IL-10 expression during the acute phase were associated with poor outcome at 3 months ( $mRS > 2$ ), while association with infections after stroke was not significant.

**Conclusions:** Circulating monocytes modify their pattern of cytokine expression acutely after stroke, mainly resulting in increased IL-10 expression. High levels of IL-10 showed correlation with 3-month outcome, suggesting that peripheral immune activation during acute stroke might have possible clinical implications.



**Fig.** (a, b, c) IL-10, TNFalpha and IL-1beta gene expression in stroke patients and healthy controls. Data are expressed as Fold Induction (over healthy controls in arbitrary units). Statistics: Kruskal–Wallis test followed by Dunn's Multiple Comparison Test \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ . (d) IL-10 gene expression at 6 h from symptom onset in patients with good ( $mRS \leq 2$ ) and poor 3-month outcome ( $mRS > 2$ ). Data are expressed as Fold Induction (over first column in arbitrary units). Statistics: Unpaired  $t$  test. \* =  $p < 0.05$ . IL-10, interleukin-10; TNFalpha, Tumor Nerosis Factor alpha; IL-1beta, interleukin-1 beta; HC, healthy controls; SP, stroke patients; AU, arbitrary units; mRS, modified Rankin Scale.

## ESOC-1081

### 11. Experimental/Translational Medicine

#### Orphan receptor Nur77-Deficiency results in impaired microglial activation and worsens functional outcome following cerebral ischemia in mice

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**Introduction:** Cerebral ischemia results in a sterile inflammation accompanied by activation and recruitment of both resident and hematogenous immune cells. Nur77, also known as Nerve Growth Factor IB (NGFIB) is an intracellular transcription factor which regulates the inflammatory response in macrophages via the Nuclear Factor- $\kappa$ B. The aim of this study was to investigate a potential influence of Nur77 regarding the activation of resident microglia and recruitment of hematogenous immune cells following experimental stroke in mice.

**Methods:** Nur77-deficient ( $n = 13$ ) and wildtype mice ( $n = 12$ ) were subjected to transient middle cerebral ischemia (MCAO, 30 min). Animals underwent functional tests and were sacrificed 24 h and 72 h after reperfusion. Infarct volume, activation of micro- and astroglia, immigration of immune cells and cell death were analyzed via (immuno-)histological studies.

**Results:** Nur77-deficiency resulted in worsened functional outcome ( $p < 0.001$ ) and increased infarct volumes 72 h after ischemia/reperfusion ( $p < 0.01$ ) compared to the wildtype group. Nur77-deficient mice showed enlarged astroglial scar formation ( $p < 0.01$ ) and increased cell death within the ischemic lesion ( $p < 0.05$ ). Evaluation of resident and immigrating immune cells revealed attenuated microglial activation 24 h after MCAO. Seventy-two hours after MCAO a diminished number of microglia/macrophages ( $p < 0.05$ ) and neutrophil granulocytes ( $p < 0.001$ ) could be observed within the infarcted core.

**Conclusion:** Nur77-deficient mice developed enlarged infarcts and aggravated functional outcomes, accompanied with increased cell death. Surprisingly, Nur77-deficient mice showed impaired microglia activation and reduced influx of hematogenous immune cells. These results indicate a prominent influence of the receptor Nur77 in regulation and activation of the cellular immune response and development of subsequent brain injury.

## ESOC-0135

### 11. Experimental/Translational Medicine

#### Adrenomedullin provide protective effects against aging and ischemic white matter injury in mice brain

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**Background and Aims:** Adrenomedullin, a potent antioxidative peptide, was originally isolated from pheochromocytoma cells and reduces insulin resistance by decreasing oxidative stress. White matter damage induced by aging, hyperglycemia and oxidative stress play a crucial role in cognitive impairment in post-stroke patients. In this study, we assess whether adrenomedullin deficiency and aging exacerbate ischemic white matter injury after prolonged cerebral hypoperfusion.

**Methods:** All animal procedures were approved by the Animal Care Committee of Juntendo University. Adrenomedullin knockout heterozygous (AM+/-), wild-type young/aged mice underwent bilateral common carotid artery stenosis using microcoils. Measurement of physiological parameter, such as blood glucose, and immunohistochemistry for several neuronal and glial markers were analyzed until 28 days after hypoperfusion.

**Results:** After hypoperfusion, white matter damage progressed in a time-dependent manner in AM+/- group compared with the wild-type group. The number of oligodendrocyte progenitor cells gradually increased after hypoperfusion, whereas oligodendrocytes decreased following a transient increase, but the ratio of increase was mild in the AM+/- group ( $P < 0.05$ ). Oxidative stress was detected in oligodendrocytes, with a larger increase in the AM+/- group ( $P < 0.05$ ). Aged mice showed the same tendency, but white matter damage was worse, especially in the aged AM+/- group.

**Conclusions:** This study showed that adrenomedullin downregulation results in increase in oxidative stress after cerebral hypoperfusion in mice cerebral white matter. White matter injury was more exacerbated because of hyperglycemia in aged AM+/- group. The results indicated that adrenomedullin may be an important target in the control of ischemic white matter injury.

## ESOC-0444

### 11. Experimental/Translational Medicine

#### Secondary brain injury following intracerebral haemorrhage (ICH): The neurotoxic effects of haemoglobin and its degradation products on human neurons in vitro

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**Background:** ICH is a devastating clinical entity for which current management is limited. The role of secondary injury, which results in neurological deficit beyond the effects of acute extravasation of blood into the brain parenchyma, is being increasingly recognised. Orchestrated by inflammatory cascades, this noxious insult, resulting in oedema and neurotoxicity, contributes to a "perihaematoma penumbra" that may be amenable to therapeutic intervention. Several toxic stimuli have been implicated, including haemoglobin and its breakdown products.

**Aims:** To assess the degree of neurotoxicity of haemoglobin, hemin, bilirubin, biliverdin and iron on human neurons in vitro.

**Methods:** Differentiated human neural stem cells (hNSC) and differentiated SHSY-5Y human neuroblastoma cells were treated at several time points (2 h, 4 h, 6 h, 10 h) with varying concentrations (0–100  $\mu$ M) of haemoglobin, hemin, bilirubin, biliverdin and iron. Cell viability was determined through the activity of intracellular aminopeptidase and lactate dehydrogenase release was used to assess cytotoxicity.

**Results:** After 4 hours, viability of differentiated hNSC reduced with increasing concentrations of haemoglobin and hemin. Comparable, but more modest effects were seen with biliverdin and bilirubin. There was a significant increase in dead:live cell ratio with increasing concentration of haemoglobin and hemin in differentiated SHSY-5Y cells which was most pronounced with hemin. This neurotoxicity was maximal at 10 hours.

**Conclusion:** Focussed therapeutic approaches for limiting neurological sequelae following ICH are needed. Inhibition of secondary neurotoxic cascades may be beneficial, and could possibly be achieved through targeted manipulation of haemoglobin metabolism to limit neuronal exposure to noxious mediators; in particular haem.

## ESOC-0051

### 11. Experimental/Translational Medicine

#### Strong improvement of ApoE/LDL-R signals and amyloidogenesis by telmisartan in post-stroke SHR-SR

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**Objective:** Telmisartan, an angiotensin receptor blocker (ARB), is expected to reduce not only the level of blood pressure (BP) but also neuroinflammation and neurotoxicity, then we examined the effects of telmisartan on both cholesterol transport-related proteins (ApoE/LDL-R) and AD pathology in spontaneously hypertensive rat stroke-resistant (SHR-SR) after transient middle cerebral artery occlusion (tMCAO).

**Methods:** SHR-SR received tMCAO for 90 min at 12 weeks of age, and then were divided into 3 experiment groups including a vehicle, low-dose telmisartan (0.3 mg/kg/day), and high-dose telmisartan (3 mg/kg/day).

**Results:** Immunohistochemical analysis showed that ApoE expression of cortical neurons was strong in the vehicle group at 6, 12 and 18 months of age, and LDL-R expression of cortical neurons was transiently increased at 6 months of age only on the ipsilateral side. However, telmisartan dramatically suppressed the expression of ApoE/LDL-R at both doses. Meanwhile, the numbers of amyloid  $\beta$  (A $\beta$ )-positive neurons and senile plaque (SP) in the ipsilateral cerebral cortex progressively increased with age until 18 M in the SHR-SR after tMCAO. To our surprise, low-dose/high-dose telmisartan significantly reduced the number of A $\beta$ -positive neurons as well as SP at 6, 12, and 18 M.

**Conclusion:** These findings suggest that both low and high doses of telmisartan prevented the activation of ApoE/LDL-R in SHR-SR after tMCAO, reducing both intracellular A $\beta$  and extracellular SP accumulations after tMCAO in SHR-SR, with a further improvement by combined BP lowering.

## ESOC-0833

### 11. Experimental/Translational Medicine

#### Prehospital heart rate variability analysis in acute stroke patients: Correlation with stroke severity and short term outcome

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**Objective:** To evaluate prehospital heart rate variability (HRV) as a predictor of stroke severity and short term clinical outcome.

**Methods:** HRV was registered during ambulance transportation of acute ischemic stroke patients using a non-invasive, 2 lead ECG registration device. Assessment included time domain, frequency domain, nonlinear and time-frequency analysis.

**Results:** Patient characteristics are summarized in Table 1. Four patients were treated with IV rtPA and one patient was treated as part of a clinical trial comparing IV rtPA with placebo. Disease and outcome characteristics are summarized in Table 2. No correlation between HRV parameters and in hospital mortality could be demonstrated. Peak HF was found to correlate significantly ( $p = 0.037$ ) with the NIHSS score on admission. Parameters inversely associated with the NIHSS score at 24 hours included pVLF, aVLF and alpha2 ( $p = 0.037$ ). Peak HF was positively associated with the NIHSS score at 24 hours ( $p = 0.037$ ). Peak VLF was inversely associated with the mRS score at 90 days ( $p = 0.044$ ).

**Conclusion:** The results of this preliminary study indicate that prehospital HF and VLF are associated with stroke severity and outcome. Further study is needed to evaluate this effect in a larger population.

Table 1

	Study group (n = 5)
Male gender	3 (60%)
Age (years) (S.D.)	70.6 (18.6)
Arterial hypertension	3 (60%)
Diabetes mellitus	0 (0%)
Cardiac arrhythmia	2 (40%)
Coronary artery disease	1 (20%)
Antihypertensive treatment	3 (60%)
Anti-arrhythmic therapy	1 (20%)

Table 2

	Study group (n = 5)
<b>Disease characteristics</b>	
NIHSS admission (S.D.)	15 (4)
NIHSS 24 hours (S.D.)	15 (14)
<b>Outcome characteristics</b>	
Survival on discharge	4 (80%)
mRS 90 days (S.D.)	3 (3)

## ESOC-1133

### 11. Experimental/Translational Medicine

#### Effects of anti-LINGO-1 treatment on structural and functional regeneration after cortical stroke in mice

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Stroke is one of the leading causes of death and the most common cause of adult disability in the western industrial countries. Whereas thrombolysis with tissue plasminogen activator (tPA) is an approved neuroprotective therapy, neurorestorative pharmacological interventions targeting post-acute treatment of stroke are still elusive. Blocking the function of Nogo-66 transmembrane protein LINGO-1 has been demonstrated to enhance axonal sprouting and neuronal survival following various kinds of brain injury. So far the implications of these results for the structural and functional regeneration following stroke have not been investigated. In the present study thirty-eight C57BL/6 mice were subjected to a photothrombotic cortical ischemia and treated either with a LINGO-1 function-blocking protein (n = 20) or vehicle (n = 18) twice a week for forty-nine days. Extensive sensorimotor and cognitive testing was used to quantify the animals' deficit and recovery process. The impact of anti-LINGO-1 on structural regeneration was evaluated by poststroke neurogenesis in the dentate gyrus (DG) and the subventricular zone (SVZ). Anti-LINGO-1 treatment improved recovery from sensorimotor deficits whereas stroke did not have an effect on cognitive performance in this study. Animals treated with anti-LINGO-1 showed more newborn neurons in DG and SVZ than vehicle-treated or sham animals. Anti-LINGO-1 has proven a promising effect on the recovery of sensorimotor function following stroke. Effectiveness even after delayed application 24 hours after onset of ischemia opens up new possibilities in the treatment of chronic stroke.

# Epidemiology of Stroke

## ESOC-1375

### 12. Epidemiology of Stroke

#### Stroke in commercial flights: Beyond economy class stroke

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Stroke on board has been communicated in retrospective case series, mainly focused on economy class stroke. Data on the actual incidence, etiology and prognosis of stroke in commercial flights are lacking.

A prospective registry was designed to include all consecutive patients referred from an international airport (40 million passengers a year) to our hospital with a diagnosis of ischemic stroke or TIA and onset of symptoms during a flight or immediately after landing.

Forty-three patients, 30 ischemic strokes and 11 TIA, were included in a 76 months period (January 2008–April 2014). Estimated incidence of stroke was 1 stroke in 35000 flights. Etiologies of stroke or TIA were atherothrombotic in 16(37%), cardioembolic in 7(16%), economy class stroke syndrome in 7(16%), arterial dissection in 4(9%), lacunar stroke in 4(9%), and undetermined in 5(12%). Carotid stenosis >70% was found in 13(30%) patients. Although overall prognosis was good and thrombolysis applied in 44% of the cases, only 33% of patients with stroke onset during the flight arrived on time window for treatment. Only one patient prompted a flight diversion.

We found an elevated prevalence of high-grade carotid stenosis among patients with stroke linked to commercial flights, suggesting carotid disease might be a risk factor for stroke in this setting. Economy class stroke syndrome and arterial dissection were also registered as important stroke etiologies. Onset-to-door times need to be shortened. Implementation of stroke education programs for the aircrew, and flight diversion protocols are mandatory.

## ESOC-0451

### 12. Epidemiology of Stroke

#### Male and female strokes compared

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**Background:** Uncertainty remains about whether stroke affects men and women similarly. We studied differences between men and women in stroke severity and survival.

**Methods:** We used the Danish Stroke Register, which contains information on all hospital admissions for stroke in Denmark between 2003 and 2012 ( $N = 79\ 617$ ), and the Danish Registry of Causes of Death. Information was available on age, sex, civil status, stroke severity, stroke subtype, socioeconomic status and the cardiovascular risk profile. We studied only deaths due to the index stroke, on the assumption that death reported as due to stroke on a death certificate was due to the index stroke if death occurred within the first month after the stroke. Multivariate Cox regression analysis and multiple imputation for missing information were applied.

**Results:** Stroke was the cause of death for 5512 of the 79 617 patients (6.9%). After the age of 60 years, women had more severe strokes than men. Up to the mid-60s, no difference in the risk for death from stroke was seen between the two sexes. For people aged > 65 years, however, the risk gradually became greater in men than in women and significantly so

(>15%) from the mid-70s (adjusted for age, civil status, stroke severity, subtype, socioeconomic status and cardiovascular risk factors). Analysis of deaths within 1 week of the stroke gave similar results.

**Conclusions:** Stroke affects women and men differently. Elderly women were affected more severely than elderly men but survived stroke better.

## ESOC-1404

### 12. Epidemiology of Stroke

#### ESUS: A descriptive analysis in an Italian stroke registry

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Cryptogenic stroke accounts to 25% of ischemic stroke. Most of these strokes could be embolic, and for these has been proposed the definition of embolic stroke of undetermined source (ESUS).

**Objectives:** To evaluate the frequency of ESUS and to explore the potential association among ESUS and other clinical features.

**Methods:** This hospital-based study of a consecutive series of stroke patients from a stroke unit to evaluate the prevalence of ESUS according to the new proposed criteria was carried out.

**Results:** A total of 2,217 consecutive patients (1,280 males, 937 females) were included in this study. According TOAST classification 308 patients were classified as cryptogenic stroke (14%). According TOAST classification 308 patients were classified as cryptogenic stroke (14%). Using ESUS criteria, 183(8%) stroke patients met a clinical definition for ESUS. Out of these, 69 ESUS stroke patients were women (38%). The most frequent vascular risk factor was the hypertension (70%) followed by hyperlipidaemia (29%), smoking (16%) diabetes (9%), and obesity(7%). Six patients experienced a previous TIA.

Neuroimaging showed in 84% of ESUS patients an anterior stroke, in 13% a posterior stroke and in 3 % anterior and posterior stroke. According to NIHSS score, 41% of ESUS were minor stroke, 30% were moderate stroke and 14% were severe stroke.

**Conclusion:** An extensive application of new criteria for ESUS is an useful tool for the physicians for a correct diagnosis of these patients in order to improve their secondary prevention.

## ESOC-0365

### 12. Epidemiology of Stroke

#### Increased incidence of subarachnoid hemorrhage during cold temperatures and influenza epidemics

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**Background:** The incidence of aneurysmal subarachnoid hemorrhage (SAH) peaks in winter. We aimed to investigate if the increased incidence in winter can be explained by cold temperatures or an increased incidence of influenza.

**Methods:** We linked a nationwide sample of SAH patients registered between 1995–2010 with weekly temperature and with influenza-like illness consultation data. With Poisson regression analyses we calculated incidence density ratios (IDR) with corresponding 95% confidence intervals (CI) for the association between SAH incidence with temperature and influenza epidemics, and repeated these analyses after adjustment for study year (aIDR). We used time-window shift analysis to investigate if there was a delayed effect of influenza epidemics on SAH incidence. In addition, we linked SAH incidence data from European population-based studies with daily temperature data from the European Climate Assessment.

**Results:** A total of 18,714 SAH events were registered between 1995 and 2010 in the Netherlands. The aIDR for SAH during influenza epidemics was 1.061 (95%CI:1.022–1.101) in the univariable and 1.030 (95%CI:0.989–1.074) in the multivariable analysis. This association declined gradually in the weeks following epidemics. For each °C drop in mean weekly temperature, the IDR for SAH was 1.005 (95%CI:1.003–1.008) in the univariable and 1.004 (95%CI:1.002–1.007) in the multivariable analysis. In the European population-based studies the IDR of SAH was 1.098 (95%CI:1.083–1.111) for each °C temperature drop.

**Conclusion:** There is an increased incidence of SAH during cold temperatures and epidemic influenza. Future studies with individual patient data are needed to investigate possible causality between temperature, influenza, and SAH.

## ESOC-0916

### 12. Epidemiology of Stroke Incidence and attack rates of stroke and transient ischaemic attack in Auckland, New Zealand, in 2011–2012

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**Introduction:** There have been few recent population studies reporting the burden of acute cerebrovascular disease. We aimed to determine the incidence (first ever) and attack rates (incident and recurrent) of stroke and TIA in an ethnically diverse community.

**Methods:** The fourth Auckland Regional Community Stroke study (ARCOS IV) used multiple overlapping case ascertainment methods to identify all hospitalized and non-hospitalized stroke and TIA events that occurred in people ≥16 years of age usually resident in Auckland (population ≥16 years is 1.12 million), over the 12 months from 1st March 2011. **Results:** Two thousand eight hundred twenty-nine people [1464 (52%) women, mean (standard deviation) age of 71.6 (14.6) years] presented with stroke (2096 people), TIA (785) or both stroke and TIA (52). 91% of the stroke patients were admitted to hospital and 82% of the TIA patients were seen in a hospital setting (emergency department, outpatient clinic or admitted). By 28 days, 392 (13.9%) of the stroke and TIA patients had died. There were 40 incident TIAs, 116 strokes and 154 strokes and TIAs combined, per 100,000 people per year standardized to the WHO world population. The annual attack rate for TIA was 63, for stroke was 149, and for stroke and TIA combined was 212, per 100,000 people per year.

**Conclusions:** This study has described the burden of acute cerebrovascular disease in a developed country in an age of aggressive primary and secondary vascular risk factor management. These results may be used to inform evidence based planning of health care services.

## ESOC-0229

### 12. Epidemiology of Stroke Phenotype and mortality of renal replacement therapy recipients with acute stroke: A National Linkage Study

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**Background:** There is little data describing the epidemiology of stroke in renal replacement therapy (RRT) patients. We aimed to describe the phenotype and mortality outcomes of acute stroke in RRT patients.

**Methods:** Retrospective linked cohort study using data from the UK Renal Registry and SINAP (Stroke Improvement National Audit Programme; a national stroke quality register) of patients admitted with stroke to hospitals in England from April 2010–December 2012. Pseudonymised person-level data linkage was carried out. Mortality data was obtained from the national register of deaths in England.

**Results:** Of 84,330 patients with acute stroke admitted to 96 hospitals and reported to SINAP, 439 were RRT recipients: 292 (67%) haemodialysis, 41 (9%) peritoneal dialysis and 105 (24%) transplant. The proportion of stroke due to intracerebral haemorrhage (13% vs 11%) or undetermined stroke (3% vs 1%) was higher in RRT recipients ( $p < 0.0001$ ). RRT recipients were younger (median 69 vs 77 years;  $p < 0.0001$ ) and were more likely to have stroke whilst an inpatient (15% vs 5%;  $p < 0.0001$ ). In ischaemic stroke patients, the distribution of Oxford Community Stroke Project classification was similar between RRT and non-RRT patients. 30 day mortality was similar for RRT and non-RRT patients (16% vs 13%;  $p = 0.11$ ) but 90 day mortality was higher in RRT recipients (24% vs 19%;  $p = 0.017$ ).

**Conclusion:** The phenotype of stroke in RRT recipients reported to the national stroke quality register of England is broadly similar to other stroke patients but occurs at younger age and with worse medium term survival.

## ESOC-0658

### 12. Epidemiology of Stroke Validation of diagnosis of transient ischaemic attack in the Swedish Stroke Register (RIKSSTROKE) TIA-module

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**Introduction:** To the Swedish Stroke Register (Riksstroke; RS), a module for registration of transient ischaemic attacks (RS-TIA) was added in 2011. We report a diagnostic validation study of patients included in RS-TIA. **Methods:** During the 1st year 59 out of 74 Swedish hospitals adopted the TIA-module and included 7745 patients. A time-based TIA-definition (complete remission of symptoms <24 hours) was used.

For the validation study, a sample of 180 patients (30 patients each from 6 hospitals), with a similar distribution of age and sex as in the full RS-TIA, was prepared. Two independent observers assessed the original

medical records with respect to quality of documentation (completeness of reporting of clinical symptoms, signs and features) and final diagnosis (likely TIA, possible TIA, unlikely TIA, ischemic stroke) according to prespecified criteria.

**Results:** Out of the 180 patients assessed, the two observers agreed in 138 patients (77 %) that the event was a likely or possible TIA, in 5 patients (3%) that the event was an ischemic stroke, and in 3 patients (2%) that the event was unlikely to be due to TIA. Disagreement was present in 34 patients; in 15 patients (8%) on TIA vs ischemic stroke, and in 19 patients (11%) on TIA or ischemic stroke vs a non-vascular cause.

**Conclusion:** There was interobserver agreement on diagnosis of TIA in the majority of patients included in RS-TIA. Diagnostic precision may be further improved by more careful documentation of symptoms and signs in medical records, and use of a diagnostic manual.

## ESOC-1476

### 12. Epidemiology of Stroke Ischaemic preconditioning by recent TIAs and strokes in 2,730 consecutive stroke patients

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**Background:** Preconditioning improves acute ischaemic stroke (AIS) outcome in animals, and possibly in humans. The influence on AIS of preceding ischaemic events (PIE) such as TIAs and AIS occurring at different intervals, sites and for different durations can be studied in humans.

**Methods:** Using consecutive AIS from the ASTRAL registry we compared in univariate analyses patients who never had PIEs (controls) with those with recent PIEs at different time points (acute within 24 h; subacute 2 to 7 days before event), at various locations (PIE within or outside the territory of the subsequent AIS) and for different durations (PIE lasting <24 h vs. >24 h). Endpoints were admission NIHSS, difference between initial and 24 h-NIHSS ( $\Delta$ NIHSS), and 3-month modified Rankin score (mRS)  $\leq 2$ .

**Results:** There were 162 acute PIEs (TIA = 126), 83 subacute PIEs (TIA = 57) and 2'485 control patients. Admission NIHSS after subacute but not acute PIEs was lower than controls ( $p < 0.05$ ), which was due to subacute PIEs occurring in the same territory.  $\Delta$ NIHSS was higher in recent PIEs than in controls ( $p < 0.05$ ), but mRS at 3 months was not different. Recent TIAs lead to higher  $\Delta$ NIHSS than recent strokes, but neither influenced NIHSS nor mRS. Acute and subacute PIEs in the same territory had comparable  $\Delta$ NIHSS and mRS.

**Conclusions:** In patients with AIS, we found short term beneficial effects of PIE occurring 2–7 days before a stroke, in particular if occurring in the same territory and if they were of short duration. However, this did not result in a better 3-month outcome.

## ESOC-1046

### 12. Epidemiology of Stroke Ethnic differences in stroke outcomes in the state of Qatar

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**Objective:** To describe the Ethnic differences in Stroke Outcomes in the State of Qatar.

**Methods:** A one year prospective Stroke Registry search was performed and outcomes with regard to stroke subtype, severity, complications,

length of stay [LOS] and prognosis at 90 days were analyzed and reported based on ethnicity of the patient population.

**Results:** Of 894 strokes, 50.7% [454] were South East Asian [SEA], 18% [162] Qatari, 17.6% [158] Non Qatari Arabs [NQA], 9.8% [88] Far eastern [FE] and 2.6% [24] Caucasians. Out of 356 [39.8%] patients < 50 years old 65.9% were FE ( $p < 0.001$ ).

ICH's were highest in 31/88 [35.2%] FE compared to other groups (SEA [17%], Q [14.1%], NQA [12%] and 8.3% Caucasian). Small 158/247 [63.9%] and large 41/247 [16.5%] vessel strokes were commoner in SEA while cardio-embolic strokes 2/13[15.3%] in Caucasians. NIHSS  $\geq 11$  at presentation were seen in FE 20/72 [27.7%] compared to others (SEA [20.3%], Q [19.8%], NQA [16.4%] and Caucasian [15.7%]). Complications were highest in the Qatari 26/137[18.9%] and FE 11/76 [14.5%]. Qatari's 47/158 [29.7%] and FE 21/88[23.8%] had LOS  $\geq 10$  days. 90 day outcome [mRS 5–6] was worst in Qatari's 24/87[27.5%] versus FE 7/38 [18.4%], SEA 31/196 [15.8%], NQA 11/79 [13.9%] and 1/11 9% in Caucasians ( $p < 0.001$ ).

**Conclusions:** The FE's were younger, suffered more intracranial hemorrhages, had longer LOS, more severe strokes and complication rates while Qatari's were older, suffered ischemic strokes with highest LOS secondary to complications and poor outcomes. Caucasians were >50 years with highest cardio-embolic strokes, best outcomes and shortest LOS.

## ESOC-0496

### 12. Epidemiology of Stroke Population-based incidence study of transient ischemic attacks according to the tissue-based definition

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**Introduction:** As information about the incidence of transient ischemic attack (TIA), according to the tissue-based definition, is scarce we aimed to ascertain its epidemiology and the proportional change attributable to the shift from the time-based to the tissue-based definition.

**Materials and methods:** Incident TIA cases were ascertained in a prospective population-based registry including patients residing in the L'Aquila district, in a two-year period (2011–2012).

**Results:** Out of 804 screened patients, we found 151 TIA incident cases according to the tissue-based definition and 30 patients with transient symptoms and inadequate or not performed brain investigations (acute neurovascular syndromes [ANS]). Twenty nine further patients with transient symptoms and with an acute infarction at brain neuroimaging would have been diagnosed as TIA according to the time-based definition. The crude annual incidence rate in the 151 TIA patients was 25.3/100,000 (95% CI 21.5–29.6); the rate, standardized to the 2011 Italian population, was 23.6/100,000 (95% CI 19.1–26.5) and standardized to the European 2011 population was 20.0/100,000 (95% CI 19.9–27.7). Considering the 30 patients with ANS, the crude annual incidence rate increased up to 30.3/100,000 (95% CI 26.1–35.0). If we had included the 29 patients complying with the time-based definition, the crude annual incidence rate would have been 35.2/100,000 providing a +16.2% variation in TIA incidence.

**Conclusion:** We found a low TIA incidence, only in part attributable to the change in definition, but mostly attributable to improvement in preventive strategies. The case-ascertainment based upon the tissue-based definition sounds poorly compatible with the population-based study design.

## ESOC-0503

## 12. Epidemiology of Stroke

## Timing and mode of hospital admission for acute ischemic stroke in the L'Aquila district

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**Introduction:** The aim of the present study was to analyze the timing and mode of admission of patients with a first-ever ischemic stroke (FE-IS) in the L'Aquila district.

**Material and methods:** All patients with a FE-IS residing in the L'Aquila district were included in a population-based registry from January 2011 until December 2012.

**Results:** We identified 634 patients with FE-IS; 624 (49.8% male; mean age  $\pm$  SD 75.5  $\pm$  12.9 years) were hospitalized. Considering the time interval between symptom onset and hospital arrival (SO-HA), 207 (33.2%) patients arrived within 3 hours and 255 (40.9%) within 4.5 hours from stroke onset. The median time interval from hospital arrival to ward admission (HA-WA) was 100 minutes (Interquartile Range [IQR] 65–180). We found a correlation of SO-HA and HA-WA with the National Institutes of Health Stroke Scale (NIHSS) score on admission ( $r = -0.254$ ;  $P < 0.001$  and  $r = -0.177$ ;  $P < 0.001$ , respectively). Twenty-six patients (4.1%) underwent revascularization procedures (20 intravenous thrombolyses and 6 endovascular treatments). The median time from Emergency Room (ER) arrival to initiation of rt-PA (“door-to-needle” time) was 62.5 minutes (IQR 45–82.5). Three hundred and twenty patients arrived at the ER by 118 ambulance (51.3%), 296 (47.4%) by private transportation, and 8 (1.3%) were already hospitalized at stroke onset.

**Conclusion:** The proportion of patients with acute stroke arriving early at hospital is fair but still need to be implemented by fostering public awareness and recognition of stroke symptoms. Acute stroke services need to be improved in the district.

## ESOC-0811

## 12. Epidemiology of Stroke

## Study presenting the epidemiology of stroke in 50 consecutive stroke patients visiting a private neurology clinic in South India

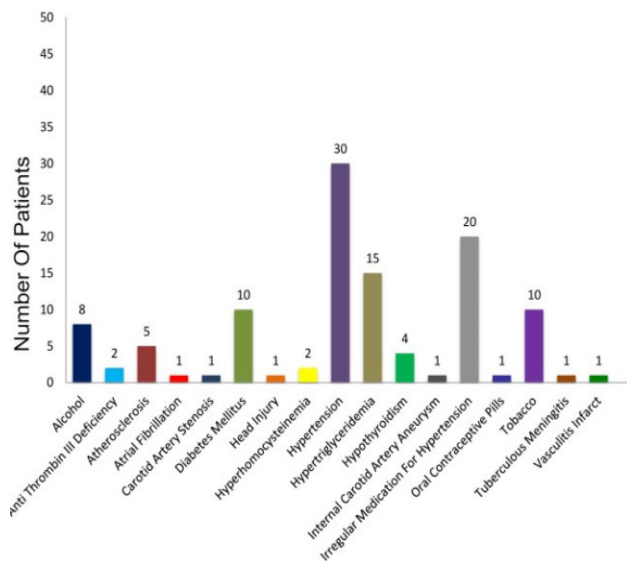
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**Aim:** To study the epidemiology of stroke in stroke patients.

**Methods:** A cross sectional study was carried out in 50 consecutive stroke patients visiting a private neurology clinic in South India. Stroke was confirmed by Magnetic Resonance Imaging (MRI). All patients were asked to fill a pre-tested questionnaire that contained questions on Socio-demographics, Dietary Habits, History of Previous Illnesses, Blood Investigations and Imaging. Subjects were made to sign a written informed consent as approved by the Institutional Review Board.

**Results:** Out of 50 patients, 30 {60%} were males (45 years = 25) and 20 {40%} were females (45 years = 19). 43 (86%) patients suffered from Ischemic Stroke and 7 (14%) from Hemorrhagic Stroke. 3 (6%) patients had Transient Ischemic Attack preceding Stroke and 4 Patients (8%) presented with recurrence of Stroke. Hyperhomocysteinemia, Antithrombin III deficiency, Vasculitis and Oral Contraceptive Pills were causes of Stroke in patients < 45 years. Different causes of Stroke were elicited. Many patients had overlapping causes.



**Conclusions:** Forty-four (88%) patients are aged > 45 years confirming risk of Stroke with increasing age. Hypertension (60%), Hypertriglyceridemia (30%), Diabetes Mellitus (20%), Tobacco (20%) and Alcohol (16%) remain the main causes of Stroke. Non-Compliance to drugs for Hypertension is the cause for occurrence of Stroke in 20 (40%) patients and is an easy to rectify cause.

## ESOC-0837

## 12. Epidemiology of Stroke

## Changes in incidence of ischaemic stroke subtypes in urban Northern Portugal 1998 to 2011: Data from two population-based studies

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**Background:** In the last decade, many preventive strategies and stroke treatments in acute phase have been implemented. The global incidence of stroke and stroke mortality has declined. In this study, we evaluate the trend in incidence of ischemic stroke subtypes eleven years apart.

**Methods:** Data from two prospective population-based studies (1998–2000 and 2009–2011) were used to estimate changes in ischemic stroke incidence. All suspected first-ever-in-a-lifetime ischemic stroke were entered into a stroke registry. Standard definitions and comprehensive sources of information were used to ascertain all stroke events. The Oxfordshire classification was used to define ischemic stroke subtypes. Patients were observed at onset and at three months.

**Results:** Between 1998 and 2011 the incidence of ischemic stroke decreased from 2.02 (95% CI, 1.81–2.24) to 1.61 (95% CI, 1.48–1.73). TACI incidence declined from 0.44 (95% CI, 0.34–0.55) to 0.29 (95% CI, 0.24–0.35) and LACI incidence from 0.79 (95% CI, 0.66–0.92) to 0.43 (95% CI, 0.36–0.49); PACI incidence increased from 0.40 (95% CI 0.31–0.51) to 0.49 (95% CI 0.42–0.56); POCI incidence remained stable changing from 0.40 (95% CI 0.31–0.50) to 0.39 (95% CI 0.33–0.46). Age-specific incidence for TACI and LACI reveals an important decrement in patients older than 65 and PACI increased in the oldest (>85).

**Discussion:** There is a trend to less severe strokes, with a decrement in TACI and an increment in PACI in the oldest patients. LACI significantly



decreased in the past decade probably related to preventive strategies, mainly blood pressure control. These trends may justify the decline in stroke mortality.

## ESOC-0850

### 12. Epidemiology of Stroke

#### Etiological variability after recurrent stroke

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**Objective:** To analyze the etiology of recurrent ischemic stroke and to investigate in which cases a different cause was detected in the second event.

**Methods:** Observational study of patients with ischemic stroke (2010–2014). Variables: Baseline/clinical data, prior cerebral infarction (CI) or transient ischemic attack (TIA). Etiologies of current and previous stroke/TIA and their concordance were recorded.

**Results:** A total of 1197 patients were included, 57.1% were male, mean age 70.5 years. 18.5% (222) had a prior ischemic stroke (CI 58.1%, TIA 34.2% and TIA+CI 7.7%). The cause of the previous stroke was: undetermined / unreported (53.2%), cardioembolic (17.1%), lacunar (13.3%), atherothrombotic (9.2%) and unusual (3.2%). The concordance between past and present etiology was analyzed, being the most consistent cardioembolic (94.7%), followed by atherothrombotic (74.1%) and unusual (62.5%), with low agreement in the lacunar (30%) and undetermined (39.8%) ( $P < 0.0001$ ). The most frequent cause of recurrence in lacunar and undetermined / unreported stroke was the cardioembolic cause (37.5% and 40%, respectively). In 39.8% of prior strokes of undetermined etiology, a current cause was not identified. The mean time to recurrence was higher in those who changed etiology respect to those who maintained the previous (73.1 vs. 46.3 months,  $P = 0.003$ ).

**Conclusion:** The etiologic subtype that most frequently recurs with the same etiology is the cardioembolic stroke. Current cardioembolic cause is more frequent in patients with prior lacunar or undetermined/unreported strokes. In up to one third of patients with stroke of undetermined / unreported cause, no etiology is found after recurrence.

## ESOC-0243

### 12. Epidemiology of Stroke

#### Risk factors for stroke – a study in a tertiary care hospital of South India

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Diseases of the cerebral blood vessels are the second most common cause of death worldwide after ischemic heart disease. They are leading cause of adult disability in united states and Europe becoming more frequent with increasing age. The incidence of stroke increases exponentially from 30 yrs of age and etiology varies with age. Advanced age is one of the most significant risk factor.

These diseases cause ischemia, infarction and intracranial hemorrhage. Ischemia and infarction constitute 85 to 90 percent of the total cases in western countries while 10 to 15 percent are intracranial hemorrhages. Incidence of infarctions is more than hemorrhage.

**Aim of the study:** To evaluate the risk factors of stroke in our hospital.

**Material and methods:** One hundred cases of stroke according to WHO definition admitted into medical wards in Narayana Medical College and Hospital, Nellore, during a period of 1 year from July 2012 to June 2013.

Appropriate history was taken regarding symptoms and the risk factors. Meanwhile all the patients were appropriately managed.

**Result:** The male to female ratio in the present study is 70 is to 30. The average age was between 25 and 86 years. Hypertension is the most common risk factor seen in 82 percent cases. Diabetes is present in 40 percent of cases. Smoking history is present in 56 percent. Alcoholism is present in 30 percent. Dyslipidemias are present in 24 percent; h/o TIA in 12 percent.

**Conclusion:** Hypertension is the most common risk factor for stroke followed by diabetes and smoking.

## ESOC-1340

### 12. Epidemiology of Stroke

#### Siesta-strokes: Clinical characteristics and outcome of ischemic strokes occurring during day-sleep

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**Objectives:** Circadian and sleep-related cardiovascular changes may play a role in stroke pathogenesis. Several studies have examined acute ischemic strokes (AIS) occurring during night-sleep, but none has addressed the question of strokes occurring during day sleep (DS) (“siesta-strokes”).

**Methods:** We used the Acute STroke Registry and Analysis of Lausanne (ASTRAL) which records consecutive AIS admitted to a single stroke center within 24 hours after last proof of good health. Demographics, risk factors, laboratory variables, stroke pathophysiology, clinical and radiological findings and 3 and 12 months outcomes were compared in a multivariate approach between patients with known stroke onset while awake (KO) and DS.

**Results:** DS occurred in 50 of 2'471 consecutive AIS (2.0%). There were no significant differences in demographic or clinical characteristics. Fewer DS patients were treated with intravenous thrombolysis or endovascular treatment (12.0% vs 28.7%, multivariate odds ratio 0.12, 95% confidence intervals 0.02–0.88), mainly due to late arrival at the hospital ( $4.9 \pm 6.4$  hours vs  $2.2 \pm 3.40$ , OR 1.06, 95%CI 1.01–1.11). Patients with DS had more strokes of undetermined localization, mostly lacunar type (21.7% vs 13.8%, OR 2.88, 95%CI 1.25–6.61). Discharge NIHSS and modified Rankin Scale scores at 3 and 12 months were similar in adjusted analyses. **Conclusion:** Day-sleep strokes (“siesta strokes”) occur in about 2% of all ischemic strokes. They are similar to wake-onset stroke except for the lower rate of recanalisation treatment, explained by the admission delay. Exploiting treatment windows up to 6 hours and using advanced imaging may increase acute treatment rates.

## ESOC-0270

### 12. Epidemiology of Stroke

#### Autumn weather is associated with increase in cerebrovascular disease mortality in the subsequent winter

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A number of studies have considered the relationship between winter weather and the rate of stroke deaths, but findings have been inconsistent. Ireland has a temperate oceanic climate influenced by the North Atlantic current that means that it infrequently experiences extremes of winter

weather. In the last decade it has however experienced a number of extreme winters. We performed a study to determine how weather patterns influenced mortality.

**Methods:** Seasonal data for Sunshine (% of seasonal average), Rainfall (% of seasonal average) and Temperature (degrees Centigrade above seasonal average) were collected for Autumn (September–November) and Winter (December–February) using official Irish Meteorological Office (Met Eireann) data since 2002. Data was used from the meteorological station closest to the main population centre (Casement Aerodrome, Dublin). National cerebrovascular mortality data was obtained from Central Statistics Office's Quarterly Vital Statistics. Excess winter deaths were calculated by subtracting (nadir) 3rd quarter mortality (July–September) from subsequent first quarter (January–March) 30-day mortality data. Local data reports a median onset to death duration for stroke of 20 days.

**Results:** Data for 12 years were analysed. Mean winter mortality excess was 25.1% (SD 8.4). Rainfall (123.9%), temperature (+0.57 C), and sunshine (104.3%) all exceeded long term averages. Excess winter mortality did not correlate significantly with winter weather (Rainfall:  $r = 0.21$   $p = 0.5$ , Temperature:  $r = 0.21$ ,  $p = 0.5$ , Sunshine,  $r = 0.14$ ,  $p = 0.6$ ). Winter mortality excess however correlated strongly with the weather in the preceding autumn (Rainfall:  $r = 0.13$   $p = 0.7$ , Temperature:  $r = -0.61$ ,  $p = 0.03$ , Sunshine,  $r = 0.58$ ,  $p = 0.04$ ).

**Conclusion:** Winter cerebrovascular disease mortality appears lower following warm, cloudy autumns.

## ESOC-0257

### 12. Epidemiology of Stroke Association of migraine with ischemic stroke – multicentre registry study

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**Introduction:** Migraine with aura is an established risk factor of ischemic stroke. However, clinical features of ischemic stroke related with migraine are not clarified.

**Purpose:** We verify the clinical features of ischemic stroke in patients with migraine.

**Method:** One thousand six consecutive patients with acute ischemic stroke admitted to the 7 hospitals during Apr. 1, 2012 and Mar. 31, 2013 are registered. Clinical characteristics, subtype of ischemic stroke based on the TOAST, radiological findings and history of migraine diagnosed through the International Classification of Headache Disorders; 2nd Edition are registered.

**Results:** Among 1006 patients with acute ischemic stroke, 20 patients had migraine headache (2%). Migraine group was younger than non-migraine group ( $64.4 \pm 16.5$  and  $74.6 \pm 12.0$  years respectively). There were no significant differences between both group about the prevalence of hypertension, ischemic heart disease, atrial fibrillation, dyslipidemia, diabetes mellitus, past history of stroke and smoking and alcohol drinking habit. The prevalence of obesity was higher in migraine group. There were no significant differences between both group about subtype of ischemic stroke, stroke lesion, and prevalence of old infarction and microbleeds. Stenosis in vertebrobasilar artery was more frequent in non-migraine group. Patent Foramen Ovale (PFO) was more frequent in migraine group. Clinical severity of stroke on onset was milder in migraine group.

**Conclusion:** Patients with migraine were younger and had milder symptoms of stroke. No differences regarding subtype of ischemic stroke and stroke lesion were observed.

## ESOC-1495

### 12. Epidemiology of Stroke Procalcitonin and midregional pro-atrial natriuretic peptide as markers of silent brain infarcts: The Northern Manhattan Study

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**Background:** Chronic infections and hemodynamic dysfunction may be risk factors for silent brain infarcts (SBI). We hypothesized that selected blood biomarkers of infection (procalcitonin, or PCT), and hemodynamic stress (midregional pro-atrial natriuretic peptide, or MRproANP) would be associated with SBI in the multiethnic, urban Northern Manhattan Study (NOMAS) cohort.

**Methods:** The NOMAS cohort was designed to assess risk factors for incident vascular disease, and a subsample underwent brain MRI ( $n = 1178$ ). Our primary endpoint, SBI ( $n = 172$ ) was defined as a cavitation on the fluid-attenuated inversion recovery sequence of at least 3 mm and distinct from a vessel due to the lack of signal void on T2 sequence, and of equal intensity to cerebrospinal fluid. Biomarkers were measured in a blinded batch analysis. We calculated odds ratios and 95% confidence intervals (OR, 95% CI) using logistic regression models to estimate the association of PCT and MRproANP levels with silent brain infarcts after adjusting for demographic, behavioral, and medical risk factors.

**Results:** Mean age was 70 ( $\pm 9$ ) years; 60% were female. After adjusting for confounders, those with PCT in the top quartile, compared to the lowest quartile, were at increased risk of SBI (adjusted OR 2.2, 95% CI 1.3–3.7). Those with MRproANP levels in the top quartile, compared to the lowest quartile, were also at increased risk of SBI (adjusted OR 3.1, 95% CI 1.7–5.9).

**Conclusion:** Higher levels of procalcitonin, a marker of infection, and MRproANP, a marker for hemodynamic stress, were independently associated with silent brain infarcts in this multiethnic, urban cohort.

## ESOC-0248

## 12. Epidemiology of Stroke

## Understanding in-hospital stroke management and outcomes in the Australian Stroke Clinical Registry (AUSCR)

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**Background and Purpose:** The quality of care for people who experience stroke whilst in hospital for another condition has not been previously studied in Australia. Our aim was to compare patient characteristics, quality of care indicators, and outcomes for in-hospital strokes with those for community-onset strokes.

**Methods:** We used data from the Australia Clinical Stroke Registry (AuSCR) obtained from January 2010 to December 2013 (40 hospitals). Outcomes were compared using multilevel regression models and linked to the National Death Index. Utility scores were derived from the EQ-5D health-related quality-of-life (HRQoL) questionnaire assessed in eligible survivors at 90–180 days.

**Results:** Among 13,860 registrants, 817 (6%) had the onset of symptoms whilst in hospital. Patients with an in-hospital stroke were more likely to be female (51% vs. 46%) and older (median age 78 vs. 76 years,  $p = 0.015$ ) compared to community-onset cases. Fewer patients with an in-hospital stroke received stroke unit care (61% vs. 79%;  $p < 0.001$ ). After accounting for patient and hospital characteristics, patients with in-hospital strokes were less likely to be discharged home (adjusted OR 0.31, 95% CI 0.25–0.39) and more likely to die within 180 days from onset (aOR 2.02, 95% CI 1.69–2.43) or report worse HRQoL (mean difference utility score  $-0.11$ , 95% CI  $-0.16$  to  $-0.06$ ) compared with community-onset strokes.

**Conclusions:** Compared to community-onset strokes, patients with an in-hospital stroke receive less stroke unit care and experience worse outcomes. These findings suggest an important opportunity for focused strategies to improve outcomes for patients who experience a stroke whilst in hospital.

## ESOC-0437

## 12. Epidemiology of Stroke

## High carotid intima-media thickness is a predictor for incident stroke and ischemic heart disease in Japanese urban cohort: The Suita study

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**Introduction:** Carotid intima-media thickness (IMT) has been increasingly a subclinical marker for the risks of stroke and ischemic heart disease (IHD). However, few studies have examined the associations between IMT and stroke and IHD in Asia.

**Methods:** We studied 5,331 Japanese individuals (mean age 55.3 years) at the baseline survey. Mean-IMT was defined as the mean of the proximal/distal IMTs for both common carotid arteries (CCAs) at 10 mm proximal points to the beginning of the bulb dilations. Adjusted hazard ratios (HRs) of stroke and IHD were calculated by the Cox proportional hazards model.

**Results:** During 8.7-year of follow-up in average, 185 strokes and 125 IHD events occurred. The adjusted HRs (95% confidence intervals, CIs) in the fourth quartile ( $\geq 0.95$  mm) of Mean-IMT for strokes and IHD were 2.5 (1.1–5.5) and 2.9 (1.0–8.7), respectively, compared with the first quartile ( $< 0.75$  mm). The highest quartile of Maximum-IMT of all areas ( $\geq 1.7$  mm) and CCA ( $\geq 1.15$  mm) had 1.9 and 1.7 times increased risk of stroke, and 2.3 and 2.4 times increased risk of IHD, compared with the lowest quartiles of all areas ( $< 1.0$  mm) and CCA ( $< 0.9$  mm), respectively. The adjusted HRs (95% CIs) for stroke and IHD were 1.3 (1.0–1.7) and 1.6 (1.3–2.0) with 0.1 mm increases in Maximum-IMT of CCA, respectively. The HRs (95% CIs) in subjects with plaques (Maximum-IMT  $\geq 1.4$  mm) of CCA and areas were 1.6 (1.1–2.2) and 1.4 (1.0–2.0) for strokes, and were 2.6 (1.7–3.8) and 2.6 (1.5–4.3) for IHD, respectively.

**Conclusion:** Carotid IMT, especially Maximum-CCA is strong predictors of stroke and IHD in Asians.

## ESOC-0116

## 12. Epidemiology of Stroke

## Vascular parkinsonism and episodes of stroke: The Japanese multi-center study of vascular dementia

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**Background:** In the post-stroke state, vascular dementia (VaD) and vascular parkinsonism (VaP) are well-known as deteriorating conditions of activities and qualities of daily life. We previously reported the clinical features of VaP in patients with VaD. In this study, we investigated the relationship between VaP and episodes of stroke.

**Methods:** We used retrospective database of VaD which included patients visiting from 2000 to 2005 in 12 Japanese medical centers. Parkinsonism-related items were analyzed statistically.

**Results:** In 12 medical centers, 217 patients with VaP were recruited in this study. Sixty-nine patients (30.8%) were co-morbid with VaP (male 75.4%, mean onset age 71.5 y). Patients with stroke were 155 (69.2%), including 45 patients (66.2%) with VaP and 110 patients (73.8%) without VaP. There was no difference between them ( $p = 0.16$ ). In patients with VaP, onset of stroke was significantly younger ( $p = 0.016$ ). When analyzing in frequencies of cerebral infarction, cerebral hemorrhage and subarachnoidal hemorrhage, there was no difference between patients with and without VaP ( $p = 0.08, 0.13, 0.69$ ). Gait disturbance was the most important symptom (62.3%,  $p < 0.0001$ ) in diagnosing VaP. In gait disturbance,

freezing was most frequent ( $p = 0.0004$ ). Postural impairment and no abnormal involuntary movement were emphasized in the diagnosis.  
**Conclusion:** It is suggested that stroke are common in VaP and the history of any type of stroke is important. VaP is diagnosed as a clinical syndrome characterized by freezing gait, postural instability and no abnormal involuntary movement.

## ESOC-1563

### 12. Epidemiology of Stroke

#### Clinical features in transient ischaemic attack (TIA) and transient ischaemic attack (tia) mimics: Distinguishing between the two entities

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**Background:** Transient ischaemic attack (TIA) is defined as a reversible episode of acute focal neurological deficit of presumed vascular origin. However, it remains a diagnostic challenge to distinguish a TIA from non-cerebrovascular conditions that also cause transient focal neurological symptoms (TIA mimics). Thus, the aim of this study was to identify clinical features in patients with TIA and patients with TIA mimics.

**Methods:** We studied 1339 consecutive patients admitted to our department with suspected TIA from February 2010 to December 2013. Clinical characteristics, radiological findings, and outcome were recorded. The final diagnosis of TIA or TIA mimic was given after assessment by a stroke specialist.

**Results:** Of the 1339 patients, 362 (27.0%) had a minor stroke, 397 (29.7%) suffered from a TIA, while the remaining 580 (43.3%) patients had a TIA mimic. Age > 60 years (OR 2.10, 95% CI 1.58–2.78), gender (male, OR 1.6, 95% CI 1.23–2.08), hypertension (OR 2.36, 95% CI 1.75–3.18) hypercholesterolemia (OR 4.81, 95% CI 3.58–6.45), and atrial fibrillation (OR 2.36, 95% CI 1.35–4.15) occurred more likely in patients with TIA and minor stroke. Among the clinical symptoms, monoparesis (OR 1.90, 95% CI 1.29–2.80) and hemiparesis (OR 1.74, 95% CI 1.23–1.74) were identified as independent predictors of TIA or minor stroke, whereas headache (OR 0.59, 95% CI 0.43–0.81) was independently associated with a TIA mimic.

**Conclusion:** Clinical variables known as high-risk markers were found to occur more likely in TIA, while clinical symptoms less suggestive of vascular disease predicted a TIA mimic.

## ESOC-1546

### 12. Epidemiology of Stroke

#### Stroke and atrial fibrillation: Its incidence in a retrospective study from 2008 to 2012 in Fernandópolis region, State of São Paulo, Brazil

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**Context:** The relation of cause and effect between atrial fibrillation and stroke is narrow and represents a growing public health problem. However few studies have been done to measure the reality of this issue.  
**Objectives:** Track and outline a retrospective study, the incidence of stroke in the occurrence of atrial fibrillation.

**Design, target population and methods:** Cohort Study, a retrospective of adult patients aged 20 years or older who were admitted to a reference Health Service between 2008 and 2012.

**Main outcome:** Stroke incidence measured in the study population 111 926 inhabitants; projected number of people in the region of Fernandópolis, Sao Paulo, Brazil.

**Results:** A total of 923 adults diagnosed with stroke were identified during the period; of these 461 were diagnosed with atrial fibrillation at the time of stroke; 47.28% were aged 71 years or more. The incidence of atrial fibrillation as the main cause for the occurrence of cardioembolic stroke event was 0.95% (95% confidence interval 0.94% 0.96%). Incidence increased from 0.1% among adults under 55 years to 9.0% in those aged 80 or more. Among people aged 50 or older, the prevalence of atrial fibrillation was higher in whites than in blacks (2.2% vs 1.5%,  $P, 0.001$ ).

**Conclusions:** Our study confirms that atrial fibrillation is common among older adults. Atrial fibrillation proved to be a strong risk factor for stroke, reflecting the growing need for online efforts to meet the challenge of preventing stroke and the search for rhythm management in patients with atrial fibrillation.

## ESOC-0962

### 12. Epidemiology of Stroke

#### Differences in association of body mass index between stroke subtypes and acute coronary syndrome:

#### A population-based case : control study

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**Background:** There is conflicting evidence of an association between obesity and risk of stroke, and data on stroke subtypes are limited. We studied the association of pre-morbid body mass index (BMI) and stroke subtypes versus acute coronary syndrome (ACS).

**Methods:** We studied BMI in all first-ever TIA/stroke and ACS from 2002–2012 in a population-based cohort (Oxford Vascular Study) compared with a group of matched healthy controls ( $n = 618$ ) from the same population using logistic regression adjusted for age, sex and smoking. Standard BMI categories were used: underweight ( $\leq 18.4$ ); normal (18.5–24.9; reference group); overweight (25.0–29.9); obese ( $\geq 30.0$ ).

**Results:** Among 2025 TIA and strokes (mean age 71.6 years, women 53.8%, mean BMI 26.3) and 1191 ACS (mean age 71.35 years, women 35.4%, mean BMI 26.8), risk of TIA/ischaemic stroke (adjusted OR = 2.87, 95%CI = 1.13–7.34,  $p = 0.027$ ), ACS (3.26, 1.12–9.50,  $p = 0.031$ ) and particularly intracranial haemorrhage (ICH) (7.60, 2.15–26.88,  $p = 0.002$ ) were all increased in under-weight patients versus controls. The negative association was continuous throughout the full range of BMI for ICH (OR = 0.93, 0.88–0.98/unit,  $p = 0.008$ ), whereas it flattened out for TIA/ischaemic stroke (BMI > 30: 1.15, 0.88–1.50,  $p = 0.29$ ) and reversed for ACS (BMI > 30: 1.46, 1.05–2.03,  $p = 0.026$ ). On direct comparison, BMI > 25 was more common in ACS than TIA/ischaemic stroke (OR = 1.31, 1.09–1.57,  $p = 0.004$ ). Results were unchanged after exclusion of TIA.

**Conclusions:** Under-weight is a significant risk factor for stroke and ACS. The negative association with BMI was particularly strong for ICH. Obesity is a stronger risk factor for ACS than for ischaemic stroke.

## ESOC-0998

## 12. Epidemiology of Stroke

### Effects of meteorological conditions on the risk of stroke events—HEWS—Stroke Study

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**Background:** Seasonal variation in the incidence of cerebrovascular diseases has been reported in many countries. However, little is known about the relationship between meteorological change and stroke incidence. We conducted a multi-center, retrospective and observational study in Hiroshima district.

**Methods:** Clinical data from 3935 stroke patients, admitted between January 2012 and December 2013 at seven institutes, were collected retrospectively. The subtypes of ischemic stroke were classified according to the TOAST Classification as lacunar infarction, atherothrombotic stroke, cardioembolic stroke, and the other. The daily rates of stroke events were compared to the daily mean thermo-hydrological index (THI), the atmospheric pressure, and the daily changes of these variables for the seven days preceding a stroke event using Poisson regression analysis.

**Results:** We divided onset days into five quantiles based on the THI, atmosphere, and their changes. The frequency of intracranial hemorrhage was significantly higher on cold days (RR 1.65, 95%CI 1.30–2.09), and a decline in temperature one day before the onset from two day before (RR 1.32, 95%CI 1.06–1.64). The frequency of atherosclerotic stroke was significantly higher when temperature surged one day before the onset from two day before onset (RR 1.32, 95% CI 1.07–1.61). Atmosphere and atmosphere change did not show significant influence on the frequency of stroke onset.

**Conclusions:** High incidence of intracranial hemorrhage was relevant to cold day and declined temperature on one day before. Atherothrombotic stroke was relevant to increased temperature on one day before. It was suggested that meteorological change may also influence stroke onset frequency.

## ESOC-0742

## 12. Epidemiology of Stroke

### The distribution of modified Rankin scale scores change according to eligibility criteria in acute ischaemic stroke trials

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**Background:** Shifts in the distribution of ordinal scales like modified Rankin scale (mRs) are being increasingly used as outcome measures in acute ischaemic stroke trials. The assumption is that there is an equal chance of being in any strata. Distribution across strata is relevant for sample size calculation and statistical analysis. Eligibility criteria usually are standard, but could change the distribution of outcomes.

**Aims:** To assess the distribution of mRs scores across its different strata in patients with acute ischemic strokes according to usual eligibility criteria used in stroke trials.

**Methods:** Usual eligibility criteria in acute stroke trials (NIHSS > 3- < 25 and time from symptom onset < 6 hours) were applied to a prospective cohort of acute ischemic stroke patients from a single centre. mRs scores were adjudicated at discharge. Median values were calculated and Wilcoxon 2 sample test was used to compare strata distribution for each set of criteria to the crude sample.

**Results:** From 1548 patients, selection criteria yielded 803 (52%) patients for NIHSS criteria, 555 (39%) for time and 336 (22%) for both. When NIHSS were used, distribution was slightly homogeneous (median = 3) but not significant (p = 0.07) and when time was used, distribution was homogeneous (median = 3) and significantly different from the crude distribution (p = 0.002).

**Conclusions:** Usual eligibility criteria produced 1/5 reduction in potential selected population and a distribution of mRs scores significantly different from the unselected data sample. Distribution of scores from 1 to 5 was homogeneous, and can be analysed with multivariate ordinal logistic regression assumptions.

## ESOC-0505

## 12. Epidemiology of Stroke

### Changes in stroke incidence and case fatality in the L'Aquila district over two decades

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**Background:** Stroke incidence and case fatality in Western countries are decreasing. We evaluated changes in stroke epidemiology in the district of L'Aquila.

**Methods:** All residents in the district with a first-ever stroke (FES) in 2011–2012 were included in a population-based registry. All events were identified by active monitoring of all inpatients and outpatients health services and of death certificates. Current results were compared with those obtained in 1994–1998 and already published.

**Results:** Eight hundred forty-seven FES (51.4% women; mean age  $\pm$  SD, 75.4  $\pm$  13.2 years) were included in the registry. The crude annual incidence rate decreased from 293/100,000 in 1994–1998 to 142/100,000 in 2011–2012. After standardization to the 2011 Italian population, the rate decreased from 323/100,000 to 130/100,000 (incidence rate ratio [IRR] 0.42; 95% CI, 0.34–0.51; P < 0.001). Declines were observed for ischemic stroke (IS) (from 266/100,000 to 98/100,000; IRR 0.37; 95% CI, 0.29–0.47; P < 0.001) and intracerebral (ICH) (from 41/100,000 to 23/100,000; IRR 0.54; 95% CI, 0.30–0.92; P = 0.023) but not for subarachnoid hemorrhage (SAH). We observed a reduction in 1-year case fatality from 1994–1998 to 2011–2012 for all strokes (from 37.9% to 33.1%; relative risk [RR] 0.87; 95% CI, 0.77–0.99; P = 0.031) and IS (from 33.8% to 26.0%; RR 0.77; 95% CI, 0.65–0.90; P = 0.001) but not for ICH or SAH.

**Conclusion:** Despite aging of the population, we observed a decreased stroke incidence and mortality over the last two decades, partly explainable by improved stroke preventive strategies and management, but also by the occurrence of competing diseases causing earlier deaths.

## ESOC-0506

## 12. Epidemiology of Stroke

### Increased burden of ischemic stroke in the oldest old over two decades

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**Background:** Aging of Western populations emphasized the relevance of ischemic stroke (IS) in the elderly. We evaluated demographic changes in IS patients aged 80 years and over in the past two decades in the district of L'Aquila.

**Methods:** All residents in the district presenting with a first-ever IS in 2011–2012 were included in a population-based registry by active monitoring of all inpatients and outpatients health services and of death certificates. Current results were compared with those obtained in 1994–1998 and already published.

**Results:** Of 634 first-ever IS included in the registry in 2011–2012, 289 events occurred in patients aged 80 years and over with a 24.4% increase as compared to 1994–1998 (45.6% vs. 36.6%;  $P < 0.0001$ ). No changes were observed in gender and stroke type distribution. Elderly patients were more frequently hospitalized in 2011–2012 than in 1994–1998 (97.9% vs. 90.9%;  $P < 0.0001$ ), had more brain neuroimaging studies (98.3% vs. 79.6%;  $P < 0.0001$ ), and a shorter mean hospital stay ( $9.4 \pm 5.7$  vs.  $12.1 \pm 9.7$  days;  $P < 0.0001$ ) without relevant changes in hospital mortality (20.4% vs. 23.6%;  $P = 0.284$ ), despite a decline in 30-day (27.7% vs. 34.6%;  $P = 0.029$ ) and 1-year (40.1% vs. 51.6%;  $P = 0.0005$ ) case fatality rates. Notably, only proportions of arterial hypertension (82.0% vs. 65.0%;  $P < 0.0001$ ) and atrial fibrillation (43.9% vs. 30.2%;  $P < 0.0001$ ) increased in 2011–2012 compared to 1994–1998.

**Conclusion:** Comparing data of 2011–2012 with those of 1994–1998 we found a 24.4% increased proportion of IS in the oldest old and greater proportions of arterial hypertension and atrial fibrillation with decreased 30-day and 1-year case fatality rates.

## ESOC-0546

### 12. Epidemiology of Stroke

#### Stroke trends in Malmö, Sweden: Incidence and survival

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**Background:** The overall declining stroke incidence trend in high-income countries has not been consistent for all age groups. The aim of this study was to investigate temporal trends in incidence and 2-years survival between 1993 and 2009, in Malmö (300 000 inhabitants), Sweden.

**Methods:** Cases with first-ever stroke were retrieved from Malmö Stroke Register (STROMA). Since 1989, systematic search for suspected or established cases of stroke in Malmö citizens over the age of 18 years who were hospitalized and/or attended the hospital outpatient clinic and/or died was made. Date of death was retrieved from the Swedish Cause of Death Register. Age-standardized incidence and incidence for different age groups was calculated (all/men/women). Time-trends were analysed using log linear regression i.e. the natural logarithm of the age-standardized incidence as a linear function over time. Cox proportional hazard regression (age- and sex adjusted) was used to compare survival over time.

**Results:** 11019 cases (46% men and 54% women) with a first-ever stroke were identified between 1993 and 2009. During the study period, the age-standardized incidence decreased by 2.0% ( $p < 0.05$ ) for men and by 1.0% ( $p < 0.05$ ) for women. The decrease was mainly driven by the age-group 75–84 years. No decreasing trend was observed for younger age groups. Stroke survival improved for most years observed compared to 1993.

**Conclusion:** The overall declining stroke incidence and stroke fatality trend in high-income countries has now been also confirmed in Malmö, Sweden. The cause of absence of decline in incidence in the younger age groups needs to be further studied.

## ESOC-1175

### 12. Epidemiology of Stroke

#### High burden of ischemic stroke in Croatia is largely due to modifiable risk factors

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**Background:** Incidence and mortality of ischemic stroke in Croatia are higher than in developed countries.

**Methods:** Observational prospective cohort study following-up (1–3 years) first-ever ischemic stroke patients identified in a population-based incidence study ( $N = 751$ ) (study 1, S1) and a concurrent case-control study (215 patients, 125 controls, S2) were conducted in one of Croatia's counties (2007–2010).

**Results:** Atrial fibrillation (AF) was common in patients (36.1% in S1, 40.9% in S2) and mostly (>50%) unrecognized before the stroke. In a multivariate analysis, odds of stroke increased with tobacco smoking ( $OR = 3.95$ , 95%CI 1.33–10.8), unhealthy diet ( $OR = 2.12$ , 1.12–4.01) and AF ( $OR = 9.40$ , 4.01–22.0), and decreased with higher education ( $OR = 0.33$ , 0.11–0.98), moderate alcohol consumption ( $OR = 0.48$ , 0.25–0.93), higher fasting HDL ( $OR = 0.14$ , 0.07–0.30) and pre-stroke use of anticoagulants ( $OR = 0.09$ , 0.01–0.59), antihypertensives ( $OR = 0.52$ , 0.27–1.00) and statins ( $OR = 0.29$ , 0.12–0.69). All patients were managed in stroke units with neuroimaging within 48 hours in 93.1% (S1) and 100% (S2) patients, acute aspirin in 84.0% (S1) and 100% (S2) patients and thrombolysis in 1.9% (S1) and 2.8% (S2) patients. Among the acute phase survivors, 30.9% died over the subsequent 1–3 years; only 15.4% of those with AF were treated with warfarin at any time between day 15 and death or end of study and 73.5% received low-dose aspirin; only 44.2% of those with dyslipidemia were treated with statins.

**Conclusion:** Acute stroke management and mortality do not seem considerably different from those in developed countries, but post-acute mortality is higher, likely due to inappropriate management of prognostically unfavorable comorbidity.

## ESOC-0670

### 12. Epidemiology of Stroke

#### Age associations with fast campaign awareness and recall in patients presenting with stroke/TIA; Results from Stroke and TIA Awareness and Response to Symptoms (STARS) Study

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**Background:** As the population ages, it is vital that public education campaigns promoting stroke awareness and the need for an emergency response (e.g. F.A.S.T.) are accessible by the elderly.

**Method:** We interviewed consecutive patients with stroke/TIA and/or their relatives (if they had sought medical help on the patients behalf) presenting to the hyper-acute stroke unit, Sheffield UK in May-June and Aug-Oct 2014. We assessed knowledge of the F.A.S.T. campaign in relation to age.

**Results:** Two hundred fifty-two participants were interviewed within 72 hours of admission (215 patients, 37 relatives). In age subgroups <65 (n = 66), 66–79 (n = 100), >80 (n = 86), awareness of a stroke media campaign was reported by 92% vs. 85% vs. 74% respectively (P trend 0.004) with campaign awareness in those aged > 80 much lower than in those <65 (OR = 0.26, 0.09–0.72) P = 0.01. Similarly, the ability to name one or more F.A.S.T. components correctly (i.e. Face/ Arm/ Speech/ Time) declined with increasing age group; 58% vs. 39% vs. 38% (P trend 0.02) with lower recall in those aged > 80 vs. those aged <65 (OR 0.43, 0.22–0.85), P = 0.01). Of those who were aware of the campaign, 159 (79%) had seen it on the television and television was the most common source of F.A.S.T. knowledge in all age subgroups. Most participants in each age group (98%, 97% and 92%) watched television regularly.

**Conclusion:** Awareness of the media campaign and recall of F.A.S.T. declined significantly with increasing age. Further research is needed to establish how stroke media campaigns can be more accessible and memorable for older people.

## ESOC-1058

### 12. Epidemiology of Stroke

#### Accuracy of ICD-10AM coding for transient ischaemic attack (TIA)

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**Background:** Diagnostic coding is often used in stroke research. However, few data exist regarding the accuracy of Transient Ischaemic Attack (TIA) codes in Australia.

**Aims:** To determine the accuracy of ICD-10 Australian Modification (AM) diagnostic codes assigned to patients with neurologist diagnosed TIA.

**Methods:** ICD-10AM codes were identified for patients with suspected TIA treated at Monash Medical Centre, Australia (2004–2007). Coding accuracy was assessed against final neurologist diagnosis using the 24-hour criterion (clinical TIA). Assignment of a TIA code of G45.3, G45.8 or G45.9 to a patient with neurologist confirmed TIA was considered true positive and TIA mimics were considered false positives.

**Results:** ICD-10AM codes were available for 336/488 (68.9%; 95% Confidence Interval 64.6%–72.8%) patients. Clinical TIA was confirmed in 209/336 (62.2%; 56.9%–67.2%). Evaluation of ICD-10AM codes for clinical TIA revealed: sensitivity 0.76 (0.69–0.81), specificity 0.43 (0.34–0.51), Positive Predictive Value 0.68 (0.62–0.74), Negative Predictive Value 0.51 (0.42–0.61). Mean age was slightly higher in those assigned a TIA code (66.4 +/- 13.7) compared with a non-TIA code (62.3 +/- 15.6; p < 0.02). Patients with symptoms lasting less than one hour were more likely to be assigned a TIA code than those with symptoms lasting more than one hour (p < 0.001).

**Discussion:** ICD10AM codes are sensitive for clinical TIA, but insufficiently specific. These data may help to estimate measurement error when using administrative datasets for TIA research.

## ESOC-0311

### 12. Epidemiology of Stroke

#### Sensitivity of hospital data coding of acute stroke in a district general hospital in the UK

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**Background:** Accurate recording of stroke diagnosis is necessary for understanding of stroke frequency, demographics and epidemiology and

for hospital trusts to ensure financial reimbursement and target monitoring. Studies of stroke coding using ICD codes reported varying estimations of true stroke incidence. This study aims to assess the sensitivity and positive predictive value (PPV) of coded stroke diagnosis from a single acute hospital trust when compared to multiple overlapping stroke incidence data.

**Methods:** Twelve-month coding data on all patients with a diagnosis of stroke using ICD-10 codes 160, 161, 162, 163 and 164 was collected. Over the same period a single physician collected stroke data from multiple overlapping sources, including; neurology/TIA/stroke clinics, neuroimaging review, coding department and bereavement department data. Datasets were compared to assess the accuracy of coding department detection of acute stroke.

**Results:** Six hundred sixty-four confirmed stroke cases were identified using multiple overlapping methods; 502 cases were identified by the coding department. Sensitivity of coding department data was 75.6% (95% CI: 72.15–78.82). PPV was 96.3% (95% CI: 94.36–97.79). Seven patients identified by the coding department were missed by multiple overlapping methods. 19 patients were incorrectly coded as stroke by the coding department.

**Discussion:** The sensitivity of ICD-10 coding for identification of in-hospital acute stroke is insufficient for accurate prediction of stroke incidence. Lack of accuracy has wide ranging implications on stroke service provision and epidemiological knowledge. Multiple overlapping methods identified multiple issues as to why stroke coding diagnoses were missed. Improved data capture methods are required to overcome these issues.

## ESOC-1028

### 12. Epidemiology of Stroke

#### Women initiatives for stroke in Europe: A new European task force against stroke in women

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Epidemiological studies have demonstrated that women have a higher prevalence of stroke over their lifetime than men and worse functional outcome after stroke. Sex-specific differences contribute to these features. In Europe, there are significant East-West differences in stroke incidence and related mortality rates being higher in Central-Eastern Europe where stroke victims are on average younger compared to Western Europe. In Western Europe, where women outnumber men in the over 80 age group, stroke in women is on the rise due to their longer life-expectancy and related higher prevalence of stroke due to atrial fibrillation.

WISE-Women Initiatives for Stroke in Europe is a European Stroke Organization (ESO) working group focused on stroke in women to improve the knowledge on gender differences in stroke in Europe taking into account the regional discrepancies in stroke care.

WISE includes representatives from most European regions and members from USA and Brazil who are involved in stroke research in women.

For 2015, main aims of the working group are:

1. Publication of a WISE position paper
2. Review and update of available epidemiological data
3. Identification of weaknesses and strengths from a gender perspective at scientific, institutional, and public awareness level in supporting stroke victims
4. Promotion of an observational study on stroke in women
5. Design of a RCT on stroke prevention

During the first ESO Conference in Glasgow the II WISE assembly will take place in order to define the working group bylaws and the working strategy for the next 5 years to fight stroke in women.

## ESOC-1054

## 12. Epidemiology of Stroke

### Survival of young ischemic stroke patients in Estonia in 2003–2012

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**Introduction:** Young stroke patients face a long lasting burden of disability and a worse survival compared to their healthy counterparts.

**Aims:** The aim of the study was to analyze the survival, its influencing factors and the time trends in young ischemic stroke patients in 2003–2012.

**Methods:** We performed a retrospective study of all consecutive patients aged 15–54 years treated in Tartu University Hospital and North Estonia Medical Centre from January 2003 to December 2012 with the discharge diagnosis of ischemic stroke. Stroke was classified according to the NIHSS score, the TOAST and the Bamford criteria. For time trend analysis we divided the study period into two groups (2003–2007 and 2008–2012). The survival data were obtained from the Estonian Population Register.

**Results:** Of the 723 patients, 486 (67%) were men. The survival rate at 28 days, 1 year and 5 years was 0.96 (95% CI 0.94–0.97), 0.92 (95% CI 0.90–0.94), and 0.85 (95% CI 0.82–0.88), respectively. The survival was significantly worse for men ( $P = 0.01$ ) and with the advancing age ( $P = 0.04$ ) and stroke severity ( $P < 0.01$ ). Clinically, total anterior circulation infarction and etiologically, cardioembolic stroke had the lowest survival rates ( $P < 0.01$ ). The time trend analysis showed an improved 28-day survival rate among the whole study population ( $P < 0.001$ ) and among men ( $P < 0.001$ ) in the later period.

**Conclusion:** We identified several factors that are related to the lower survival rate in young stroke patients. The improved short-term survival during the study period is probably due to the improvements in acute care.

## ESOC-1305

## 12. Epidemiology of Stroke

### Incidence of hospitalized stroke in the Czech Republic from the National Registry of Hospitalized Patients

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**Background:** Stroke is a leading cause of mortality and morbidity in Eastern Europe. However detailed stroke incidence data are not available.

**Methods:** We previously validated the accuracy of coding of stroke diagnoses in the National Registry of Hospitalized Patients (NRHOSP), a nationwide registry of prospectively collected data regarding each hospitalization in the Czech Republic (CR) since 1992. The accuracy of coding of the main stroke diagnosis [International Classification of Diseases Tenth Revision (ICD-10): subarachnoid hemorrhage (I60), intracerebral hemorrhage (I61) and cerebral infarction (I63)] included in a CR national registry was high (91%, 91% and 82%, respectively). We calculated the incidence of hospitalized stroke in the CR using the validated NRHOSP. We calculated the overall stroke incidence and the incidence rates of the three main stroke types: cerebral infarction (I63), subarachnoid hemorrhage (I60) and intracerebral hemorrhage (I61). The results of the

Validation study assessing the accuracy of coding of stroke diagnoses in NRHOSP were applied to appropriately adjust the rates from the NRHOSP data.

**Results:** The overall incidence of hospitalized stroke in the CR is 240 per 100 000 population. The incidence of hospitalized stroke according to stroke types I60, I61 and I63 is 8, 29 and 210 cases per 100 000 population, respectively.

**Conclusions:** The incidence data of hospitalized stroke in the CR can be compared to previously reported rates for Central and Eastern Europe. Future studies will expand beyond hospitalized cases.

## ESOC-0584

## 12. Epidemiology of Stroke

### Prevalence and prognosis of intracranial stenosis in acute ischemic stroke

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**Introduction:** Intracranial stenosis (ICS) is common among stroke patients of Asians, Blacks, and Hispanics ancestry. Furthermore, stroke patients with ICS have higher recurrence rate of ischemic stroke and death than those without ICS. This study aimed to determine the prevalence of ICS in our stroke registry.

**Methods:** We reviewed the charts of 554 patients who were admitted with acute ischemic stroke between the dates January 2011 and August 2014. ICS was defined as any intracranial stenosis >50% on cerebrovascular imaging. The demographic data, NIHSS scores at admission and mRS in follow-up period were recorded. We determined etiologic stroke subtypes using the automated Causative Classification System (CCS).

**Results:** A total of 64 (11.6%) patients with ICS (42 males [65.6%] and 22 females [34.4%]; mean age  $67.3 \pm 12.4$  [37–98] years) were included in the study. ICS was more common in men ( $p = 0.019$ ). Sixty patients (10.8%) had symptomatic ICS and 41 patients (7.4%) had isolated ICS. DM was significantly higher in the ICS group compared to others ( $p = 0.007$ ). The mean NIHSS score was 5.97 (0–26) at admission and it was significantly lower than others ( $p < 0.001$ ). There were 51 (79.7%) patients with large-artery atherosclerosis and 2 (3.1%) patients with cardioaortic embolism, according to the CCS. Eleven (17.2%) patients remained undetermined-unclassified. The outcome was significantly better than others ( $p < 0.001$ ). Recurrent stroke was higher in the ICS group, but was not significantly ( $p = 0.49$ ).

**Conclusion:** ICS was seen in 11.6% of acute ischemic stroke in our registry. Diabetes mellitus appears to be the major risk factor for ICS.

## ESOC-0591

## 12. Epidemiology of Stroke

### Etiologic subtypes of posterior circulation strokes

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**Introduction:** Acute infarcts in posterior circulation (AIPC) has been reported 17–40% in the previous studies. The most frequent cause of AIPC was embolism from cardioaortic, vertebrobasilar atherosclerosis or dissection, followed by large-artery atherosclerosis (LAA), small vessel disease and other causes. The aim of this study was to determine the etiologic subtypes of AIPC in our stroke registry.

**Methods:** We reviewed the charts of 554 patients who were admitted with acute ischemic stroke between the dates January 2011 and August 2014. The demographic data, the National Institutes of Health Stroke Scale (NIHSS) scores at admission and detailed investigations to determine etiologic focus of stroke were recorded. We determined etiologic stroke



subtypes using the automated Causative Classification System (CCS). The modified Rankin Scale (mRS) scores were recorded in follow-up period. **Results:** A total of 88 (15.9%) patients with AIPC (47 males [53.4%] and 41 females [46.6%]; mean age, 65.82 ± 14.04 (25–92) years) were included in the study. The mean NIHSS score was 4.75 (0–26) at admission. Hyperlipidemia was significantly higher in AIPC compared to others ( $p = 0.004$ ). Otherwise, atrial fibrillation and congestive heart failure were significantly lower ( $p = 0.025$ ,  $p = 0.004$ ). There were large-artery atherosclerosis (LAA) ( $n = 32$ , 36.4%), cardioaortic embolism ( $n = 23$ , 26.1%), small vessel disease ( $n = 8$ , 9.1%), other cause ( $n = 4$ , 4.5%) and undetermined causes ( $n = 21$ , 23.9%). The large-artery atherosclerosis was significantly higher in AIPC groups ( $p = 0.005$ ). **Conclusion:** AIPC was found in 15.9% of acute stroke patients in this registry. LAA was the most common cause of AIPC opposite to previous studies.

## ESOC-1287

### 12. Epidemiology of Stroke Patients with symptomatic internal carotid artery stenosis ineligible for endarterectomy can be stented with acceptable safety

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**Aim:** Superiority of carotid artery stenting (CAS) vs. carotid endarterectomy (CEA) is debated. However, some patients are ineligible for CEA because of high risk of surgery, stroke in progression (SIP) or anatomical obstacles. This study reports the safety and feasibility of CAS in patients with symptomatic internal carotid artery (ICA) stenosis ineligible for CEA.

**Method:** Retrospective single-center experience of all CAS treated patients with symptomatic ICA stenosis. Detailed clinical and radiological information was collected. Patients were deemed 'stable' if they were referred from an out-patient clinic with transient ischemic attacks or persistent minor symptoms or 'unstable' if they were referred from another hospital with SIP or recent embolic ischemic/hemodynamic symptoms. Restenosis of more than 60% or recurrent ischemic events were followed.

**Results:** Forty-five ICA stenoses were successfully treated in 46 patients. Three of 48 stenting attempts failed resulting in ICA coiling in 2 cases. Four of 46 patients (9%) died in-hospital. All of those were unstable patients. Twenty-four of 45 stents were placed in stable patients. Those patients experienced recurrent ischemic events in 5 (21%) cases and restenosis in 7 (29%) cases. Unstable stented patients did not experience late adverse events. Follow-up length, procedural complications, age, sex, devices used and pre-procedural comorbidity was comparable in the two patient groups.

**Conclusion:** CAS in patients ineligible for CEA is feasible and reasonable safe. Our data suggests that patients stented early after an ischemic event may face an increased risk for severe procedural complications as opposed to patients stented in a delayed fashion.

## ESOC-1295

### 12. Epidemiology of Stroke Long term follow-up of carotid artery stenting in symptomatic patients ineligible for endarterectomy

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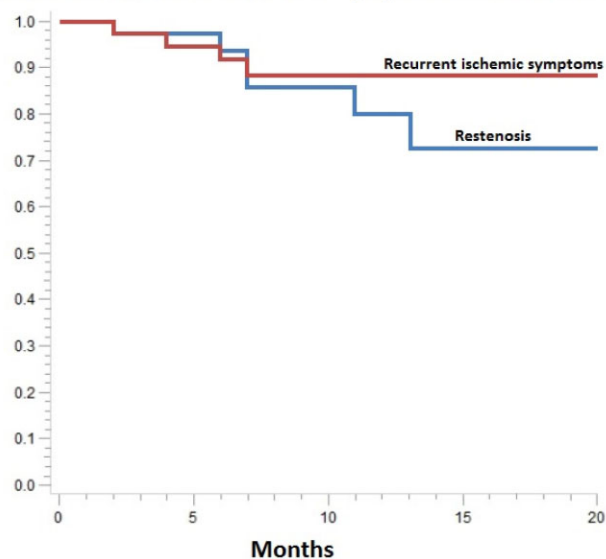
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**Aim:** Durability of carotid artery stenting (CAS) has been suggested to be approximately 95% in large clinical trials. The rate of recurrent ischemic events in patients ineligible for carotid endarterectomy (CEA) is unknown. This study assesses the durability of CAS in patients with a symptomatic internal carotid artery (ICA) stenosis ineligible for CEA.

**Method:** Retrospective single-center experience of all patients treated with CAS from 2011 to 2014. Patients were followed with duplex sonography in an outpatient clinic for detection of restenosis above 60% or recurrent ischemic events from the stented ICA.

**Results:** Forty-six patients were identified. Four patients died within few weeks after the procedure and 3 patients had unsuccessful stent placement. Thirty-nine patients were included in the analysis. Median age: 65 (range 42–90). Male: 39 (79%). Median follow-up length: 13 months (range 2–26). No patients died during follow-up. No restenosis was observed in 32 patients (82%). Thirty-four patients (87%) did not suffer recurrent ischemic events (Figure). Recurrent ischemic events only occurred within 6 months while restenosis occurred until 13 months.

#### KM curve of recurrent ischemic symptoms and restenosis



**Conclusion:** The durability of CAS in patients ineligible for CEA is slightly less than, but comparable to, patients eligible for CEA. This study suggests a discrepancy between recurrent ischemic events, which cluster within the first six months, and restenosis, occurring later. Larger trials need to confirm these findings.

## ESOC-1298

## 12. Epidemiology of Stroke

## Are patient selection criteria for randomized endovascular therapy stroke trials too rigid?

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**Aim:** Patient enrollment into randomized clinical trials (RCTs) can be a challenging endeavor. Recent RCTs of endovascular therapy (EVT) in acute ischemic stroke (AIS) has shown low patient enrollment from multiple centers. This study assesses all EVT treated patients within one year for eligibility into five recent stroke trials.

**Methods:** Retrospective single-center study. All patients with attempted EVT for anterior circulation AIS were identified. Detailed clinical and radiological information was collected. Patients were followed for 3 months. Inclusion and exclusion criteria was obtained from online sources and assessed for the following trials: IMS-III, SWIFT-PRIME, ESCAPE, PRO-ACT II and MR-CLEAN.

**Results:** Ninety-nine patients were identified. Median age: 71 (range 33–94). Male: 52 (53%). Median stroke severity: NIHSS 16 (range 5–26). Eighty-nine patients had three months follow-up. Forty-two (47%) patients experienced favorable 3-months outcome (mRS 0–2). Patient eligibility for the RCTs varied from 58% to 100% (58% SWIFT-PRIME, 71% IMS-III, 84% PRO-ACT II, 88% MR-CLEAN, 100% ESCAPE). Age was the predominant censoring factor (4% to 9% of patients). There were no significant differences in terms of procedural or late complications and 3-months clinical outcome between eligible and ineligible patients. However, patients eligible for SWIFT-PRIME had slightly worse outcomes ( $P = 0.05$ ).

**Conclusion:** Patient selection criteria in recent RCTs seem sapient with high rates of eligibility, and are unlikely to have been the predominant reason for low enrollment. Since procedural safety and clinical outcomes were similar in eligible and ineligible patients, exclusion criteria may be broadened in particular regarding age restriction.

## ESOC-1299

## 12. Epidemiology of Stroke

## Being an endovascular stroke trialist is not an 'eight to four' occupation

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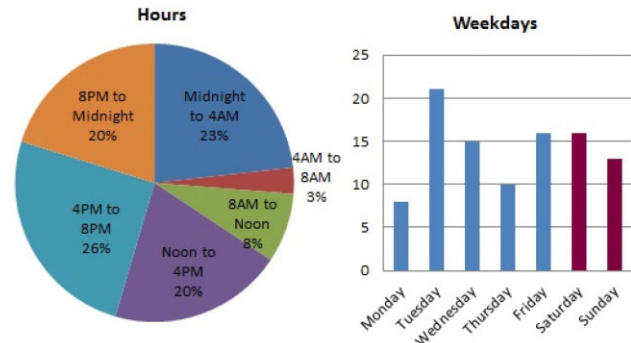
**Aim:** Recent randomized clinical trials of endovascular therapy (EVT) in acute ischemic stroke have shown low patient enrollment from multiple centers. Patients with acute ischemic stroke may present at any hour of the day. Sparse resources outside normal working hours combined with late patient presentation could lead to difficult patient enrollment. This study aims to assess when patients eligible for recent randomized EVT trials present.

**Methods:** Single-center analysis of all anterior circulation stroke patients treated with endovascular therapy (EVT) within 1 year. On-hours was defined as the time from 8 AM to 4 PM on weekdays. Inclusion and exclusion criteria was obtained from online sources and assessed for the following trials: IMS-III, SWIFT-PRIME, ESCAPE, PRO-ACT II and MR-CLEAN.

**Results:** Ninety-nine patients were identified. Median age: 71 (range 33–94 years). Male: 52 (53%). Median stroke severity: NIHSS 16 (range 5–26). Patients presented mostly between noon and 4AM evenly

throughout the week (Figure). In total 78 (79%) patients presented off-hours. The majority of patients eligible for recent EVT trials presented off-hours (77% PRO-ACT II, 77% SWIFT-PRIME and 77% MR-CLEAN, 79% ESCAPE, 80% IMS III)

**Conclusion:** Patients predominantly present from noon to 4AM, every day of the week. Since the majority of EVT trial eligible patients present outside normal working hours care should be taken to ensure sufficient resources for EVT off-hours.



## ESOC-0422

## 12. Epidemiology of Stroke

## Lower income district of Budapest associated with higher case fatality of younger stroke patients

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**Background:** Hungary has a single payer health insurance system which makes access to care universal and offers a potential for uniform quality of disease-management. On the other hand within Budapest there are important regional differences regarding socioeconomic status of the population. Less wealthy socioeconomic conditions were reported by some studies to be associated with higher incidence and more severe state in the acute phase of stroke but not with higher 30-day or 1-year case fatality.

**Methods:** Based on the national database of the health insurance fund, we have identified 4779 hospitalized stroke patients dwelling in the least (district 8,  $n = 2618$ ) and the most wealthy district (district 12,  $n = 2161$ ) of Budapest, respectively, with a first-ever stroke episode between 2002 and 2007. These patients were followed up for case fatality of any causes, hospital diagnoses, and stroke recurrence until March of 2013.

**Results:** Global case fatality was higher in the less wealthy district (59% vs. 54%,  $p = 0.003$ ). A more striking difference was found in the younger age-groups: 33% of patients aged 41–50 years from district 8, while only 16% of those from district 12 have deceased. Case fatality was higher in all age groups in the less wealthy district, with largest differences in the working age groups.

**Conclusions:** Patients belonging to lower socioeconomic groups of the same universal healthcare system show strikingly higher stroke fatality. It would be of utmost importance to identify patient groups in which improving healthcare management would improve national stroke statistics.

## ESOC-1396

## 12. Epidemiology of Stroke

## Stroke cases in the US Centers For Aids Research (CFAR) Network of Integrated Clinical Systems (CNICS) cohort

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**Introduction:** Stroke in HIV-infected patients is increasingly common in the antiretroviral therapy (ART) era. Potential explanations include aging of the population, HIV-related inflammation and metabolic side effects of some antiretroviral medications. The large and well-characterized CNICS cohort is a tremendous resource for modern studies of CVA in HIV, with up to ten fold more cases than previous studies.

**Methods/results:** Each stroke case was adjudicated by two neurologists using the NHLBI funded Multi-Ethnic Study of Atherosclerosis criteria. We used descriptive statistics and linear regression. Of 128 stroke events adjudicated thus far (additional adjudication is ongoing) from patients enrolled between 1994–2012, 65% of individuals were ages 40–59 and 19% ≤40 years; 28% were female and 63% African-American. Average age at stroke onset significantly increased with calendar year (0.8 years/calendar year,  $p = 0.001$ ). Traditional risk factors included 36% with treated hypertension, 20% diabetes, 25% on statins, and 51% were smokers. Non-traditional risk factors included Hepatitis C in 29%, illicit drug use in 21% and infectious causes in 20%. CD4 count closest to stroke event was <200 in 32%, 200–349 in 17%, and 350–499 in 12%. Ischemic strokes were most common (84%), with TOAST subtypes of large vessel atheroembolic (18%), cardioembolic (24%), small vessel (23%), and other/unknown (35%). The case-fatality rate was 9%.

**Conclusions:** The average age at stroke onset in this HIV-infected cohort, though still young overall, increased in more recent years. Strokes were largely ischemic and tended to occur in young, male, African-Americans, with low CD4 counts and other non-traditional risk factors.

## ESOC-0500

## 12. Epidemiology of Stroke

## Gender differences in stroke incidence and outcome: Results from a population-based registry

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**Background:** Gender differences in stroke have been described. This study evaluates first-ever stroke (FES) incidence, severity, and outcome by gender.

**Methods:** Prospective population-based registry including all patients with FES residing in the L'Aquila district in the years 2011–2012.

**Results:** We included 847 patients, 51.4% women. Crude annual FES incidence was similar in men (141.8/100,000) and in women (142.2/100,000). Women were older at stroke onset (78.1 ± 12.7 vs 72.6 ± 13.2 years;  $P = 0.002$ ), had more subarachnoid hemorrhages (6.2% vs 2.9%;  $P = 0.012$ ), and higher proportion of atrial fibrillation than men, while hypercholesterolemia and coronary heart disease were more frequent in men ( $P < 0.05$  in all cases). Stroke severity at onset was worst in women than in men (median NIHSS score 8 [IQR 3.25–15] vs 6 [IQR 3–12];

$P = 0.001$ ) as also disability at discharge (mRS score ≥3, 85% vs 78%;  $P = 0.017$ ). Additionally, women had a higher 30-day (29.7%; 95%CI 25.4–34.0 vs 20.9% 95%CI 17.0–24.8) and 1-year case-fatality rate (38.6%; 95%CI 34.0–43.2 vs 27.2% 95%CI 22.9–31.5) and were more likely to be discharged to long-term rehabilitation facilities (42.1% vs 30.8%;  $P = 0.006$ ) than men. The multivariate logistic regression analysis showed that age and NIHSS scores were independent predictors of 30-day and 1-year mortality or disability while gender was not.

**Conclusions:** Incidence of stroke was similar in women and in men but women had a poorer stroke-related prognosis. The poorer prognosis may be attributable, at least in part, to the older age and to the greater stroke severity in women than in men.

## ESOC-0501

## 12. Epidemiology of Stroke

## Burden of atrial fibrillation in ischemic stroke: Results from a population-based registry

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**Background:** Atrial fibrillation (AF) is a known risk factor for ischemic stroke (IS). The study evaluates the current burden of AF in first-ever ischemic stroke (FEIS) patients.

**Methods:** Prospective population-based registry (2011–2012) to investigate the prevalence of AF and its influence on prognosis in patients with FEIS.

**Results:** Among 634 patients included with FEIS, 200 (122 women; 61%) had documented AF (31.5%): paroxysmal in 32 (16%), persistent in 4 (2%), and permanent in 164 (82%) patients. AF was newly diagnosed in 41 patients (20.5%). Mean age ± SD at stroke onset was higher in women than in men (82.7 ± 7.7 vs 79.6 ± 8.5 years;  $P = 0.009$ ). Fifty patients (25%) were taking oral anticoagulants at stroke onset (mean INR ± SD: 1.9 ± 0.85). With respect to patients without the arrhythmia, those with AF were mostly women, aged 80 years and older, and hypertensive ( $P < 0.05$  in all cases). Patients with AF had greater stroke severity on admission (median NIHSS score 9 [IQR 4–17] vs 6 [IQR 3–12];  $P < 0.001$ ), more disabling strokes at discharge (mRS score ≥3 74.4% vs 52.9%;  $P < 0.001$ ), and higher 30-day (29.5%; 95%CI 24.0–35.6 vs 18.6% 95%CI 15.6–22.0) and 1-year (40.2%; 95%CI 34.1–46.6 vs 25.2% 95%CI 21.8–29.0) case fatality rate (CFR). AF was an independent predictor of 30-day and 1-year mortality and of disability at discharge.

**Conclusions:** In patients with AF, strokes were more severe on admission, more disabling at discharge and with higher 30-day and 1-year CFRs. More aggressive diagnostic and therapeutic preventive strategies for AF are needed, mostly in women and in elderly patients.

## ESOC-0756

## 12. Epidemiology of Stroke

## Aetiology, severity and outcome of ischaemic cerebrovascular events in patients with active cancer: A population-based study

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**Background:** Cancer patients are at increased risk of TIA and ischaemic stroke, but it is uncertain how the nature and risk of events differs between those with active cancer and those in remission or without cancer.

**Methods:** We compared aetiological subtype (TOAST), severity (NIHSS) and disability (Rankin) of TIA and ischaemic stroke in a population-

based study (Oxford Vascular Study) in patients with active cancer versus no cancer or cancer that was in remission/cured.

**Results:** Of 2433 patients with a first TIA or ischaemic stroke, 324 had history of prior cancer, of whom 103 had active cancer. Those with active cancer more often had stroke than TIA (75% vs 62%,  $p = 0.037$ ) and tended to have more severe strokes than the inactive/no-cancer group (NIHSS > 3: 35% vs 25%;  $p = 0.053$ ). Pre-morbid disability (Rankin score > 2) was increased in patients with active cancer ( $p = 0.014$ ), and remained higher on follow-up (69% vs. 36% at 1-month, 77% vs. 40% at 1-year and 97% vs. 69% at 5-years, all  $p < 0.0001$ ). All differences remained after adjustment for age, sex and baseline vascular risk factors. TOAST subtyping identified non-significantly more 'other determined' events in the active cancer group (4.9% vs. 2.1%), including hypercoagulable states and nonatherosclerotic vasculopathies.

**Conclusion:** Patients with active cancer presenting with TIA/stroke have more severe events and greater disability on follow-up than patients without cancer or those in remission or cured.

## ESOC-0977

### 12. Epidemiology of Stroke

#### Mumbai Stroke Registry: Long term follow up of 456 first ever stroke cases in a population based study

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**Background:** Non Communicable Diseases pose great health burden and present enormous challenge for national economies. Stroke is second leading cause of death and third leading cause of DALYs lost worldwide. Data suggests that 5 million die and 5 million more are left with chronic disability each year.

**Aims:** The Study objectives were to determine long-term outcome of 456 stroke patients from Mumbai Stroke registry in terms of disability, mortality and quality of life after stroke.

**Methods:** The survivors were traced and interviewed by the stroke team by hot and cold pursuit. Barthel Index, was used to assess activities of daily living, deaths were verified by death certificates.

**Results:** Four hundred fifty-six of 156,861 residents from H ward in Mumbai, suffered first stroke in 2005–06 and were followed up till 2012 at 28, 90 days, one year and 7 years. At the end of the study 15% were lost to follow up. At 28 days, mortality was 29.8%, 33% at 90 days, 40% at end of one year and 58.10% at 7 years. Percentage of patients with moderate to severe disability was 39% at 28 days, 23% at 90 days, 15.3% at 1 year and 8.5% at 7 years respectively. At end of 7 years only 17% were independent.

**Conclusions:** Public awareness, health education on warning symptoms of TIA, early stroke by optimum use of existing mass media is of utmost importance in success of stroke campaigns. Better rehabilitation services and training of caregivers will possibly help reducing the burden in stroke survivors.

## ESOC-0502

### 12. Epidemiology of Stroke

#### Increased cancer prevalence in stroke patients in the Netherlands; PSI Stroke Study

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**Introduction:** Cancer and stroke are the two leading causes of morbidity and mortality worldwide. We studied stroke and cancer characteristics in stroke patients with and without a history of cancer.

**Methods:** Prospective multicenter cohort study of 3184 patients presenting with stroke. Biographical and stroke characteristics between the patients with ( $n = 357$ ) and without ( $n = 2827$ ) a history of cancer were compared. From the subgroup of 357 patients with a history of cancer, type of cancer and treatment characteristics were collected. Prevalence of cancer types was compared with the prevalence of the general population with Standardized Prevalence Ratio (SPR).

**Results:** Stroke patients with a history of cancer were on average 8 years older than those without (71 versus 63 years). There were no major differences in stroke characteristics between these two groups. Overall prevalence of cancer was higher in stroke patients than in the age and sex matched general population (SPR 1.2, 95% C.I. 1.1–1.4). High SPRs were observed for cancer of head and neck (SPR 3.1, 95% C.I. 2.0–4.2), central nervous system (SPR 18.7, 95% C.I. 10.0–27.3), lower respiratory tract (SPR 2.3, 95% C.I. 1.5–3.2) and urinary tract (SPR 2.2, 95% C.I. 1.5–2.9).

**Conclusion:** The overall prevalence of cancer, specifically that of head and neck, central nervous system, lower respiratory and urinary tract is higher in stroke patients than in the age and sex matched general population. Stroke characteristics were not different between patients with or without a history of cancer. More attention is needed for stroke prevention in specific cancer survivors.

## ESOC-0381

### 12. Epidemiology of Stroke

#### Increased risk of ischaemic stroke with high levels of coagulation factor VIII activity in combination with oral contraceptives

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**Background:** Coagulation factor VIII (FVIII) is a well-established risk factor for venous thrombotic disease. Its role in the aetiology leading to ischaemic stroke (IS) is less well studied, especially among young people. The aim of this study was to determine whether high levels of FVIII

activity (FVIII:C) increase the risk of IS and how this association is affected by oral contraceptive use.

**Methods:** We included young women (aged 18–50), who either experienced an ischaemic stroke between 1990 and 1995 or who were free of this disease as controls matched on age, year of inclusion and region. Risk factors, including OC use, were determined by questionnaire. Citrated plasma samples were stored until the measurement of FVIII:C. Logistic regression was used to obtain odds ratios (OR) as measures of relative risk. Levels of FVIII:C were categorized based on the 90th percentile and quartile cut-offs of the control group. A dummy variable was constructed to assess the risk for the combination of high FVIII and OC use.

**Results:** High FVIII:C levels were associated with increased risk of IS (P90 [OR 3.3, 95% Confidence interval 1.9–5.8], Q4 vs Q1 [OR 3.6, 2.0–6.5]). The combination of OC use and high FVIII:C increased IS risk substantially compared with no OC and low FVIII:C (OR = 15, 6.4–35). Adjustments for levels of von Willebrand Factor (VWF) did not materially change results.

**Conclusion:** High levels of FVIII:C increase the risk of IS in young women. This risk is further increased by oral contraceptives use.

## ESOC-1500

### 12. Epidemiology of Stroke

#### Concomitant headache in acute ischaemic stroke: relation with ct angiography and CT perfusion characteristics

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**Background and purpose:** Headache in the acute phase of ischaemic stroke is a prevalent symptom with a largely unknown pathophysiology. It often occurs in young patients without cardiovascular risk factors suggesting a role for vessel wall elasticity. Also, headache often occurs during clot manipulation and is more prevalent in stroke patients with a migraine history suggesting activation of the trigeminal system by spreading depression in the penumbra. We investigated with CT-angiography (CTA) and CT-perfusion (CTP) whether headache was related to atherosclerosis, clot burden or penumbra size.

**Methods:** We included 233 patients with ischaemic stroke from our Leiden Stroke Cohort and the Dutch Acute Stroke Trial. CT, CTA and CTP were performed <9 hours of stroke onset. Headache characteristics were prospectively collected with a semi-structured questionnaire. We assessed atherosclerosis by measuring signs of calcium in any intracranial artery. Clot burden score was assessed by CTA and penumbra size by CTP. We calculated risk ratios (RR) with adjustments for age and sex with multivariable regression.

**Results:** Eighty-eight (38%) of the patients reported headache at stroke onset. Patients with intracranial atherosclerosis less often had headache than those without (34% versus 51%; RR: 0.67; 95% CI: 0.48–0.93). In patients with large clots (37% large versus 49% small; RR: 0.79; 95% CI: 0.48–1.30) or large penumbra volumes (38% large versus 37% small; RR: 1.03; 95% CI: 0.62–1.72) no significant difference in headache occurrence was found.

**Conclusions:** Stroke patients with concomitant headache less often have intracranial atherosclerosis than patients without headache. This finding supports the theory that vessel wall elasticity plays a role in the development of stroke related headache.

## ESOC-0953

### 12. Epidemiology of Stroke

#### Perioperative spinal cord ischemia: Case series and comparison with non-perioperative ischemia

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**Background:** Spinal cord infarction is a rare but often devastating disorder caused by a wide array of pathologic conditions, including perioperative ischemia during aortic repair or spinal surgery.

**Objective:** The authors aimed at better understanding causes, presentation and outcome of perioperative spinal cord ischemia using consecutive patients from two neurovascular centers.

**Methods:** Consecutive subjects enrolled in the ASTRAL-E registry (Lausanne, 2003–2014) and ASTRAL-B registry (Bruges, 2014) with acute vascular myelopathy and spinal cord imaging were selected and categorized according to the perioperative vs. non-perioperative occurrence.

**Results:** The population existed of 13 men and 12 women (median age 63.8, range 37–86 yr). 4 of the 25 patients (16%) had spinal cord infarctions related to surgery. In two patients, ischemia developed during spinal surgery, in one after endovascular aortic dissection type B repair and in one following nephrectomy. The majority of patients (21, 84%), both perioperative (18/21) as non-perioperative (3/4), had at least one cardiovascular risk factor. MRI imaging (of whom 70% with DWI) showed 9 anterior spinal artery patterns, 6 unilateral anterior/posterior spinal patterns, 2 posterior patterns, no central patterns, and 8 patients without visible ischemic lesions. Most patients (8, 32%) had thoracolumbar lesions. In general, the prognosis at three months was quite favorable with one perioperative patient deceased (1/4, 25%) and zero non-perioperative patients (0/11).

**Conclusion:** Clinical findings, imaging patterns and long-term prognosis seem to be similar in patients with perioperative ischemic myelopathy as in other. A prospective multicenter registry for this disease would be helpful to better characterize and study it.

## ESOC-0217

### 12. Epidemiology of Stroke

#### Inter-rater reliability of a national acute stroke register

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Medical quality registers are useful sources of knowledge about diseases and the health services. However, there are challenges in obtaining valid and reliable data. This study aims to assess the reliability in The Norwegian Stroke Register, as well as to identify problem areas and suggest improvement strategies.

We randomly selected 111 patients having had a stroke in 2012. An experienced stroke nurse completed the Norwegian Stroke Register paper forms for all 111 patients by review of the medical records. We then extracted all registered data on the same patients from the Norwegian Stroke Register and calculated Kappa statistics with 95% confidence intervals for nominal variables. For two time variables, we calculated the Intra-class Correlation Coefficient.

Substantial to excellent reliability ( $\kappa > 0.60$ ) was observed for all variables related to past medical history, functional status, stroke subtype and discharge destination. Although excellent reliability was observed for time of stroke onset ( $\kappa > 0.80$ ), this variable was hampered with a substantial amount of missing values. Some variables related to treatment and examinations in hospital displayed low levels of agreement ( $\kappa < 0.20$ ). This applies to heart rhythm monitoring, swallowing test performed and mobilized out of bed within 24 hours after admission.

A majority of the variables in The Norwegian Stroke Register have substantial to excellent reliability. The problem areas seem to be the lack of completeness in the time variable indicating stroke onset and poor reliability in some variables concerning examinations and treatment received in hospital.

## ESOC-0620

### 12. Epidemiology of Stroke

#### Neurological complications related to coronary angiography or percutaneous coronary intervention in Sweden 2003–2011

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*Background:* Neurological complications, particularly stroke, are rare but dreaded complications to coronary interventions. As acute reperfusion treatment of stroke has developed during the last decade immediate identification and treatment of stroke following coronary intervention is essential.

*Methods:* All reported neurological complications registered in the Swedish Coronary Angiography and Angioplasty Register (SCAAR) on patients undergoing coronary intervention in Sweden 2003–2011 ( $n = 340\,782$ ) were collected, adjudicated and analyzed regarding medical management, treatment and follow up.

*Results:* After review of the 735 reported neurological complications, 586 patients (0.17 %) were adjudicated to have suffered a neurological complication within 24 h of the procedure. The complications were as follows: 54.1 % ischemic stroke, 2.7 % hemorrhagic stroke, 3.8 % stroke UNS (CT not performed), 24.7 % TIA (CT performed), 7.8 % TIA (CT not performed) 0.7 % subarachnoid bleeding, and 6.1 % other neurological complications (seizures, confusion, peripheral nerve impairment). In 269 (79%) of the patients with ischemic stroke symptoms were observed within 3 hours of onset and 14 patients received reperfusion treatment; 11 thrombolysis, one thrombolysis + thrombectomy, and one thrombectomy. Of patients treated with thrombolysis ten had a good outcome and two suffered haemorrhagic complications.

*Conclusion:* Stroke as a complication to coronary interventions is rare but may be devastating. Good medical management to recognize stroke symptoms early and performing neuroimaging without delay is imperative as reperfusion treatment may be considered for ischemic complications and for patients with haemorrhagic complications medication need to be modified.

## Genetics, Proteomics, Metabolomics

### ESOC-1374

#### 13. GENETICS, PROTEOMICS, METABOLOMICS

##### Serum amyloid A (SAA) plasma levels as a predictor of infection in aneurysmal subarachnoid hemorrhage

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**Introduction:** Aneurysmal subarachnoid haemorrhage (aSAH) is associated with high rates of mortality/morbidity. Infections occurring just after the haemorrhage are one of the main causes of outcome worsening and death. Until now, no efficient blood biomarker is available for the early detection and prevention of this complication. The aim of this study was to use proteomics strategies to discover biomarkers for infection prediction in aSAH patients.

**Material and methods:** The plasma proteome of infected (n = 4) and non-infected (n = 4) patients was compared using the 10-plex tandem mass tag isobaric labelling quantitative mass spectrometry. Among the differentially expressed proteins SAA was selected for further ELISA verification in 54 infected and 27 no infected patients. The combination of SAA with clinical parameters was established using PanelomiX.

**Results:** At the day of infection, proteomic results gave rise to 17 significantly regulated proteins. Among those, SAA levels were significantly higher in infected patients than in no infected ones (ratio:15.86). Furthermore, we found that at the admission to the hospital its levels were significantly higher in patients that will develop an infection during hospitalisation (p = 0.002) reaching a performance of 75.3% (80% SP, 71.8% SE). Combining SAA with three clinical parameters (WBC, WFNS, age) improved its performance to an AUC of 94.4% (100%SP, 83%SE).

**Conclusion:** Our data suggested that the combination of SAA with clinical parameters could be an efficient tool for infection determination in aSAH patients. Their prediction capacity would potentially lead to an earlier antibiotherapy and improvement of the long-term outcome of these patients.

### ESOC-0628

#### 13. GENETICS, PROTEOMICS, METABOLOMICS

##### Exome array analysis on cerebral venous thrombosis: preliminary results

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The genetic component of cerebral venous thrombosis (CVT) is largely unknown and so far has been assessed only by candidate gene studies. To better understand the genetic basis of CVT, we have established an international consortium of CVT cases, the Biorepository to Establish the Aetiology of Sinovenous Thrombosis (BEAST), which currently includes 9 European research centres.

We have analysed exome array data of 374 European individuals with CVT and 2469 healthy controls from the 1958 Birth cohort part of the WTCCC (Wellcome Trust Case Control Consortium), genotyped using the Illumina HumanCoreExome BeadChip. After performing PCA (Principal Components Analysis) to remove outliers for population stratification, we have retained for analysis 147 CVT cases and 2152 WTCCC controls. We have applied rigorous quality control procedures and assessed the association of the genotyped variants with cerebral venous thrombosis using logistic regression.

We have identified several potential associated loci on chromosome 2, 6 and 9 at a significant  $P < 9 \times 10^{-7}$ . Interestingly, the associated locus on chromosome 6 is located within the human major histocompatibility complex, while the locus on chromosome 9 is located in and near ABO gene, suggesting potential implications of these regions in CVT. The locus on chromosome 2 does not seem to have an obvious role in CVT. However, these are preliminary results, and further additional analysis on an increased sample with matched CVT cases and controls followed by replication will be required to confirm these associations.

### ESOC-0111

#### 13. GENETICS, PROTEOMICS, METABOLOMICS

##### Developing a blood biomarker based stroke clock

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**Introduction:** Application of acute therapies for ischemic stroke is constrained because of diagnosis uncertainty and the dynamic nature of stroke biology. Developing a blood biomarker stroke clock which describes the evolution of stroke in an individual would make treating stroke easier.

**Methods:** Blood samples were collected from 8 male spontaneously hypertensive rats at 0, 1, 2, 3, 6 and 24 h post stroke induction by middle cerebral artery occlusion. RNA was extracted from whole blood stabilized in PAXgene tubes and mRNA expression was detected by oligonucleotide Affymetrix microarray.

**Results:** Using a pairwise comparison model, 2045 genes were identified to vary significantly over time ( $p \leq 10^{-7}$ ). Some of the top20 most changed genes are already known to be relevant to the ischemic stroke pathophysiology (e.g. Il-1R, Nos2, Prok2). Cluster analysis showed multiple stereotyped and time dependent profiles of gene expression. Direction and rate of change of expression for some profiles varied dramatically during these 24 h. Profiles with potential clinical utility including hyper acute or acute transient upregulation (with expression peaking from 2 to 6 h after stroke and normalisation by 24 h) were identified. Combining different genes profiles (e.g. Myo1E, Mrga10 and Prok2) will allow the construction of a tool capable of determining the stroke onset time.

**Conclusion:** Gene expression profiles vary acutely in the blood of rats after stroke and have the potential to allow the construction of a stroke clock and to have an impact on IS treatment decision making.

## ESOC-0396

### 13. GENETICS, PROTEOMICS, METABOLOMICS

#### A pharmacopigenetic study identifies genes with altered methylation associated with vascular recurrence in ischemic stroke patients treated with clopidogrel

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Antiplatelet therapy reduces vascular recurrence in ischemic stroke, however, there is variability in patient's response to this treatment. Genetic studies have described polymorphisms in CYP450 genes associated with resistance to clopidogrel. However none Epigenome Wide Association studies (EWAs) have been performed to analyze whether epigenetics is associated with clinical response (new vascular events) to clopidogrel.

**Methods:** From a cohort of 1.967 ischemic stroke patients, we selected 21 patients with a new vascular event (myocardial infarction, ischemic stroke or cardiovascular death) despite correct medication compliance and 21 patients without vascular recurrence during the first year of follow up. Epigenome was analyzed with the Infinium Human-Methylation Beadchip that detects >450.000 methylation sites. The replication cohort comprises 190 subjects with complete follow up and vascular recurrence data. The vascular recurrence was detected by telephone interviews and confirmed with a hospital medical record. All pre-processing, correction, normalization and analysis steps were implemented using R and Illumina GenomeStudio software package. Mann-Whitney U-test was used to analyze the levels of methylation.

**Results:** After quality filters, 452.449 CpG sites were analyzed. Four gene regions were found with p-values < 10<sup>-6</sup>, one site remained significant in the replication study (p < 0.05). A deep analysis of this region revealed another methylation site associated with vascular recurrence. These methylation sites were located in one TNF receptor associated factor gene, previously linked with atherosclerosis progression and with CD40L regulation.

**Conclusions:** We have successfully performed the first pharmacopigenetic study in clopidogrel treated patients suggesting that epigenetics are involved in vascular recurrence during clopidogrel treatment.

## ESOC-0997

### 13. GENETICS, PROTEOMICS, METABOLOMICS

#### How to discover brain specific stroke biomarkers? Immuno-laser microdissection of human neurons and blood brain barrier components coupled to label-free proteomics

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**Introduction and objectives:** The identification of changes in the human brain proteome after an ischemic stroke has allowed the discovery of new blood biomarkers to predict long-term functional disability. Analysis of the neurovascular unit components such as neurons and vessels, could give further insights into stroke pathophysiology.

**Methods:** Neurons and blood brain barrier units (BBB) from infarcted and healthy contralateral brain areas of 7 patients who died because of stroke were isolated by immunofluorescence staining followed by laser microdissection. Microdissected samples were analyzed through mass spectrometry using a label-free quantification method of the identified proteins. Gene ontology and pathways analyses were also conducted. Replication of interesting candidates was done by immunofluorescence in new human brain stroke samples.

**Results and discussion:** A total of 768 proteins in neurons and 1078 proteins in BBB were identified and quantified. When paired infarcted and contralateral areas were compared, 55 proteins from neurons and 23 proteins from BBB were differentially expressed (p < 0.05, fold-change >2, and peptide count ≥2), being mainly involved in mitochondrial dysfunction processes and associated with nervous system development. Top significant proteins only found in neurons, in BBB or in both neurovascular components were verified in the replication phase.

**Conclusions:** We were able to describe protein level changes in specific neurovascular components after stroke. These results highlighted novel candidates to be further explored as therapeutic targets or biomarkers for the diagnosis or prognosis of stroke.

## ESOC-1338

### 13. GENETICS, PROTEOMICS, METABOLOMICS

#### Differential gene expression by RNA-sequencing in sporadic brain arteriovenous malformations

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**Background:** The pathophysiology of sporadic brain arteriovenous malformations (BAVMs) remains largely unknown, and medical treatments are lacking. We used next-generation RNA-sequencing to identify differential expression on a transcriptome wide level comparing BAVM tissue samples to control samples of intracranial arteries to gain insight in the pathophysiology of BAVMs.



**Methods:** Single read (1 x 100 bp) RNA-sequencing was carried out on 12 resected BAVM specimens and 16 intracranial control arteries. Differentially expressed genes between BAVMs and controls were identified by negative binomial regression analysis including age as a covariate (False Discovery Rate (FDR) corrected p-value < 0.05). We performed functional pathway analysis, taking potential gene-length bias into account, to establish enhancement of biological pathways involved in BAVMs.

**Results:** Seven hundred thirty-six genes were upregulated in BAVMs including genes encoding for inflammatory cytokines and secretory products of neutrophils and macrophages. Furthermore, 498 genes were down-regulated including genes encoding for extracellular matrix and smooth muscle cell components, and genes of the transforming growth factor  $\beta$  signaling pathway. Functional pathway analysis showed enrichment of 17 biological pathways, of which protein digestion and absorption remained statistically significant after FDR correction.

**Conclusion:** We found evidence for involvement of inflammatory mediators and impaired vascular wall integrity in BAVM pathophysiology. The differentially expressed genes and pathways identified may aid in the identification of novel therapeutic targets in the future.

### ESOC-0983

#### 13. GENETICS, PROTEOMICS, METABOLOMICS Long alleles of the heme oxygenase 1 (HMOX1) promotor polymorphism associate with ulcerative carotid plaque and future thromboembolic events

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HMOX1 codes for HO1 enzyme, which degrades heme into bilirubin, iron and carbon monoxide, and maintains normal vascular function e.g. by acting as an antioxidant and modulator of vascular tone. We have previously shown HMOX1 is over-expressed in symptomatic carotid stenosis (CS). HMOX1 promoter contains GTn-repeat suggested to modulate HMOX1 expression: longer repeats have lower expression and weaker enzymatic efficacy during oxidative stress. We investigated whether HMOX1 promoter polymorphism associates with symptomatic CS and the risk of future thromboembolic events.

HMOX1 was genotyped in 85 CS patients and 964 population controls. Plaques were collected in endarterectomy and scored macroscopically for ulceration. Patients were divided into asymptomatic and symptomatic groups according to whether they had had ipsilateral ischemic symptoms during their lifetime and followed for a median of 12.7 years for thromboembolic events.

HMOX1 was highly polymorphic with 22 alleles which therefore were classified as long (>GT30), intermediate (GT30) and short (<GT30) for analysis. Symptomatic patients were more often carriers of long alleles (23%) than asymptomatic patients (8%,  $P=0.135$ ) or controls (16%,  $P=0.149$ ). Patients with ulcerative plaques carried significantly more often long alleles (35%) than patients with smooth plaques (9%,  $P=0.004$ ) or controls (16%,  $p=0.007$ ). In Cog regression analysis, the lack of a short allele significantly increased the risk of stroke (OR 4.31, 95%CI 1.11–16.68) and AMI (OR 4.15, 95%CI 1.42–12.17).

Long alleles of HMOX1 promotor polymorphism associate with ulcerative plaque phenotype and future stroke and AMI. HMOX1 genotyping might prove useful in cardiovascular risk stratification in specific target groups.

### ESOC-0379

#### 13. GENETICS, PROTEOMICS, METABOLOMICS Discovery of new brain ischemia biomarkers by MALDI Imaging Mass Spectrometry

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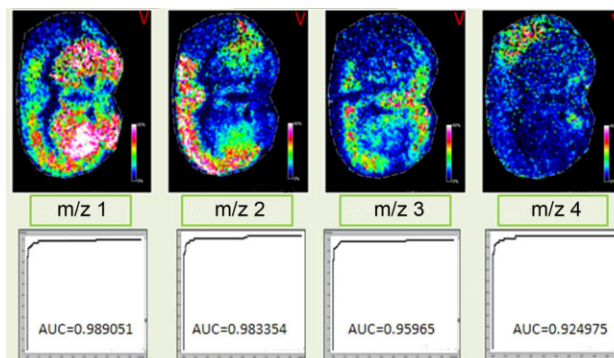
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**Introduction:** The use of biomarkers might be a complement for ischemic stroke diagnosis. MALDI Imaging-Mass-Spectrometry is a powerful technique that allows the protein distribution visualization along a tissue without labelling. Our aim is to study the distribution of proteins along mouse brain and to identify new potential biomarkers of brain ischemia. **Methods:** We performed a tMCAO (60 min) of C57BL/6J mice ( $n=4$ ) with 24 h of reperfusion (approved by VHIR ethics committee according Spanish and UE directives). We obtained brain sections for MALDI-TOF analysis. ROIs were defined on infarct and contralateral regions. The obtained mass spectra were analyzed by ClinProTools. We used PCA to select relevant m/z peaks and analyzed their capacity of discrimination by ROC curve analysis. Each m/z distribution was analyzed by Flex-Imagin3.0. Subsequent top-down and bottom-up approaches, as well as MaTIsse and MSImass list databases search, were developed to identify the protein related to each m/z.

**Results:** We identified 102 m/z with different abundances between the infarct and healthy contralateral regions ( $p < 0.05$ ). We selected 21 m/z by PCA and obtained their corresponding ion distribution maps. Thirteen m/z were found increased in the infarct region and 4 m/z showed ROC curves with AUC > 0.9 (Fig. 1). MaTIsse and MSImass list databases were used to predict the identity of 11 m/z. We identified 35 proteins by bottom-up approach that matched the MALDI-identified m/z.

**Conclusions:** For the first time, we identified by MALDI-Imaging-Mass-Spectrometry several m/z peaks with different abundances between infarct and contralateral regions of mouse brain that might represent potential biomarkers or therapeutic targets of ischemic stroke.



## ESOC-0786

### 13. GENETICS, PROTEOMICS, METABOLOMICS

#### Metabolomics discriminate etiologic subtypes among TIA patients

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**Introduction and aim:** The etiological classification of patients with transient ischaemic attack (TIA) could be difficult endeavor. Metabolomics provides the opportunity to identify new biomarkers and pathogenic pathways that could improve the diagnostic accuracy. Our aim was to discover, by using metabolomics, novel candidate biomarkers for the diagnosis of the different etiologic subtypes.

**Methods:** A cohort of 131 consecutive TIA patients <24 hours after symptoms onset was chosen. The cause of TIA was classified according to the Trial of ORG 10172 criteria: large-artery atherosclerosis (LAA, n = 33 [25.2%]), cardioembolism (n = 87 [17.6%]), small-vessel disease (n = 28 [21.4%]), undetermined (n = 47 [35.9%]).

**Results:** From the metabolome among the different causes, 93 m/z peaks differed (p < 0.05 by ANOVA Fisher's LSD) among the patients groups. Even we developed, by applying multivariate statistics, a partial-least square discriminant analyses model, its accuracy was low when considering all the 4 etiologic groups (i.e. less than 35%). However, when considering differentiation between two groups several metabolites showed ROC curve values higher than 0.7.

**Conclusion:** The different etiologic subtypes among TIA patients present specific metabolomics profile. This finding could be the first step for the discovery of new biomarkers that could improve the diagnostic work-up of stroke patients.

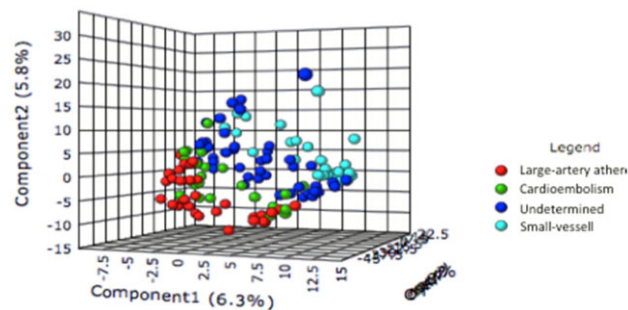


Fig. Tridimensional partial least squares discriminant analysis (PLS-DA)

## ESOC-1086

### 13. GENETICS, PROTEOMICS, METABOLOMICS

#### Circulating microRNA as potential biomarkers for patients with intracranial aneurysms

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**Background and purpose:** MicroRNAs (miRNAs) are single-stranded, small noncoding RNAs that regulate gene expression. Because they are stable in blood, they are being developed as biomarkers for different diseases. In intracranial aneurysms (IA) a major challenge is to develop efficient screening methods to prevent future aneurysmal subarachnoid hemorrhage (aSAH). We compared circulating miRNA expression levels in plasma of aSAH patients and patients with unruptured IA (UIA) to healthy controls to explore the usage of miRNAs as potential biomarkers for individuals at high risk of IA development and its subsequent rupture.

**Methods:** A total of 370 miRNAs were measured in plasma of 15 aSAH patients, of whom 11 had an additional UIA, and 15 healthy controls, using the serum and plasma specific miRNA array MIHS3016 (Qiagen). Significantly differentially expressed miRNAs (as defined by absolute fold change (FC) > 1.2 and p < 0.01) were validated using real-time (RT) PCR in an additional independent set of 15 aSAH patients, 15 patients with UIA and 15 controls.

**Results:** The miRNA array analysis showed differential expression of five miRNAs and three of these five miRNAs were validated in the independent set with miRNA-183-5p decreased in all patients (FC = -2.2, p = 1.7 x 10<sup>-3</sup>), miRNA-200a-3p increased in aSAH patients (FC = 1.8, p = 2.8 x 10<sup>-2</sup>) and miRNA-let7b-5p decreased in UIA patients (FC = -1.7, p = 1.27 x 10<sup>-3</sup>) as compared to controls.

**Conclusions:** Our results establish three circulating miRNAs as promising readily accessible blood biomarkers to be used to identify individuals at high risk of IA development and its subsequent rupture in the future.

## ESOC-1098

### 13. GENETICS, PROTEOMICS, METABOLOMICS

#### BIO Repository OF DNA In Stroke (BRAINS)

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**Introduction:** There is a genetic aetiology to sporadic ischaemic stroke. However, the genetics of such stroke in South Asians and Middle Eastern populations has been poorly investigated, partly as a result of few centres having access to enough subjects from this ethnic group. This is despite the fact that those of non-European descent have a high vascular event rate. The British Repository of DNA In Stroke (BRAINS) is a platform of several arms for collecting DNA in patients with different cerebrovascular diseases including TIA, AVMs, ischaemic and haemorrhagic stroke.

**Method:** We are recruiting DNA from highly characterised ischaemic stroke patients of South Asian and Middle Eastern ancestry in four countries: UK, India Sri Lanka and Qatar. Control subjects are also recruited. We propose to undertake a genome wide association study (GWAS) to identify susceptibility loci to ischaemic stroke and compare and contrast them to migrated Asians as well as against a Caucasian stroke population.

**Results:** In UK, we have recruited over 2393 subjects (98% cases). Total number of recruitment in India is 2190 subjects. Of these 51% (1119) are cases. In Sri Lanka 338 cases and 44 controls are recruited. In Qatar 290 cases are recruited to date.

**Conclusion:** BRAINS is designed to collect one of the largest repositories of DNA in ischaemic stroke patients from a South Asian and Middle Eastern ancestry.

**Funding:** This study is funded by the British Council/UKIERI, Henry Smith Charity, Dept of Health & Qatar National Research Fund.

## ESOC-1547

### 13. GENETICS, PROTEOMICS, METABOLOMICS

#### TXNIP gene associated to diabetes mellitus.

#### Genome-wide methylation analysis of ischemic stroke patients

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**Background:** Ischemic stroke is a heterogeneous multifactorial disorder. Diabetes mellitus (DM) is a risk factor for stroke. The prevalence of DM in acute ischemic stroke (IS) ranges from 15% to 44%. Hemoglobin A1c (HbA1c) screening is a method to diagnose DM (HbA1c levels  $\geq 6.5\%$ ). This serves as a marker for average blood glucose levels over the previous 8 weeks prior to the measurement. Epidemiological data provides evidence for a genetic component to the disease, but its epigenetic involvement is still largely unknown. Epigenetic mechanisms, such as DNA methylation, change over time and may be associated with aging processes and with modulation of the risk of various pathologies, such as cardiovascular disease, stroke and diabetes mellitus. Our goal was to identify CpG sites associated with diabetes mellitus and HbA1c levels.

**Methods:** We perform genome-wide methylation study in whole-blood DNA from 298 of ischemic stroke patients. HumanMethylation450 Bead-Chip array was used to measure DNA methylation in 426036 CpG sites.

**Results:** Our study identified successfully a novel CpG site: cg19693031 in TXNIP gene, Thioredoxin-interacting protein, ( $p = 1.02 \times 10^{-18}$ ) associated with DM. The methylation of this CpG site was inversely correlated to HbA1c, higher levels of HbA1c were associated to hypomethylation. Moreover, TXNIP has been previously associated with hyperglycemia in expression studies, being upregulated in most tissues in diabetes.

**Conclusions:** We identified a potentially novel CpG site in TXNIP gene associated to diabetes mellitus. Our study extends the evidence of DM related changes in DNA methylation.

Laboratory analysis revealed NOTCH3 Gene Mutations in 11 subjects. Four of these NOTCH3 mutations are new, not yet published (2x c.269G>A, 1x c5282G>A, 1x c3664T>G). One new NOTCH3 Mutation was found in 80 years old female patient and in all (!) her 5 asymptomatic children (c3664T>G).

We present a detailed description of all these cases with neuropsychological pattern as well as magnetic resonance brain imaging changes.

The significance of such molecular variants is discussed.

## ESOC-1525

### 13. GENETICS, PROTEOMICS, METABOLOMICS

#### Cluster of four new NOTCH3 mutations – detailed search – but all CADASIL?

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CADASIL is a rare inherited cerebrovascular disease associated with mutations in the NOTCH3 gene and represents the most common hereditary stroke disorder.

In the period of 2010–2014 we prospectively screened consecutive stroke patients (N = 1280) for suspicious CADASIL pattern (recurrent subcortical strokes, strokes of unknown origin, extensive or untypical white matter lesions, dementia, migraine headaches, positive familiar history).

## Hypertension, Hyperglycemia, Hyperthermia

### ESOC-0185

#### 14. Hypertension, Hyperglycemia, Hyperthermia Effect of single and dual renin-angiotensin blockade on stroke in patients with and without diabetes in VALIANT

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**Background:** Concern has been raised about a possible increase in risk of stroke in patients with diabetes treated with the combination of the renin-inhibitor aliskiren and an angiotensin converting enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB). We compared the rate of stroke in patients with and without diabetes treated with single or dual renin-angiotensin system (RAS) blockade after acute myocardial infarction (AMI).

**Methods:** We performed a *post-hoc* analysis of the Valsartan in Acute Myocardial Infarction trial (VALIANT) in which 14,703 patients with heart failure, left ventricular systolic dysfunction or both, were randomized to captopril (C), valsartan (V) or both (C + V) after 0.5–10 days after AMI and followed for a median of 2.1 years. We used Cox proportional-hazard regression to estimate the hazard ratios [HR (95% confidence intervals)] of stroke in each treatment group.

**Results:** Among patients with diabetes, 60/1303 (4.6%) receiving captopril, 60/1337 (4.5%) valsartan and 41/1340 (3.1%) valsartan plus captopril suffered a stroke: V + C vs. V or C HR 0.68 (0.47–0.96),  $p = 0.03$ . The corresponding numbers in patients without diabetes were 106/3606 (2.9%), 97/3572 (2.7%) and 99/3545 (2.8%): V + C vs. V or C HR 0.99 (0.78–1.26),  $p = 0.92$  (interaction  $p = 0.08$ ).

**Conclusions:** The risk of stroke after myocardial infarction in patients with diabetes was lower in patients treated with both an ACE inhibitor and ARB than in patients receiving either monotherapy.

### ESOC-1523

#### 14. Hypertension, Hyperglycemia, Hyperthermia Prehospital blood pressure differentiates stroke etiology

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**Introduction:** Elevated admission blood pressure (BP) in acute stroke is common, and differs among stroke etiologies. The relationship between prehospital BP and stroke etiology is unknown. We tested the hypothesis that higher prehospital BP values are associated with intracerebral hemorrhage (ICH) and lacunar stroke relative to other stroke etiologies.

**Methods:** A retrospective analysis of an Emergency Medical Services (EMS) centralized database of electronic patient health care reports (including serial BP measurements) of all patients with an EMS dispatch code for suspected stroke transported to the Emergency Department (ED) of a single hospital during an 18-month period. Stroke etiology was classified according to TOAST criteria.

**Results:** A total of 877 patients were transported by EMS to the ED with suspected stroke. Of these, 514 patients were diagnosed with acute stroke (360 ischemic, 103 TIA, 51 ICH). In ischemic stroke patients, etiology was large-artery atherosclerosis (14.4%), cardioembolic (37.5%), lacunar (12.8%), other determined etiology (4.7%), and cryptogenic (30.6%). Mean prehospital SBP was higher in ICH ( $172 \pm 32$  mmHg,  $p = 0.047$ ) than large-artery atherosclerosis ( $157 \pm 27$ ), cardioembolic ( $151 \pm 27$ ), other determined etiology ( $134 \pm 19$ ), and cryptogenic stroke ( $157 \pm 24$ ). Mean prehospital SBP in lacunar stroke was higher ( $169 \pm 32$  mmHg,  $p = 0.002$ ) than cardioembolic and other determined etiology. Higher rates of mean prehospital SBP  $\geq 180$  mmHg were found in ICH (43.1%) and lacunar stroke (41.3%) when compared to other etiologies ( $p < 0.001$ ).

**Conclusion:** Higher prehospital BP, particularly  $\geq 180$  mmHg, is associated with ICH and lacunar stroke. Elevated prehospital BP may represent an acute prehospital treatment target in acute stroke patients.

### ESOC-1346

#### 14. Hypertension, Hyperglycemia, Hyperthermia Temperature change, short- and long-term mortality in acute ischemic stroke

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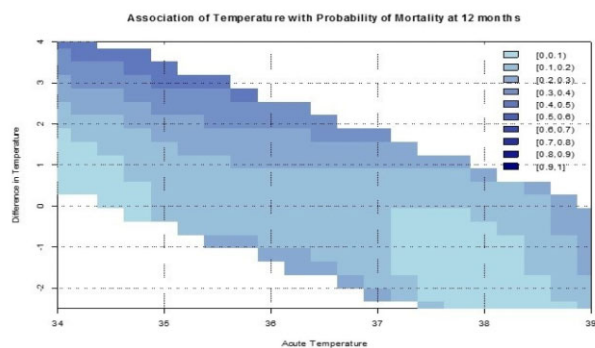
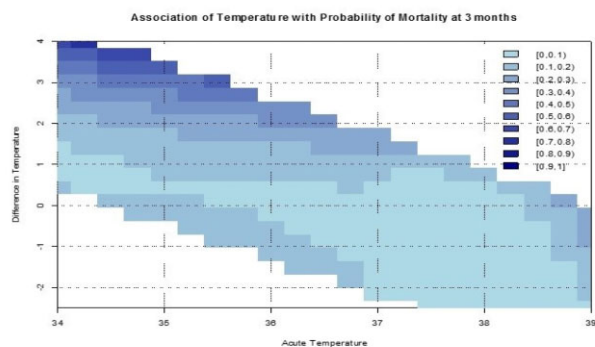
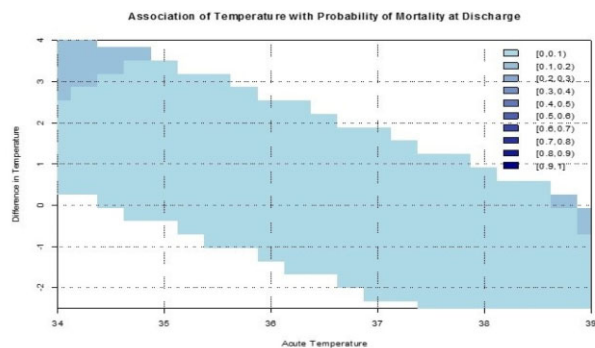
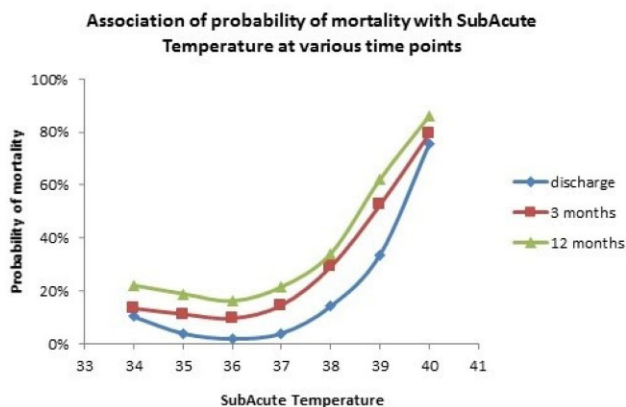
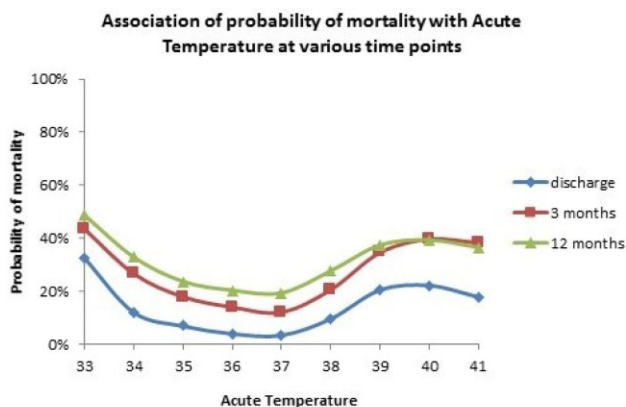
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**Aim:** The aim of the study is to explore the association between baseline temperature (T) levels, T change during the first 24 hours, and mortality in a representative acute ischemic stroke (AIS) population.

**Methods:** All patients registered in the Acute Stroke Registry and Analysis of Lausanne (ASTRAL) between 2003 and 2013 were analyzed ( $n = 2,555$ ). The outcome was mortality at 7 days, 3 and 12 months. A local polynomial surface algorithm was used to assess the effect of T values on the three outcomes.

**Results:** Hypo- and hyperthermic admission T values were associated with more unfavorable outcomes in the short- and long-term. This association disappeared with subacute hypothermia but strengthened with hyperthermia.  $T < 37^\circ\text{C}$  that increased over 24 hours was associated with a higher, and  $T > 37^\circ\text{C}$  that decreased with a lower mortality.

**Conclusions:** Both hypo- and hyperthermia on admission are associated with increased short- and long-term mortality after AIS. A T decrease of initially elevated body temperatures over 24 hours reduced mortality. We found little evidence that spontaneous hypothermia in the acute stage of stroke was associated with short- or long-term benefits.



## ESOC-0483

#### 14. Hypertension, Hyperglycemia, Hyperthermia The blood pressure variability increases only the day of neurologic deterioration in ischemic stroke

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**Introduction:** Blood pressure (BP) of the day and a day before early neurologic deterioration (END) was evaluated in patients with symptomatic cerebral artery occlusion.

**Method:** Patients who arrived within 24 h of onset, were not treated by recanalization therapy or failed to make a successful recanalization and

had a symptomatic occlusion at internal carotid artery and middle cerebral artery, were consecutively identified. In patients with END, the mean and standard deviation (SD) of systolic BP at the day and one-day before of END were estimated. In those without END, they were presumed according to the day of and one-day before median value of END.

**Results:** Of enrolled 131 subjects (age, 69.3 ± 12.4; median baseline NIHSS, 14), END were occurred in 41.2%. END occurred at median 2nd day (interquartile range, 1st–3rd day) of symptom onset. At the day of END, patients with END were showed significantly higher SD and mean of SBP compared to those without END (Table). At one day before END, mean of SBP was significantly associated with END (P = 0.05). In multi-variable analysis, one-SD increase of SBPSD at day of END independently increased 2.18 odds (95% confidence interval, 1.37–3.47) of END.

**Conclusion:** In acute ischemic stroke, daily assessment of BP variability would be helpful in predicting the onset of END.

**Table.** Daily BP parameters and END

	END (+)	END (-)	P
1 day before END			
SBPmean	142.5 ± 17.1	132.8 ± 15.7	<0.001
SBPSD	15.1 ± 5.6	14.4 ± 5.6	0.52
At day of END			
SBPmean	137.9 ± 18.2	131.7 ± 18.2	0.04
SBPSD	16.6 ± 7.9	12.1 ± 4.0	0.01

**ESOC-1516**

**14. Hypertension, Hyperglycemia, Hyperthermia Blood pressure lowering with transdermal glyceryl trinitrate is not associated with improvement in cerebral perfusion**

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<sup>1</sup>Medicine, University of Alberta, Edmonton, Canada

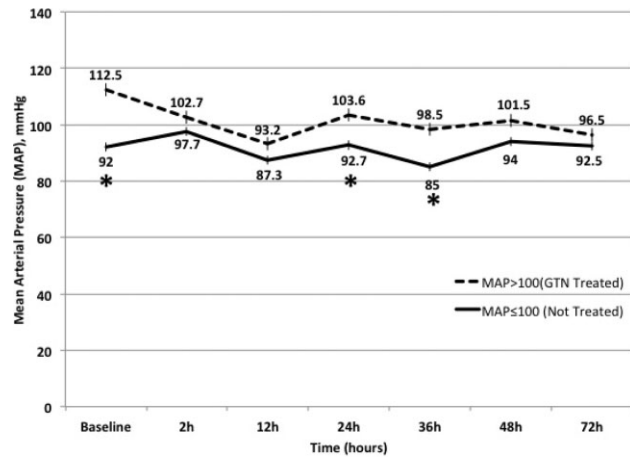
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**Background:** Hyper-acute treatment with the vasodilator glyceryl trinitrate (GTN) has been hypothesized to be beneficial in acute ischemic stroke, potentially via an increase in cerebral blood flow. We tested this hypothesis with serial perfusion-weighted MRI (PWI) in acute stroke patients.

**Methods:** Thirty-five patients underwent PWI immediately before and 72 h after BP management. Patients with mean baseline arterial blood pressure (MAP) >100 mmHg (n = 20) were treated with transdermal glyceryl trinitrate (GTN) (0.2 mg/h) for 72 hours without a nitrate-free interval. Patients with MAP ≤ 100 mmHg (n = 15) were not treated. The primary endpoint was the mean relative delay time (rDT) within the hypoperfused region.

**Results:** Mean ± SD baseline MAP was 112.5 ± 12 mmHg and 92 ± 7.5 mmHg in the GTN-treated and untreated groups (p < 0.0001). Baseline PWI was performed 22.9 ± 15 h after symptom onset. The mean baseline rDT was similar in the GTN-treated (3.9 ± 1.7 s) and untreated (4.3 ± 1 s, p = 0.4) groups. The median(IQR) baseline infarct volume was 7.2(49) ml in the GTN-treated group and 32.6(49.5) ml in untreated patients (p = 0.2). MAP in GTN-treated patients decreased by 11.4 ± 12.2 and 15.8 ± 23 mmHg at 2 h and 72 h respectively. Repeat PWI was performed at 72 ± 18 h. Mean rDT was unchanged in the GTN-treated (0 ± 1.2 sec) and untreated patients (0.2 ± 1.8 sec) and did not differ between groups (p = 0.9). Infarct growth was similar in both groups (3(13.9) ml vs. 15.5(45) ml, p = 0.1).

**Conclusion:** GTN is associated with a fall in BP in acute ischemic stroke patients, but there is no improvement in cerebral perfusion.



**Fig. 1** Temporal profile of mean arterial blood pressure (MAP) in glyceryl trinitrate (GTN) treated and untreated patients. \*p < 0.05

**ESOC-1530**

**14. Hypertension, Hyperglycemia, Hyperthermia Blood pressure reduction with labetalol/glycerine trinitrate does not affect cerebral blood flow in acute ischemic stroke**

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**Background:** Blood pressure (BP) reduction in acute ischemic stroke has been postulated to be harmful via reduced cerebral blood flow (CBF). We tested this hypothesis with stratified BP reduction in a 3-group non-randomized prospective study of serial CBF measurements.

**Methods:** Fifty-two patients underwent perfusion-weighted MRI (PWI) pre and 15 minutes following antihypertensive therapy. Treatment was stratified by mean arterial pressure (MAP); >120 mmHg (n = 14 patients): intravenous labetalol (5–20 mg) and sublingual (SL) glyceryl trinitrate (0.3 mg); MAP 100–120 mmHg (n = 19): SL glyceryl trinitrate(0.3 mg); MAP < 100 mmHg(n = 19): no antihypertensive drugs.

**Results:** Baseline PWI was performed at a mean ± SD 23.4 ± 15 h from symptom onset. Baseline mean relative CBF (rCBF) in hypoperfused tissue was 0.84 ± 0.17 in the MAP >120 group, 0.7 ± 0.2 in the MAP 100–120 group and 0.84 ± 0.17 in MAP < 100 group (p = 0.07). Median (IQR) hypoperfused tissue volume (CBF < 18 ml/min/100 g): MAP > 120:6(17.3) ml; MAP100–120: 8.9(70) ml, and MAP < 100: 32(41.4)ml(p = 0.05). The time between pre and post-treatment PWI was 26.3 ± 9.8 min. Median post-treatment MAP reduction was 12.5(12.9) mmHg in the MAP > 120 group, 6(16.4) mmHg in MAP100–120 group and 0.3(10) mmHg in the MAP < 100 group (p = 0.04). The mean post-treatment change in rCBF was similar in all 3 groups (MAP > 120: 0.03 ± 0.12, MAP 100–120: -0.06 ± 0.19, and MAP < 100: 0.01 ± 0.11, p = 0.5). Also, there was no difference in hypoperfused tissue volume after MAP reduction, between groups (MAP > 120: -0.2 ± 13.8 ml, MAP 100–120: -2 ± 17 ml, and MAP < 100: -1.9 ± 16.5 ml, p = 0.5).

**Conclusion:** Acute BP reduction in ischemic stroke does not exacerbate acute hypoperfusion severity or volume. The stability of CBF following antihypertensive therapy suggests these drugs may be safer acutely than has been assumed

## ESOC-0407

### 14. Hypertension, Hyperglycemia, Hyperthermia Chronic hyperglycemia is related to poor clinical outcome in acute ischemic stroke

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University Medical Center Utrecht, Utrecht, Netherlands

**Background and purpose:** Acute hyperglycemia (HG) is clearly associated with poor clinical outcome after ischemic stroke, but the relation between chronic antecedent HG and outcome is less clear. The aim of our study was to determine if chronic HG, measured by hemoglobin A1c (HbA1c), is associated with poor outcome in patients with acute ischemic stroke and to determine the role of acute HG in this context.

**Methods:** We included 812 patients participating in the Dutch Acute Stroke study (DUST) (mean age 66 ± 14 years; 61.5% male). Patients were categorized into 3 groups based on HbA1c level: no (<39 mmol/mol), moderate (39–42 mmol/mol) or severe chronic HG (>42 mmol/mol). Study outcome was poor clinical outcome after 3 months (Modified Rankin Scale >2). A subgroup analysis for patients with and without known diabetes was performed in the group with severe chronic HG.

**Results:** Severe chronic HG was associated with poor outcome (RR 1.40; 95% CI 1.09–1.79). After adjustment for admission glucose levels the RR was 1.27 (95% CI 0.96–1.67). Adjustments for vascular risk factors and stroke severity did not influence this association. The RR for poor outcome was higher in patients with severe chronic HG and known diabetes (1.52; 95% CI 1.12–2.07) than in patients with chronic HG without known diabetes (1.30; 95% CI 0.97–1.76). Moderate chronic HG was not associated with poor outcome (RR 1.12; 95% CI 0.87–1.44).

**Conclusion:** Severe chronic HG is related to poor clinical outcome in patients with acute ischemic stroke. This relation is only partially mediated by admission glucose levels.

## ESOC-0040

### 14. Hypertension, Hyperglycemia, Hyperthermia Measurement of blood pressure variability (BPV) in acute stroke: feasibility and patient satisfaction and acceptability of casual cuff, finometer and ambulatory blood pressure monitoring (ABPM)

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**Introduction:** BPV measured within 24 hours of stroke onset may predict outcome. How best to measure BPV and associated patient acceptability in the acute stroke period is uncertain.

**Methods:** Acute stroke patients were asked to complete a questionnaire relating to patient satisfaction on a range of BPV measurement devices (Figure 1); rating predetermined criteria on a visual Likert scale (0 to 10). Number of complete measurements obtained, and reasons for incomplete measures were recorded.

**Results:** Forty-five participants returned questionnaires. Survey results are shown (Figure 2). 22%, 10%, and 4% of participants reported pain, skin irritation and bruising with ABPM, respectively; only bruising (4%) was reported with the Finometer. Recording protocol was completed in

40% of 24 hour ABPM (mean duration 14 hours), 74% of Finometer recordings (mean duration 18 minutes), and 100% of casual BPs. Participant intolerance was the cause of incomplete recording in 77% of cases for ABPM, and 28% Finometer measures.

**Discussion:** Casual cuff, and Finometer monitoring was well tolerated, with few side effects. ABPM was often incomplete, and less acceptable to patients. These findings should inform the design of future studies assessing BPV in acute stroke.

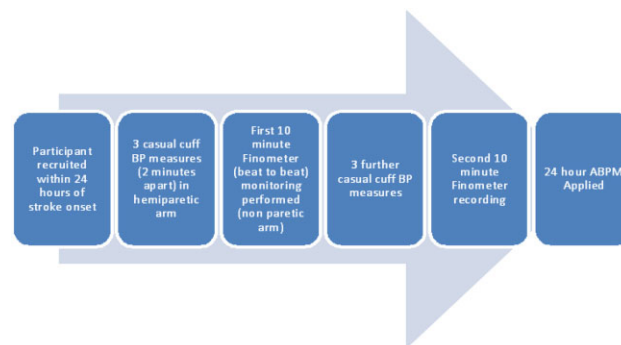


Fig. 1 BP monitoring procedures.

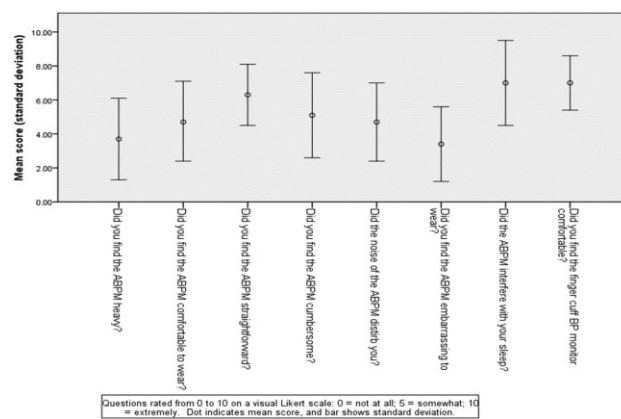


Fig. 2 Results of the patient survey for ABPM and beat to beat BP monitors.

## ESOC-0104

### 14. Hypertension, Hyperglycemia, Hyperthermia Prognostic significance of short-term acute stroke blood pressure variability (BPV): Post-hoc analysis of CHHIPS and COSSACS trials

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**Introduction:** Short-term BPV may predict acute stroke outcome. We undertook post-hoc data analysis from two RCTs to determine effect of short-term BPV on two-week outcome.

**Methods:** CHHIPS was de novo BP-lowering RCT of 179 patients within 36 h stroke onset. COSSACS was continue/ stop pre-existing antihypertensive therapy RCT in 763 patients <48 h stroke onset. Baseline BPV parameters (defined as standard deviation, coefficient of variation, varia-

tion independent of the mean, and average real variability) were derived from six standardised BPs (casual cuff BP measures over <30 minutes). Logistic regression models, adjusted for age, sex, stroke severity and mean BP, assessed relation between BPV and death/ disability (mRS > 3) at two weeks.

**Results:** Seven hundred six COSSACS and 171 CHHIPS participants were included. No BPV parameters were significantly associated with primary outcome (Table).

**Conclusion:** When derived from casual BP measures, short-term BPV is not a useful predictor of two-week outcome following acute stroke. However, BPV is not a single parameter, and differing methodology may account for the discordance with previous studies indicating longer-term (casual BPV) and short-term (beat-to-beat BPV) prognostic value.

Table: Effects of 1 SD increment in systolic BPV parameters on 2-week death/ major disability

	COSSACS OR (95%CI)	CHHIPS OR (95%CI)
Mean	0.97 (0.89 to 1.03)	1.06 (0.78 to 1.12)
Standard Deviation	0.98 (0.78 to 1.23)	0.97 (0.90 to 1.11)
Coefficient of Variation	0.98 (0.78 to 1.23)	0.89 (0.82 to 1.18)
Variation Independent of Mean	0.98 (0.78 to 1.22)	0.98 (0.85 to 1.12)
Average Real Variability	1.00 (0.80 to 1.26)	0.93 (0.90 to 1.12)

#### ESOC-0151

### 14. Hypertension, Hyperglycemia, Hyperthermia Newly-diagnosed diabetes and impaired fasting glucose are associated with unfavorable outcome in ischemic stroke patients treated with intravenous thrombolysis

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**Objectives:** Previously established type 2 diabetes is associated with worse outcome after intravenous stroke thrombolysis. We studied whether pre-diabetes and newly diagnosed diabetes are associated with unfavorable outcome in ischemic stroke patients treated with intravenous recombinant tissue plasminogen activator (IV-rtPA).

**Methods:** We studied 246 consecutive patients with ischemic stroke treated with IV-rtPA. In all nondiabetic patients, fasting glucose, 2-hour post-load glucose and HbA1c levels were determined on day 2–5. Prediabetes (classified as either impaired glucose tolerance, impaired fasting glucose or impaired HbA1c) and newly diagnosed diabetes mellitus were diagnosed according to current guidelines. Pre-existent diabetes was defined as the use of anti-diabetic medication prior to admission. Outcome measures were unfavorable outcome defined as a modified Rankin Scale score >2 at 3 months. We determined adjusted associations of prediabetes, newly diagnosed diabetes and pre-existent diabetes (versus normal glucose metabolism) with unfavorable outcome.

**Results:** Based on all three glucose tests combined, 81 patients (37%) were classified as prediabetics, 78 (35%) as newly diagnosed diabetics and 32 (15%) as pre-existent diabetics.

Newly diagnosed diabetes was independently associated with unfavorable outcome (aOR 2.9, 95%CI 1.0–8.3,  $p = 0.049$ ). Prediabetes was only associated with unfavorable outcome based on impaired fasting glucose (aOR 2.6, 95%CI 1.2–5.7). Pre-existent diabetes was also an independent prognostic factor of unfavorable outcome (aOR 2.8, 95%CI 1.1–6.9).

**Conclusions:** Newly diagnosed diabetes and impaired fasting glucose are associated with unfavorable outcome after intravenous stroke thrombolysis. This underlines the importance of further research on detection and glycemic control of these patients.

#### ESOC-0980

### 14. Hypertension, Hyperglycemia, Hyperthermia High blood pressure increases the risk of poor outcome for symptomatic intracranial large artery stenosis and occlusions: subgroup analysis of the CICAS Study

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**Purpose:** We went on this study aimed to reveal how blood pressure influences on prognosis of stroke at different severity of stenosis.

**Methods:** Data on 2426 patients in the Chinese Intracranial Atherosclerosis (CICAS) Study were analyzed. According to JNC 7, we classified blood pressure as four subgroups: normal, pre-hypertension, hypertension stage I, hypertension stage II. Poor outcome were defined as death and dependence (MRS 3–5) at discharge or 1 year. According to the severity of stenosis, we classified patients into <50% or no stenosis, 50% to 69% stenosis, 70% to 99% stenosis, and occlusion.

**Results:** During the follow-up period, there were 652 (26.88%) poor outcomes at discharge and 436 (17.97%) poor outcomes at 12-month. For patients with intracranial stenosis 70% to 99%, the rate of poor outcome at discharge were 19.25%, 23.53%, 26.67%, and 39.66% ( $P = 0.001$ ) for each blood pressure subgroup (from pre-hypertension to Hypertension Stage II). For patients with intracranial large artery occlusion, the rates were 17.59%, 22.11%, 29.53%, and 49.75% respectively ( $P < 0.0001$ ). Poor outcome rate at 12-month were 12.56%, 15.30%, 28.50%, 27.90% ( $P = 0.0038$ ) in patients with stenosis 70% to 99% for each blood pressure subgroup and 11.60%, 21.50%, 23.90%, 35.08% ( $P < 0.0001$ ) in patients with occlusion. For patients with stenosis of 50%-69%, the rate of poor outcome had no significant difference among blood pressure subgroup.

**Conclusions:** For patients with severe intracranial stenosis and occlusion, higher hypertension stage is associated with increased risk of poor outcome at discharge and 12-month. This results support lowering blood pressure therapy for those patients.

#### ESOC-0602

### 14. Hypertension, Hyperglycemia, Hyperthermia No relation between body temperature and arterial recanalization in patients with acute ischaemic stroke

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**Background:** Recanalization of an occluded intracranial artery is influenced by temperature-dependent enzymes. Lower temperatures reduce *in vitro* activity of alteplase, but whether it also affects *in vivo* recanalization is uncertain. We assessed the relation between body temperature on admission and recanalization of an occluded intracranial artery in patients with acute ischemic stroke, treated with or without intravenous alteplase.



*Methods:* Patients with acute ischemic stroke admitted within nine hours after symptom onset underwent non-contrast CT and CT angiography (CTA) in a multi-center cohort study. This substudy included all patients with a visible intracranial arterial occlusion on admission CTA and follow-up vascular imaging at 3 ( $\pm$  2) days. The relation per 0.1°Celsius increase in admission body temperature and recanalization at three days was calculated using logistic regression, and expressed as odds ratios (OR) with corresponding confidence interval (CI). Subgroup analysis was performed with regard to treatment with alteplase.

*Results:* Two hundred seventy-eight patients with 288 occluded intracranial arteries were included in this study. Recanalization occurred in 73% of occluded arteries. There was no relation between body temperature on admission and recanalization of the occluded artery observed at day 3 (crude OR per 0.1°C, 0.98; 95%CI, 0.93–1.03;  $P = 0.37$ ), or after adjustment for age, NIHSS score and treatment with alteplase (aOR, 0.99; 95% CI, 0.94–1.05;  $P = 0.70$ ). Results for patients treated or not treated with alteplase were essentially the same.

*Conclusion:* In patients with acute ischemic stroke and intracranial artery occlusion, body temperature on admission has no effect on arterial recanalization, irrespective of treatment with intravenous alteplase.

## Risk Factors for Stroke/Prognosis

### ESOC-0453

#### 15. Risk Factors for Stroke/Prognosis Ramadan fasting in patients with ischemic cerebrovascular disorder

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**Objective:** To investigate the effect of Ramadan fasting in patients with ischemic cerebrovascular stroke.

**Background:** Ramadan is the holy month in Islam during which time millions of adult Muslims abstain from intake of food and drink from sunrise to sunset, Ramadan has fallen during the longest and hottest days of the year in the Northern Hemisphere which adds to the challenge of observing the fast.

**Methods:** Descriptive cross sectional approach was selected for conducting this study during Ramadan and one month following Ramadan for 2 consecutive years 2012–2013, a total of 392 patients were studied over 4 months.

**Results:** There was no significant difference regarding overall stroke frequency or severity in Ramadan. The age was significantly higher among the non fasting, the duration of diabetes and hypertension was also significantly higher among the non fasting contrary to smoking which was higher among the fasting group. 72.7% of the fasting group were advised not to fast, while 93.4% in the non fasting group were advised not to fast. the most common location for the stroke in the fasting group was anterior circulation with a statistically significant difference between fasting and non fasting groups. There was no statistically significant difference regarding vital signs and laboratory results except for serum sodium level which was higher among the non fasting. There was a significant shift of circadian rhythm, of stroke onset from 6 am–12 pm to 12 pm–6 pm.

**Conclusion:** That Ramadan fasting has no significant effect on ischemic strokes frequency and severity.

### ESOC-1567

#### 15. Risk Factors for Stroke/Prognosis Mortality associated with intracranial parenchymal hemorrhage in anticoagulated patients

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**Introduction:** Non-traumatic intracranial parenchymal hemorrhage (ICH) is associated with high mortality, especially in anticoagulated patients. Clinical data comparing vitamin K antagonists (VKA)-related ICH and non-vitamin K antagonists (NOAC)-related ICH are still missing. The absence of validated therapies to revert anti-thrombotic effect in NOAC-related ICH is still a matter of discussion.

**Objectives:** Survival analyses of patients suffering from acute ICH according to previous anti-thrombotic therapies.

**Methods:** We retrospectively included consecutive patients admitted to a tertiary center, from August 2012 to August 2014, with the diagnosis of ICH and at least 3 months follow-up. Demographic, clinical, analytic and imagiologic data were obtained by consultation of clinical and national obit records. We used Cox Regression for survival analysis, adjusted for age. Statistical significance was defined for  $p < 0.05$ .

**Results:** We included 250 patients, mean age 72.18 (SD 12.12) years, 149 (59.6%) males. In this sample, 31 patients were anticoagulated – 23 with VKA and 8 with NOAC. Fourteen (60.1%) of the VKA-related ICH received coagulation reversal. Anticoagulated patients presented higher mortality when compared with non-anticoagulated patients: hazard ratio (HR) 1.056 (95% CI: 1.031–1.082,  $p < 0.001$ ) in VKA-related ICH and HR 1.05 (95% CI: 1.025 – 1.075,  $p < 0.001$ ) in NOAC-related ICH. There was no significant difference between VKA and NOAC-related ICH (HR 1.048, 95% CI 0.982–1.119;  $p = 0.155$ ).

**Conclusion:** Mortality is similar between ICH patients pretreated with NOAC or VKA, despite anticoagulation reversal in VKA-related ICH.

### ESOC-0486

#### 15. Risk Factors for Stroke/Prognosis Impact of organized stroke care in a tertiary care setting

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**Background and aim:** Organized stroke care essentially improves prognosis and reduces complications in Acute Stroke. Our aim is to determine the impact of establishing an organized stroke service at a tertiary hospital on patient's outcome.

**Methods:** Organization of stroke service started in April 2014, with formation of Stroke ward, stroke registry, hiring stroke coordinators & nurse specialist, & setting protocols for thrombolysis, care pathways & investigations. A dedicated multidisciplinary team formed for patient care, evaluating performance measures & coordinating consultations. Outcome measures were mortality, thrombolysis rate, disposition, length of stay (LOS), & complications.

**Results:** Thrombolysis rate increased from 5% to 9%, with mean door-CT time of 21 mins, & mean door-needle time of 51 minutes. Even 17.6% patients got tPA within 30 minutes of arrival. About 66% admitted directly to stroke ward compared to other wards ( $p = 0.001$ ). ICU admissions reduced from 17.4% to 11% ( $p = 0.001$ ). Mean investigation time (echo, carotid US, neuroimaging) was 3.1 days. Complications reduced from 43.5% to 10% ( $p = 0.001$ ), especially aspiration pneumonia (38.5% to 6.3%,  $p = 0.001$ ), UTI (14% to 3.8%,  $p = 0.001$ ), & bedsores (33.3% to 3.0). LOS (<4 days) improved from 45.5% to 57% ( $p = 0.001$ ), while 19% transferred to rehabilitation. Significantly improved mRS ( $\leq 2$ ) at 3-months follow-up (from 57% to 81.5%,  $p = 0.002$ ).

**Conclusions:** Establishing an organized stroke care in a tertiary hospital not only improves care of stroke patients, but also increases proportion of patients discharged home to live independently. This also reduces health costs spent in overall care of stroke patients.

### ESOC-1016

#### 15. Risk Factors for Stroke/Prognosis Newly diagnosed diabetes and prediabetes adversely effects outcome following acute ischemic stroke

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**Background and aims:** To describe the clinical characteristics and prognosis of ischemic stroke (IS) in patients with newly diagnosed diabetes (NDM) and pre-diabetes (PDM) compared to patients with DM and non-DM patient.

**Methods:** We analyzed our prospective stroke registry for diabetes. Patients were classified as non-DM (HbA1c < 5.7%), PDM (HbA1c 5.7 to

6.4%), and known DM. Demographics and clinical characteristics (admission NIHSS) and outcome were compared in all three groups.

**Results:** Of 894 patients in our stroke registry, 402 (45%) had DM, while 8.5% had NDM and 15.8% PDM. Of 15.8%, PDM was significantly more common in less than 50 years of age (47% vs 43.5%,  $p = 0.001$ ). Smoking was more common in PDM patients (26.8%) vs NDM (22%) and known DM (16%) ( $p = 0.01$ ). Hypertension was more common in patients with PMN ( $p = 0.001$ ). PDM was more common in Asians (110/141- 78%) vs Arabs (27/141- 19%),  $p = 0.001$ , along with NDM -57/76 vs 17/76(75% vs 22.4%,  $p = 0.001$ ). Stroke was more severe in PDM and NDM (55.4%) vs known DM (48%)  $p = 0.001$ . PDM and NDM are more likely to be disposed to rehabilitation vs DM (25.5% vs 16.2%,  $p = 0.01$ ). At discharge known DM were significantly better (mRS  $\leq 2$ ) as compared to PDM and NDM (45% vs 16.4% vs 9.0%,  $p = 0.06$ )

**Conclusion:** PDM and NDM are prevalent at an alarming level in an early age in this population with ischemic stroke. The poor outcome in such patients suggests that aggressive stroke prevention strategies need to be implemented early to prevent vascular events in the community.

## ESOC-0511

### 15. Risk Factors for Stroke/Prognosis

#### Clinical characteristics of acute intracerebral hemorrhage patients with progressively worsening symptoms during aggressive antihypertensive therapy: The SAMURAI-ICH Study

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**Objectives:** Antihypertensive therapy for acute intracerebral hemorrhage (ICH) may reduce the risk of hematoma expansion and recurrent hemorrhage. However, appropriate blood pressure levels have not been clarified because of concerns about ischemic damage in the periclot area resulting from aggressive blood pressure lowering. We aimed to elucidate the clinical characteristics of acute ICH patients whose symptoms progressively worsened during aggressive antihypertensive therapy.

**Subjects and methods:** A total of 211 patients with acute supratentorial ICH were enrolled in the SAMURAI-ICH study. All patients received a continuous nicardipine infusion within 3 h of onset (target systolic blood pressure, 120–160 mmHg). Characteristics of patients with marked exacerbation of neurological symptoms (National Institutes of Health Stroke Scale [NIHSS] score progression  $\geq 4$  points) within 72 h after admission were retrospectively investigated.

**Results:** Of the 211 patients, 5 experienced marked exacerbation of neurological symptoms and 206 did not. Clinical characteristics such as underlying disease and initial hematoma volume on admission (exacerbation group,  $16.5 \pm 13.9$  ml; non-exacerbation group,  $14.8 \pm 13.1$  ml) were not significantly different between the groups. In the exacerbation group, follow-up hematoma volume ( $56.7 \pm 59.5$  ml vs.  $17.2 \pm 15.7$  ml) and hematoma expansion after 24 h (volume,  $40.2 \pm 56.0$  ml vs.  $2.3 \pm 6.6$  ml; percentage,  $226.3 \pm 286.1\%$  vs.  $17.6 \pm 49.9\%$ ) were significantly greater ( $p = 0.000$ ) and total NIHSS score including level of consciousness, best gaze, facial, and leg motor palsy up to 72 h was significantly worsened ( $p$ )

**Conclusion:** Hematoma growth rather than brain ischemia caused early progression in patients with acute ICH under the aggressive blood pressure lowering in the SAMURAI-ICH study.

## ESOC-0201

### 15. Risk Factors for Stroke/Prognosis Door-to-stroke unit time and post-stroke complications rate of stroke patients admitted during month of Ramadan: A single center experience

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**Objectives:** Little is known about the impact of admission during month Ramadan on acute stroke patients. We examine the relation between admission during month of Ramadan on boarding time from emergency department to the stroke unit and occurrence of in-hospital complications.

**Methods:** Data was collected prospectively as part of local hospital registry and for quality purpose at king Abdulaziz Medical City in Riyadh from December 2011 till December 2013. Independent sample t test and Chi-squared were used to investigate whether the mean door-to-stroke unit time and in-hospital-post stroke complications significantly differed between Ramadan/non-Ramadan months. Stroke complications was defined as composite variable of any of the multiple stroke-related complications and death.

**Results:** A total of 604 stroke cases were admitted to the ER and subsequently to the stroke unit of which 41 cases (8.1%) were admitted during the Muslim holy month of Ramadan). A total of 93 patients (15.4%) developed one or more of the stroke-related complication. Door to stroke unit time ranged from 1.2 to 754 hours, with a median of 33.8 hours (IQR: 20.5 to 67.3). Door-to-stroke unit time did not significantly differ between Ramadan (64.2 hrs) non-ramadan (61.4 hrs) admission time ( $t = 0.22$ ,  $P = 0.81$ ) The incidence of post- stroke-related complication did not significantly differ between Ramadan 79.6%) non-Ramadan (85.0%) admission time ( $\chi^2 = 1.03$ ,  $P = 0.31$ ).

**Conclusion:** our study suggest that admission of acute stroke patients during month of Ramadan has no impact on boarding time and post-stroke in-hospital complications.

ESOC-1535

**15. Risk Factors for Stroke/Prognosis**  
**Risk factors for stroke in symptomatic vertebrobasilar disease: Results of the prospective international multicenter VERITAS Study**

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*Introduction:* Atherosclerotic vertebrobasilar disease (VBD) is the most important cause of posterior circulation stroke. Risk factors for recurrent stroke were examined in the prospective multicenter Vertebrobasilar Flow Evaluation and Risk of Transient Ischemic Attack and Stroke (VERITAS) Study.

*Methods:* Patients with recent vertebrobasilar (VB) TIA or stroke and ≥50% atherosclerotic stenosis or occlusion in vertebral and/or basilar arteries were enrolled. In addition to demographic, clinical and angiographic risk factors, hemodynamic status using large vessel flow in the VB territory measured with quantitative MRA was evaluated. All patients had standard medical management and follow-up assessment for primary outcome event of VB territory stroke. Hazard ratios (HR) and corresponding CI were calculated with Cox proportional hazard models.

*Results:* The cohort (n = 72, 44% female) had a mean age of 66 (range 40 to 90) years. Ten VB strokes occurred during median follow-up of 23 months. On univariate analysis, younger age (≤65 years), low distal flow status, diabetes, and coronary disease were significant predictors of subsequent VB stroke (p<0.25). On multivariate analysis age and flow status remained the strongest predictors.

Variables	HR (95%CI)	P value
Flow status, low	9.4 (2.4–37.6)	<.01
Age, ≤65	21.8 (2.4–196.4)	<.01
CAD	4.8 (1.2–18.6)	.02
DM	4.4 (1.1–17.8)	.04

*Conclusions:* Risk of subsequent VB stroke in patients with symptomatic VBD is highest in younger patients and those with distal flow compromise.

ESOC-0449

**15. Risk Factors for Stroke/Prognosis**  
**Risk of stroke in migraine patients using triptans**

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*Background:* Stroke is associated with migraine in recent meta-analyses. There is no information, however, on the association between stroke and the migraine sub-group using triptans known for their effect on contractile 5-HT<sub>1B</sub> receptors. We studied risk of stroke in migraine patients having used triptans for migraine headaches.

*Methods and material:* The study is based on the entire Danish population (18–80 years) during 2003–2012 (329.1 mill. person years). Users of triptans within 5 years prior to stroke were identified using the Danish Registry of Prescriptions covering all prescriptions by physicians in Denmark. Hospital admissions for stroke were obtained from the Danish Stroke Registry covering all admissions for stroke in Denmark. Information on age, gender and, income/education was obtained from Statistics Denmark. Multivariate regression statistics were used.

*Results:* During 2003–2012, 49711 hospital admissions for stroke were identified. Among these 1084 strokes were identified among users of triptans (2.3 mill. person years). Adjusting for age, gender, income and education risk of stroke was significantly higher among users of triptans. All (RR 1.08;1.01–1.14); females (RR 1.10 CI 1.02–1.18); males (RR 1.07 CI 0.96–1.19). Risk was increased for ischemic strokes (RR 1.07 CI 1.00–1.14) but not for hemorrhagic strokes (RR 1.18 CI 0.95–1.5). Risk was age dependent: RR 1.6–1.7 for women (25–40 years); RR 1.3–1.5 for men (35–45 years) (p < 0.001). At ages > 55 years RR was ≤1.0 (p > 0.05).

*Conclusions:* Risk of ischemic stroke is increased in migraine patients using triptans primarily at ages 25–45 years. Most probably the result of migraine rather than using triptans.

ESOC-1372

**15. Risk Factors for Stroke/Prognosis**  
**Adherence to Mediterranean Diet in patients with acute ischemic stroke: relationships between Mediterranean Diet score and diagnostic subtype and stroke severity indexes**

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*Background:* Mediterranean Diet has become the standard for healthy eating.

*Aim of the study:* We conducted a retrospective study to evaluate the association between Mediterranean Diet adherence, TOAST subtype and stroke outcome.

*Methods:* The type of acute ischemic stroke was classified according to the TOAST classification. At admission to our ward we administered to all patients admitted with acute ischemic stroke or to their relatives a 137-item validated food-frequency questionnaire adapted to Sicilian population. A scale indicating the degree of adherence to the traditional Mediterranean diet was used (range 0–9).

**Results:** We enrolled 198 subjects with acute ischemic stroke and 100 control subjects without acute ischemic stroke. Among stroke patients, lacunar subtype showed a higher mean Mediterranean diet score compared to LAAS subtype. Multinomial logistic regression analysis in multiple model showed that mean Mediterranean Score resulted predictive of SSS ( $p = 0.0001$ ), NIHSS ( $p = 0.0001$ ) and rankin ( $p = 0.0001$ ) scores.

**Conclusions:** Our study show as a low adherence to a Mediterranean diet style is associated with stroke prevalence and how a low adherence to this type of dietary pattern is associated to LAAS stroke subtype and a worse stroke clinical profile evaluated by means NIHSS and rankin score. We reported that patients with lower adherence to a Mediterranean Diet profile are more likely to have an atherosclerotic (LAAS) subtype of stroke, a worse clinical presentation of ischemic stroke with a higher mean NIHSS and a dependency with higher rankin score at admission.

### ESOC-1533

#### 15. Risk Factors for Stroke/Prognosis

##### Vessel wall imaging at 3.0-Tesla MRI in patients with intracranial vessel disease and in healthy controls

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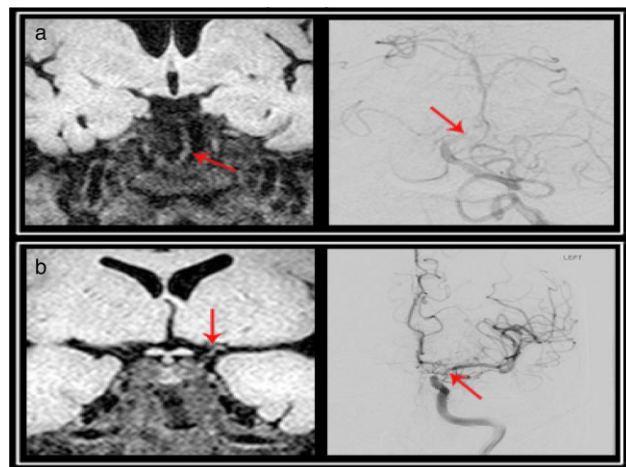
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**Purpose:** To translate a recently-proposed ultra-high field (7 Tesla) MRI protocol for assessing intracranial (IC) vessel wall morphology to the clinically available field strength of 3T to enable vessel wall imaging (VWI) routinely without contrast agent administration.

**Methods:** Following protocol development, IC stenosis patients ( $n = 16$ ) and healthy volunteers ( $n = 16$ ) provided informed, written consent and underwent FLAIR, angiography, and a custom VWI protocol (3D turbo spin echo, TR = 1500 ms; spatial resolution = 0.5 mm isotropic, and anti-driven +90 equilibrium pulse). A board-certified neuroradiologist reviewed all images.

**Results:** Vessel wall abnormalities were detected in all (12/16) participants with significant (>50%) flow-limiting stenosis on angiography. Fig. 1 demonstrates changes for two individuals with VWI lesions. Two participants had advanced moyamoya disease and extensive collateralization on DSA, both of whom had corresponding findings on VWI.

**Discussion:** We show that it is possible to perform VWI without contrast at 3T and still retain an acceptable image quality for discerning IC vessel abnormalities. Parallel work is focused on characterizing relationships between vessel wall disease and parenchymal reactivity.



**Fig. 1** (a) 57 yr/M with basilar artery stenosis. VWI (left) in the coronal plane shows hyperintense signal of a vessel wall lesion in the basilar artery

(red arrow). AP projection from left vertebral injection during DSA (right) shows corresponding stenosis (red arrow). (b) 53 yr/M following L MCA territory stroke. VWI (left) demonstrates wall thickening (red arrow) of left distal ICA continuous in the left proximal MCA which corresponds to stenosis on DSA (right, AP view from L ICA injection).

### ESOC-1569

#### 15. Risk Factors for Stroke/Prognosis

##### Relationship between blood pressure control and arterial stiffness, carotid artery and retinal damage in hypertensive patients with and without type 2 diabetes mellitus

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**Background:** Complex interactions between several vascular risk factors are often present in the genesis of stroke. Better understanding the weight of each player in causing macrovascular and microvasculature disease could help delineating more effective stroke preventive strategies.

**Aim:** In an arterial hypertensive population we aimed to compare the effect of associated Diabetes Mellitus (DM) on macro and microvascular disease.

**Methods:** We compared type 2 DM and non-DM hypertensive subjects, regarding macrovascular damage markers – aortic stiffness by pulse wave velocity (PWV) and carotid plaques and IMT by duplex ultrasound – and microvascular disease as assessed by retinal microvascular signs (RMS) on fundus photograph

**Results:** Hypertensive patients with DM ( $n = 71$ ) were more frequently male (60 vs 40%,  $p = 0.020$ ), older ( $62 \pm 8$  vs  $57 \pm 13$ ,  $p = 0.007$ ), had higher 24 h Systolic BP ( $p = 0.003$ ), HgA1c ( $p < 0.001$ ) and lower HDL ( $p = 0.014$ ) and LDL ( $p = 0.010$ ) values than non-DM ( $n = 84$ ). DM group presented higher PWV ( $11.5 \pm 1.8$  vs  $10.5 \pm 1.7$  m/s,  $p = 0.001$ ), mean IMT ( $0.78 \pm 0.16$  vs  $0.70 \pm 0.19$  mm,  $p = 0.003$ ), presence of carotid plaques (68 vs 38%,  $p < 0.001$ ), any retinopathy (62 vs 42%,  $p = 0.009$ ) and RMS score ( $2.3 \pm 2.8$  vs  $1.4 \pm 2.1$ ,  $p = 0.026$ ). Systolic BP more strongly associated with PWV ( $p < 0.001$ ) and IMT ( $p = 0.001$ ), and HgA1c values more strongly associated with IMT ( $p < 0.001$ ) with RMS higher score ( $p = 0.009$ ).

**Conclusion:** In hypertensive patients, DM contributes to both macro and microvascular disease. Whereas aortic stiffness depends mainly of BP control, DM glycaemic control concurs in determine cerebrovascular risk.

### ESOC-1482

#### 15. Risk Factors for Stroke/Prognosis

##### Long-term survival of the first-ever stroke – an hospital-based study

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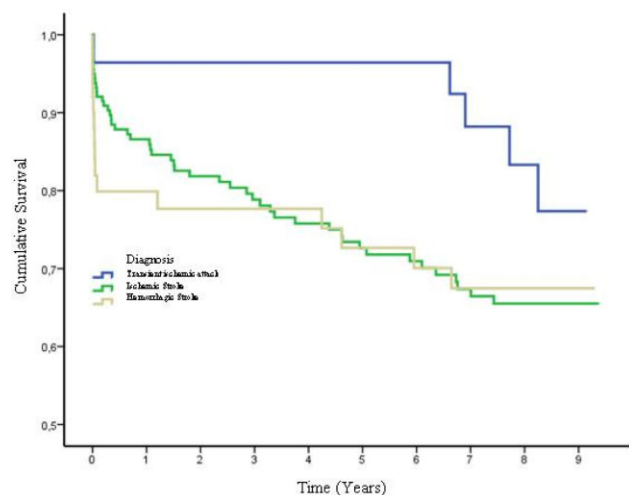
**Background:** Long-term prognosis of cerebrovascular disease isn't completely known. This study aims to determine the survival after the first-

ever transient ischemic attack (TIA) or stroke and ascertain whether there are significant differences in survival depending on pathological type.

**Methods:** Retrospective analysis of patients that attended to Centro Hospitalar do Porto, in 2004, with a first-ever TIA/stroke. The patients' characteristics were registered according to stroke type. They were followed for 9,4 years through hospital and primary care records. The overall survival was calculated by the Kaplan-Meier method. A Cox regression model was used to estimate the effect of potential predictors of survival.

**Results:** From the 504 patients admitted with TIA/stroke, 181 were excluded because a previous TIA/stroke and for 61 there wasn't enough information available. We included 262 patients, with an equal gender distribution and a mean age of  $67,7 \pm 15,1$  years. The mean follow-up time was  $5,0 \pm 3,6$  years, in which 132 patients (52,8%) died, with a mean survival rate of 7,2 years (CI95%:6,6–7,7). Survival is significantly better for TIA (8,5 years; CI95%:7,8–9,2) than for ischemic (7,0 years; CI95%:6,5–7,6) or hemorrhagic strokes (6,9 years; CI95%:5,8–7,9). Univariate analysis showed that significant predictors of death were age (HR:1,03; CI95%:1,01–1,05), acute kidney injury (AKI) (HR:3,21; CI95%:1,23–8,01) and chronic kidney disease (CKD) (HR:3,49; CI95%:1,09–11,2), atrial fibrillation (AF) (HR:1,90; CI95%:1,01–3,33) and dementia (HR:3,41; CI95%:1,24–9,38). In multivariate analysis this relationship was found for age (HR:1,03; CI95%:1,01–1,05), CKD (HR:4,09, CI95%:1,26–13,3) and AKI (HR:3,39, CI95%:1,32–8,71).

**Conclusions:** TIA patients had a better long-term survival compared with stroke. Globally, patients with worse survival were the elderly and those with kidney disease, AF or dementia.



## ESOC-1422

### 15. Risk Factors for Stroke/Prognosis Functional outcome and recurrence between embolic stroke of undetermined source (ESUS) and cardioembolic stroke in a Mexican cohort

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**Background:** The term embolic stroke of undetermined source (ESUS) has been recently introduced. Our aim is to analyse early and long-term functional outcome, recurrence and death, between patients with ESUS and Cardioembolic Stroke (CS).

**Methods:** We recruited Mexican mestizo patients from our institutional database, classified as cryptogenic and CS according to ASCOD etiologic criteria, with the qualifying event from 2003 to 2013. The criteria

proposed by the Cryptogenic Stroke/ESUS International Working Group were applied to identify all ESUS patients. Demographic, clinical, laboratory, imaging and functional outcome characteristics were collected. The endpoints were bad outcome (Modified Rankin Score 3–6), recurrence and mortality at discharge, 6 months and final follow-up. Adjusted Multivariate Cox proportional hazard analysis, and Kaplan Meier curves were used to estimate the probability of recurrence and death.

**Results:** One hundred eighty-five consecutive patients were included (103 CS [median age 59.1 years, IQR 44–73], vs. 82 ESUS [median age 34.0, IQR 27–44]), with a median follow-up of 27 months (IQR 9.5–70). More prevalent risk factors were hypertension (ESUS 8.5% vs. CS 46.6%;  $p < 0.001$ ), and smoking (ESUS 28% vs. CS 21.4%;  $p = 0.29$ ). Bad prognosis between ESUS and CS was present in 37.8% vs. 52.4% ( $p = 0.04$ ) at discharge, and 26.8% vs. 43.7% ( $p = 0.02$ ) at final follow-up respectively. Recurrence was present in 1.2% ESUS and 8.8% CS patients ( $p = 0.02$ ), with a Hazard ratio = 0.07 (CI 95% 0.007–0.76;  $p = 0.03$ ) for CS. Death was present only in 3 CS patients ( $p = 0.07$ ).

**Conclusion:** Recurrence, bad functional outcome and mortality are more frequent in CS than ESUS patients.

## ESOC-0358

### 15. Risk Factors for Stroke/Prognosis Predictors of cognitive decline after intracerebral hemorrhage

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**Objective:** We aimed to determine predictors of cognitive decline in patients with intracerebral hemorrhage (ICH).

**Methods:** We prospectively included 167 consecutive ICH survivors without pre-existing dementia. Follow-up was 4 years (interquartile range [IQR] 2.3–5.4). We determined factors associated with cognitive decline in the total cohort and in patients without pre-existing cognitive impairment, using linear mixed models. First, we investigated each predictor separately in univariate models. Next, we constructed a clinical and a radiological multivariate model, including variables with a univariate  $p$ -value  $< 0.1$ . Cognitive decline was determined based on repeated mini-mental state examination (MMSE).

**Results:** Median age was 64 years (IQR 53–75), 69 (41%) patients were female and median MMSE at baseline was 27 (IQR 23–29). Factors associated with cognitive decline in univariate analyses were previous stroke or TIA ( $\beta$ [SE]-0.50[0.21],  $p < 0.05$ ), pre-existing cognitive impairment ( $\beta$ [SE]-0.76[0.22],  $p < 0.05$ ), microbleeds presence ( $\beta$ [SE]-0.24[0.11],  $p < 0.05$ ), white matter hyperintensities ( $\beta$ [SE]-0.24[0.11],  $p < 0.01$ ) and cortical atrophy ( $\beta$ [SE]-0.48[0.13],  $p < 0.01$ ). In multivariate analysis, previous stroke or TIA ( $\beta$ [SE]-0.55[0.23],  $p < 0.05$ ), pre-existing cognitive impairment ( $\beta$ [SE]-0.56[0.25],  $p < 0.01$ ) and cortical atrophy ( $\beta$ [SE]-0.50[0.19],  $p < 0.01$ ) remained independently associated. In patients without pre-existing cognitive impairment ( $n = 139$ ), previous stroke or TIA ( $\beta$ [SE]-0.42[0.23],  $p = 0.06$ ), new stroke or TIA ( $\beta$ [SE]-0.42[0.22],  $p = 0.06$ ) and cortical atrophy ( $\beta$ [SE]-0.28 [0.14],  $p < 0.05$ ) were associated with cognitive decline in univariate analyses. In these patients, only cortical atrophy ( $\beta$ [SE]-0.38[0.17],  $p < 0.05$ ) was associated with cognitive decline in multivariate analysis.

**Interpretation:** Pre-existing cognitive impairment, cortical atrophy and vascular burden are associated with faster rate of cognitive decline after an ICH.

## ESOC-1518

### 15. Risk Factors for Stroke/Prognosis Age and "rich club" status affect the vulnerability of the structural connectome to stroke: A study of simulated lesions in older adults

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Strategic infarction describes how lesions in particular locations have profound effects on brain function. One hypothesis to explain the strategic effect is that such lesions disrupt global properties of the brain's connectome. To test this, we generated simulated lesions of the "rich club", a network of highly interconnected hubs that mediate long-distance connectivity in the brain, and subcortical nuclei often invoked in strategic infarction.

Thirty-nine healthy volunteers aged 53–93 years underwent diffusion-weighted MRI. Whole-brain tractograms were represented as network graphs. Lesions were simulated by removing a node and its connections from the graph. The proportional change in global efficiency due to lesion was calculated. Comparison was made with remaining non-rich club cortical nodes. All participants provided informed, written consent.

Lesions of rich-club nodes led to larger reductions in global efficiency ( $t = 21.0$ ,  $p < .001$ ) than lesions outside the rich club. Lesions of a left middle occipital node and the precuneus produced largest effect. Subcortical lesions were less damaging to global efficiency compared with non-rich club cortical nodes ( $t = 11.4$ ,  $p < .001$ ). Among subcortical nodes, vulnerability was highest for thalamic lesions. Age was positively correlated with vulnerability to lesions in the thalamus (right,  $r = .463$ ,  $p = .003$ ; left,  $r = .337$ ,  $p = .036$ ).

The structural connectome of older people is vulnerable to strategic lesions of rich-club nodes, though some of the key hubs are in sites rarely affected by stroke. Thalamic lesions have a large global impact that increases with age. The vulnerability of the underlying connectome could account for poorer outcome of thalamic stroke in older patients.

## ESOC-0976

### 15. Risk Factors for Stroke/Prognosis In hospital prospective stroke registry-risk factor survey

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**Introduction:** Stroke is a major public health problem. Rapid urbanization and changing patterns in lifestyle have led to rising behavioral risk factor levels in the population.

**Aim:** To understand burden of stroke it is essential to assess the risk factor profile of stroke cases.

**Methodology:** Prospective hospital based case control study was undertaken. All first-ever-stroke patients enrolled in Lilavati Hospital during the period Jan 2012-July 2013, were cases. Controls had no history of stroke and were matched for age and sex with cases. Data of cases and controls were entered in proforma approved by the Ethics Committee. We calculated Odds Ratio for developing stroke with selected risk factors.

**Results:** Data on 125 cases and 201 controls were analyzed. History of hypertension (OR 4.09; 95% CI 2.13–7.84), ischaemic heart disease (OR 1.54; 95% CI 0.82–2.90), raised serum cholesterol (OR 1.51; 95% CI 1.26–1.81), alcohol intake (OR 3.05; 95% CI 1.75–5.30), tobacco consumption (OR 1.97; 95% CI 1.10–3.52) significantly contributed to the risk of developing stroke. However dietary preferences of vegetarian or non-vegetarian diet (OR 0.92; 95% CI 0.55–1.54) and history of diabetes

mellitus (OR 0.69; 95% CI 0.38–1.23) was surprisingly not a significant contributor. 23% of cases led a sedentary lifestyle and 59% of cases had a BMI of 25 and above.

**Interpretation:** Our findings suggest that conventional risk factors significantly contribute to the risk of stroke. Aggressive interventions to reduce hypertension, promoting healthier lifestyle and community awareness, is urgently needed to reduce the burden of stroke.

## ESOC-0268

### 15. Risk Factors for Stroke/Prognosis Added value of acute multimodal CT-based imaging (MCTI): A comprehensive analysis of 1994 consecutive stroke patients

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**Introduction:** MCTI is used to assess acute ischemic stroke (AIS) patients. We postulated that use of MCTI improves patient outcome regarding independence and mortality.

**Methods:** From the ASTRAL registry, all patients with an AIS and a non-contrast-CT (NCCT), angio-CT (CTA) or perfusion-CT (CTP) within 24 h from onset were included. Demographic, clinical, biological, radiological, and follow-up characteristics were collected. Significant predictors of MCTI use were fitted in a multivariate analysis. Patients undergoing CTA or CTA&CTP were compared with NCCT patients with regards to favourable outcome (mRS  $\leq 2$ ) at 3 months, 12 months mortality, stroke mechanism, short-term renal function, use of ancillary diagnostic tests, duration of hospitalization and 12 months stroke recurrence.

**Results:** Among the 1994 AIS patients with acute CT-based imaging, factors independently associated with MCTI were young age, low pre-stroke mRS, low creatinine, known stroke onset, anterior circulation stroke, anticoagulation (CTA only), anti-hypertensive therapy (CTA only), and higher admission NIHSS (CTP only). After adjustment, we found no independent association between MCTI and 3 months favorable outcome, risk of early renal failure, hospitalization length, number of exams during the stay or 12 months stroke recurrence. However, 12 months mortality was reduced for patients undergoing CTA and CTA&CTP and likelihood of having an unknown stroke mechanism for both groups.

**Conclusion:** Our study showed that MCTI reduces mortality in stroke patients, but not handicap at 3 months, suggesting that CTA and CTP don't harm the patient: no delay in patient management, no difference in stroke treatment, and no renal impairment. MCTI is thus a safe, reliable examination.

## ESOC-0522

### 15. Risk Factors for Stroke/Prognosis Heart rate variability: An early predictor of post-stroke infection? The ongoing study PRED-SEP

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**Introduction:** Early detection of stroke-associated infections could substantially shorten treatment time, improve outcome and decrease mortality. Post-stroke infections can, amongst other mechanisms, be mainly attributable to a stroke-induced immunosuppression mediated by the autonomous nervous system (ANS). ANS activity can be determined from heart rate variability (HRV) parameters. Predictive value of HRV parameters regarding development of infections and/or sepsis is also relevant for different underlying diseases without stroke. In the current PRED-SEP

study, predictive value of HRV parameters for development of infections is examined in patients after acute ischemic stroke for the first time.

**Study description:** PRED-SEP is a monocentric, prospective, observational study in patients with acute ischemic infarction in the middle cerebral artery territory suffering severe neurological deficits (NIH stroke score  $\geq 8$ ). We investigate development of infection, SIRS, and severe sepsis in the subacute phase at days 3–5 following stroke and the functional outcome at 3 months. Infection is defined according to the PANTHERIS study comprising pneumonia, urinary tract infection and infections without determined focus. Data analyses include evaluation of the predictive value of HRV indices (calculated from 24 h-ECG-measurements within the first 48 hours after stroke) adjusted to clinical factors by means of logistic regression models (primary endpoint is infection) and examination of correlations between HRV indices, anamnestic data and pro- and anti-inflammatory blood markers (CRP, leukocytes, Copeptine, PCT, IL-6, IL-10, TNF-Alpha, m-HLA-DR).

**Current status:** Since 25-Feb-2012, 272 patients have been recruited. We plan to recruit 280 patients until 31-Jan-2015. Statistical analyses will begin once recruitment is complete.

## ESOC-1097

### 15. Risk Factors for Stroke/Prognosis Predictors of recurrent neurovascular events at one year in patients with mild ischaemic stroke

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**Background:** Mild stroke patients can experience further neurological events, leading to significant morbidity and mortality. Identification of patients at high risk would help target secondary prevention.

**Methods:** We recruited 264 mild ischaemic stroke patients. We used baseline age, Fazekas score, blood pressure, smoking status, lacunar or cortical stroke subtype, and blood-brain barrier (BBB) permeability measured one month post-stroke in normal white matter, grey matter, cerebrospinal fluid, and white matter hyperintensities as predictors. We assessed recurrent neurovascular events (transient ischaemic attack (TIA), further stroke, or new infarct on brain scan) at one year. We used multiple logistic regression to assess the relationship between neurovascular events and the predictors in each brain tissue. Ethics approval and informed consent were obtained.

**Results:** Of the 264 recruited, 181 had complete data and were used in the analysis. Sixteen patients had a further stroke, 5 a TIA, and 19 a new lesion – 33 patients in total had a neurovascular event at one year. Fazekas score, not age, risk factors or BBB permeability, was the only predictor consistently associated with neurovascular events. In normal white matter, the odds ratio for Fazekas score was 1.323 (95% confidence interval 1.011 to 1.730,  $p = 0.041$ ). Results for the other tissues were near identical, i.e. the odds of a neurovascular event increase by 30% per point increase in Fazekas score.

**Conclusions:** Fazekas is a remarkably consistent predictor of recurrent stroke or TIA with an odds ratio of around 1.3. Use of Fazekas score could help target secondary prevention.

## ESOC-0769

### 15. Risk Factors for Stroke/Prognosis Embolic stroke of undetermined source (ESUS) has different baseline characteristics and recurrence rate compared to other stroke subtypes

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**Background:** Embolic stroke of undetermined source (ESUS) is a recent clinical entity proposed for the optimization of preventive treatment in cryptogenic stroke. Our objective is to describe baseline characteristics and stroke recurrence rate of an ESUS population derived from a prospective ischemic stroke registry.

**Methods:** We analyzed patients with ischemic stroke admitted to our stroke unit in 2010. Demographic, vascular risk factors and baseline data were recorded prospectively. Stroke etiology was determined according to TOAST classification. Patients meeting ESUS criteria were identified retrospectively. Stroke recurrence was defined as any new ischemic stroke or TIA occurring during follow-up.

**Results:** Among 492 included patients, 144 (29.3%) were classified as cryptogenic stroke, 133 (92.4%) of which met ESUS criteria. Hypertension was less frequently detected in ESUS patients (60.2% Vs 71.3%;  $p = 0.018$ ), non-stenotic plaques in cerebral arteries and minor cardioembolic sources were more frequently observed in ESUS group (61.7% Vs 39.6%;  $p < 0.001$  and 74.4% Vs 47.6%;  $p < 0.001$ ). Oral anticoagulants were prescribed in 17.3% of ESUS patients at discharge. Median follow-up was 30 months (IQR: 18–40). Global 2 year-cumulative recurrence rate was 11.2% (15.6% for ESUS group and 9.4% for non-ESUS patients, Log rank  $p = 0.006$ ). Covert atrial fibrillation was detected during follow up in 13.8% of ESUS patients.

**Conclusion:** About 27% of our patients met criteria for ESUS. ESUS baseline characteristics, diagnostic findings and recurrence rate were different to other stroke subtypes. Covert atrial fibrillation seems to be a common finding in these patients.

## ESOC-1039

### 15. Risk Factors for Stroke/Prognosis The prevalence of carotid artery stenosis remains high in patients with ischaemic stroke despite prior secondary prevention therapy

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**Introduction:** The prevalence of carotid stenosis in patients presenting with TIA or stroke is reported at 10–20%, but the prevalence in a modern population in which antiplatelet therapy and statins are widely used is unknown. We therefore studied the prevalence in patients attending a Hyper-Acute Stroke Unit (HASU).

**Methods:** A prospective observational study was performed over a five month period in 2014 at a central London HASU. Consecutive patients with suspected stroke or TIA underwent CT angiography or contrast-enhanced MRA including the extracranial vessels. Carotid stenosis was defined as stenosis measuring  $>50\%$  confirmed by consultant neuroradiology review at a joint neurovascular MDT. Patient demographics and treatment prior to admission were collected. The cause of the stroke was confirmed by a consultant stroke physician or neurologist, who reviewed all patients.

**Results:** Carotid imaging studies was performed in 507 out of 564 patients diagnosed with ischaemic stroke or TIA, the remainder being too unwell.



The prevalence of carotid artery disease was 15.4% (n = 78). Carotid disease was symptomatic in 40 patients (7.9%), of which 10 (2.0%) had occlusion and 30 (5.9%) carotid stenosis. 16 had endarterectomy, one stenting and 1 was included in the medical arm of ECST-2. 38 patients (48.7%) presented on a statin, 47 (60.3%) on anti-hypertensive therapy and 33 (42.3%) on antiplatelets. Patients with carotid stenosis (mean 74.7 years) were older than patients without stenosis (p = 0.011).

**Conclusion:** The prevalence of carotid artery stenosis in patients presenting to HASU remains high despite increased use of prior secondary prevention treatments.

## ESOC-1424

### 15. Risk Factors for Stroke/Prognosis

#### Correlation between Carotid Artery Risk (CAR) score and microembolic signals in carotid stenosis

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**Background:** Microemboli detection and various plaque characteristics have been shown to predict future or recurrent stroke risk in patients with carotid stenosis. However, microemboli detection is not widely used in clinical practice due to its time consuming nature. Based on original ECST data, the Carotid Artery Risk (CAR) score is a clinical score predicting the 5-year risk of ipsilateral stroke of patients with carotid stenosis. We hypothesize that CAR score would predict the presence of microembolic signals on transcranial Doppler (TCD).

**Methods:** Twenty-seven patients (mean age  $\pm$  standard deviation: 72.04  $\pm$  10.32 year, male/female ratio: 2) with carotid stenosis have been examined. Based on CAR score, patients were stratified as low (<7.5%), intermediate (<15%) or high ( $\geq$ 15%) risk of future stroke. TCD examination for microemboli detection was performed over the middle cerebral arteries. Duration of monitoring lasted over 60 minutes in the majority of patients, while in few cases it lasted for 45–50 minutes. The following settings were used during the examination: 45–55 mm insonation depth, lowest gain possible and minimal sample volume. Microemboli were identified from Doppler spectra according to consensus criteria.

**Results:** Thirteen (48%) patients had low, 10 (37%) patients had intermediate, while 4 (15%) patients had high CAR score. Microemboli were detected in 6 (22%) patients, all of them having low (n = 3) or intermediate (n = 3) CAR score. There was no correlation between CAR score and presence of microemboli (Fisher's exact test p = 0.54).

**Conclusion:** The CAR score cannot be used to predict the presence of microembolic signals in patients with carotid stenosis.

## ESOC-1484

### 15. Risk Factors for Stroke/Prognosis

#### Minor care leads to worse prognosis in minor stroke

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**Objectives:** The purpose of this study was to identify modifiable risk factors contributing to unfavorable outcomes in patients suffering from minor strokes.

**Methods:** Data was obtained from the prospective registry of patients hospitalized in the stroke unit between January 2013 and June 2014. Medical urgent care was analyzed in patients having a minor stroke (NIH  $\leq$  4) compared to moderate-severe stroke (NIH > 4). Variables predicting longterm prognosis in patients with a minor stroke were evaluated in univariate and multivariate analysis.

**Results:** A total of 495 ischemic stroke patients with previous modified Rankin Scale  $\leq$  2 were included in the registry. Of them, 237 had a minor stroke. In patients with a minor stroke, Stroke code was less often activated (p = 3). On multivariate analysis women (OR 2.37, 95%CI 1.11–5.07) and not receiving urgent intensive care (stroke code activation, neuroimaging 2 at 3 months).

**Conclusions:** Minor stroke receives less attention than moderate-severe stroke and not receiving urgent intensive care is associated with unfavorable outcome.

## ESOC-0237

### 15. Risk Factors for Stroke/Prognosis

#### Elevated pulse pressure in the subacute stage of ischemic stroke is associated with poor outcome

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**Background and purpose:** Despite extensive scientific evidence supporting the crucial role of blood pressure (BP) on the prognosis of acute ischemic stroke, there are contrasting findings in literature. We aimed to identify BP components measured during the acute and subacute stage of ischemic stroke possibly influencing its long-term functional outcome.

**Materials and methods:** A daily BP monitoring was carried out for each of 95 patients with acute ischemic stroke, from a minimum of 2 days to a maximum of 10 days after stroke onset. The following daily BP parameters were obtained for each patient: mean systolic BP, mean diastolic BP, mean pulse pressure and coefficient of variation of systolic BP. The average values of these BP parameters were calculated for the acute and the subacute phase of ischemic stroke. Functional outcome at three months after stroke onset was assessed using a responder analysis, which took into account modified Ranking scale score (mRS) and baseline severity of stroke (NIHSS).

**Results:** Multivariate logistic regression analysis showed a significant correlation between high mean pulse pressure measured during the subacute phase of ischemic stroke and worse prognosis at three months after the stroke onset. The statistical significance of this correlation was maintained even after correction for age, history of hypertension, mean systolic BP measured in the acute phase and thrombolysis.

**Conclusion:** Elevated levels of mean pulse pressure during the subacute stage of ischemic stroke might be an independent predictor of long-term functional outcome.

## ESOC-1342

### 15. Risk Factors for Stroke/Prognosis

#### A comparison of junior and senior clinicians in comparing patient outcomes following stroke

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**Introduction:** Predicting outcomes following stroke is useful for advising patients and caregivers. This study compared the accuracy of junior and

senior clinicians in predicting patient outcomes six months post-stroke (independence, severe dependence or death, and residence).

**Methods:** Our local ethics committee approved this study for audit purposes. 570 stroke patients were assessed by 15 different clinicians. At the initial assessment, clinicians were asked to predict six month modified Rankin Score (mRS) and residence (home, residential care or death). Six month mRS and residency status were compared with the predictions. Clinicians were divided into two groups based on their clinical experience: junior clinicians (0–4 years) and senior clinicians (7–40 years).

**Results:** The sensitivity for predicting residing at home was high for both groups (>0.87), but specificity lower (0.54 and 0.67) for junior and senior clinicians, respectively. Predicting residential care was similar for both groups: sensitivity <0.39, specificity >0.83. When predicting death, junior clinicians had a lower sensitivity than senior clinicians (0.13 vs. 0.45), with specificity high for both groups (>0.95). Sensitivity for predicting an independent outcome (mRS 0–2) was not significantly different. When predicting severe dependence or death (mRS 5–6), sensitivity was lower for junior clinicians compared to senior clinicians (0.28 vs. 0.50), although specificities were similar (>0.94).

**Conclusion:** Both junior and senior clinicians demonstrated accuracy when predicting good outcomes (home or independence). Prediction of poor outcomes (severe dependence or death) was less accurate, particularly for junior clinicians. Outcome predictions may be assisted by prediction scores or models.

#### ESOC-0460

### 15. Risk Factors for Stroke/Prognosis Guidance on flying post stroke

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**Background:** Northwick Park Stroke Unit in London is close to Heathrow airport and serves many domestic and foreign travellers suffering recent strokes. The team is often asked to advise patients on their fitness to fly post stroke. However, there is no clear national or international guidance for doctors on assessing fitness to fly.

Flying post stroke is often not practical and poses risks from the reduced PaO<sub>2</sub> in pressurised aircrafts and the risk of post stroke complications.

**Method:** We reviewed physiological factors that may contribute to flying risk, performed a PubMed search and reviewed current aviation authorities and airline medical guidelines, including the 'UK Civil Aviation Authority', 'International Air Transport Association' and 'Aerospace Medical Association'.

**Results:** Current guidelines and PubMed search gave varying timescales of fitness to fly, ranging from 3 days to 3 months. These guidelines were generally based on unreferenced 'expert' opinion and physiological data with limited clinical research. With evidence of relative hypoxia and impaired cerebral autoregulation post stroke, patients are less able to compensate for the reduced oxygen partial pressure in pressurised cabins, leading to worsening brain tissue hypoxia as well as seizure risk.

**Recommendations:** Current theoretical data suggests that the risk of flying and subsequent complications reduces after 2 weeks post stroke. However, there is a need for more evidence to produce clear guidance. We are currently surveying patients who have flown post stroke from our unit in the past 4 years to retrospectively assess the clinical risk and consequences of flying post stroke.

#### ESOC-1051

### 15. Risk Factors for Stroke/Prognosis Premorbid frailty prior to stroke leads to a longer length of hospital stay and higher 30-day mortality

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**Introduction:** Frailty is characterised by the loss of physiological reserves with increased vulnerability to hospitalisation, institutionalisation and death in response to stressors. The effects of premorbid frailty upon the length of hospital stay (LOS) and 30-day mortality after stroke are unknown.

**Methods:** All individuals aged 75 years and over presenting to Cambridge University Hospitals following an ischaemic stroke, haemorrhagic stroke or transient ischaemic attack with a recorded premorbid Canadian Study of Health and Aging Clinical Frailty Scale (CFS) were included in the study. LOS and 30-day mortality were collected and patients allocated into one of two cohorts: 'non-frail' (CFS scores 1–4) and 'frail' (scores 5–8). Individuals with the highest frailty score (terminal phase of life) were excluded.

**Results:** Two hundred fifty-seven individuals were included in the study: 111 non-frail and 146 frail individuals. Mean age in years was 83.3 (SD 5.2) and 86.7 (SD 5.9) respectively. Median LOS in days was 9.9 (IQR 16) for non-frail and 16.5 (IQR 21.9) for frail cohorts ( $p < 0.05$ ). Infarcts accounted for 95 (85.6%) of strokes in the non-frail cohort and 119 (81.5%) of the frail cohort. Following infarcts, 30-day mortality was increased in the frail cohort (22, 18.5%) versus the non-frail cohort (4, 4.2%) ( $p < 0.05$ ). There was no significant difference between cohorts in 30-day mortality following other types of cerebrovascular event.

**Discussion:** These results demonstrate premorbid frailty leads to longer hospital admissions and increased 30-day mortality after infarcts. The introduction of routine frailty assessment for acute strokes should be considered to aid prognosis in clinical practice.

#### ESOC-0610

### 15. Risk Factors for Stroke/Prognosis Incidence of diabetes mellitus among vascular and non-vascular patients in a neurology-stroke department

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**Introduction:** Diabetes mellitus (DM) is a basic risk factor for stroke (STR). Our previous studies proved, that high number of patients with atrial fibrillation (AF), hyperlipidemia (HL) and hypertension (HT) is revealed during neurological hospitalization, including those persons, whose history or reason for hospitalization do not include cerebrovascular disease. Now patients with DM were analyzed.

**Patients and methods:** We reviewed the history of all patients treated at our department in 2010. The diagnosis of DM was based on control laboratory tests. In the case of 4 patients blood glucose sample was not valuable because of technical problem. The 337 DM patients were divided into five groups: G1) patients admitted for first acute STR, G2) patients with previous stroke admitted for a recurrent STR, G3) patients with a history of STR, but admitted for a different reason, G4) TIA, neuroimaging did not prove relevant lesion (9.5%), G5) patient history and reason

for hospitalization did not include STR. Patients were classified into further groups (previously known/not known DM).

**Results:** DM was present in 14.6 % of 2311 patients. The distribution of patients was the following: G1) 21.4%, G2) 5.3%, G3) 15.7%, G4) 9.5%, G5) 48.1%. In 7.4% of patients DM was revealed during neurological care. G1 included 9.7%, G2 11.1%, G3 only 1.9% and the STR-negative (G5) 9.3% of patients.

**Conclusion:** The proportion of patients newly diagnosed with DM is high, as with other vascular risk factors. In patients with previous STR, the DM care seems to be relatively successful.

## ESOC-0924

### 15. Risk Factors for Stroke/Prognosis

#### An intracranial petri dish? Formation of abscess in prior large stroke after decompressive hemicraniectomy

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Development of brain abscess following an infarction is rare. There have been 11 cases in the literature. Because of this uncommon complication following large stroke, many patients were treated with antibiotics only and did not survive. We present two cases in which patients received aggressive surgical resection of brain abscess and survived. The analysis in the literature in the context of our cases confirmed our finding that surgical intervention of brain abscess in post-stroke patients offers the most benefit. We present two cases of patients with large hemispheric strokes that underwent decompressive hemicraniectomy for malignant infarct and edema. Each re-presented prior to cranioplasty with swollen fontanelle and was found on MRI to have an intracranial abscess within the infarcted tissue. Both underwent surgical evacuation/debridement, followed by antibiotics, and delayed cranioplasty. In this setting, we reviewed the literature, identifying only 11 other cases of this phenomenon. In reviewing ours and other published cases, several trends became clear. The interval from stroke to abscess identification ranged from 12 to 58 weeks. Of the 13 total patients, only 3 had undergone surgical decompression for the stroke. Overall mortality among the cases was 38.5%. All but one of patients treated medically (without surgical evacuation of abscess) died. Secondary abscess formation after significant ischemic stroke is a rare condition that carries potential for high morbidity/mortality. The limited body of literature with the addition of our two cases supports aggressive management with surgical drainage of brain abscess to increase survival.

## ESOC-0685

### 15. Risk Factors for Stroke/Prognosis

#### Impact of risk factors on pre-hospital delay in stroke patients. Is it time to focus awareness campaigns?

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**Background:** Early management of stroke has a key role in reducing mortality and dependence, but only half of stroke patients arrive in the first

three hours. In addition, most strokes happen in patients with known major risk factors. This study investigates the prevalence of risk factors in stroke patients at our hospital and their impact on pre-hospital delay.

**Methods:** An observational study was conducted on a sample of consecutive stroke patients diagnosed by a neurologist in our Emergency Department between 15th November 2013 and 14th April 2014. Subarachnoidal haemorrhage and in-hospital stroke patients were excluded. Descriptive, bivariate and multivariate analyses were performed.

**Results:** One hundred thirty-eight patients (52.2% male) were included (mean age 73.97 years). 90.6% patients carried at least one major stroke risk factor. Most prevalent risk factors were hypertension (76.8%), a familial history of stroke (45.7%), dyslipidemia (42.8%), and Diabetes Mellitus (37.7%). 23.2% had suffered a previous stroke or TIA. Median delay for patients with and without known major risk factors for stroke was 180 and 79 minutes respectively ( $p < 0.05$ ). Only patients with known atrial fibrillation or a familial history of stroke were significantly more prone to be managed within the first three hours.

**Conclusions:** Prevalence of major risk factors is high in stroke patients. Hypertensive, diabetic and dyslipemic patients, smokers, or even those with a previous stroke or TIA didn't arrive the hospital earlier than patients without such conditions. Educational strategies may focus on these groups, most when global strategies have failed reducing pre-hospital delay in the long term.

## ESOC-1229

### 15. Risk Factors for Stroke/Prognosis

#### Prognosis in Oxfordshire TACIs patients treated with intravenous thrombolysis according to intracranial arterial status

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**Aims:** Total Anterior Circulation Infarct syndromes (TACIs) are associated with worse prognosis, and are more likely to have proximal intracranial arterial occlusions (IAO).

Our aim is to assess the proportion of patients with clinical TACIs without IAO (presumably better outcome) in a cohort of IV thrombolysed (IVT) patients, and determine their outcome.

**Methods:** The Catalan Stroke Code & Reperfusion registry is a region-wide, prospective, web-based and externally monitored database that includes data from all patients treated with IVT and/or endovascular treatment (EVT). We selected TACIs patients treated with IVT < 4.5 hours

between Jan-2011 to Dec-2013 for whom a vascular study prior to IVT was available. EVT patients were excluded ( $n = 465$ ). Dichotomized outcome was assessed using mRS at three-months (good prognosis defined as mRS 0–2 or returning to previous functional situation).

**Results:** The cohort included 564 IVT-treated TACIs. After excluding 6 stroke-mimics, we found 118 (21.1%) patients without IAO. No significant differences regarding age, sex, and previous functional status were found between groups. IAO-patients had more severe strokes (median NIHSS 18 vs. 16;  $p < 0.001$ ), and worse outcome compared to non-IAO (68.4% vs. 54.2%;  $p = 0.004$ ). In IAO-patients more cardioembolic strokes were detected ( $p = 0.049$ ). There were no differences in onset-to-treatment time, vascular study performed, extracranial internal carotid occlusion, symptomatic haemorrhagic transformation, and recurrence.

**Conclusions:** One fifth of TACIs treated with IV-rtpa did not have IAO at hospital arrival. Absence of IAO is associated to slightly better outcomes but still more than half of these patients do not reach functional independence.

### ESOC-0283

#### 15. Risk Factors for Stroke/Prognosis Stroke subtype and recanalization rate after endovascular treatment

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Higher recanalization rate has been reported in cardioembolic stroke after intravenous tPA. Our aim was to evaluate if stroke subtypes and in particular the recently described ESUS (embolic stroke of undetermined source) are associated with different rates of revascularization after endovascular treatment (EVT).

**Methods:** Retrospective analysis of a prospective registry of 266 patients with anterior cerebral arterial occlusion and EVT (primary or with previous intravenous tPA) during 5 years. Stroke subtype was classified as cardioembolic (CE), atherothrombotic (AT) and ESUS. We excluded 13 patients with undetermined source due to incomplete work-up or double cause and 13 with infrequent causes. The independent association of stroke subtype with complete revascularization (final TIC1 2b/3) was evaluated by logistic regression analysis adjusting for baseline, clinical and neuroimaging variables.

**Results:** Fifty-four patients were AT (mean age 65, median NIHSS 18), 138 CE (mean age 69, median NIHSS 19) and 46 ESUS (mean age 57, median NIHSS 17). TIC1 2b/3 was achieved in 63%, 74% and 87%, respectively. Time from onset to groin puncture was comparable between groups but the procedure duration was  $96,7 \pm 79$ ,  $68,3 \pm 55$  and  $66 \pm 56$ , respectively. ESUS (OR:3.63 CI 1.27 to 10.38) but not CE (OR:1.8 CI 0.92 to 3.72) using AT stroke subtype as reference category, and previous treatment with intravenous tPA (OR:1.85 CI 1.01 to 3.41), but neither age nor baseline NIHSS were associated with TIC1 2b/3.

**Conclusions:** These findings suggest that ESUS subtype and previous treatment with tPA are associated with a higher probability of complete revascularization after TEV.

### ESOC-0190

#### 15. Risk Factors for Stroke/Prognosis Palliative care issues in inpatients dying following stroke

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Published guidance on palliative care of dying stroke patients contains little data on symptom prevalence and management. We determined the palliative care needs of dying patients our unit with a low overall mortality rate (1-month: 8.8%, Inpatient: 12.9%) in a University Teaching Hospital with both specialist stroke and palliative care services on-site.

**Methods:** Clinical records of consecutive stroke patients who died over 2 years were evaluated as part of a quality improvement/ audit exercise. Notes were reviewed by physicians with training in stroke and palliative care.

**Results:** Fifty-four deaths were identified, (33 (61.1%) female, mean age 79.3 yrs), median Stroke-Death interval was 20 days (range 0–389). Do Not Attempt Resuscitation (DNAR) orders were in place in 86.8% of patients. The median DNAR-Death interval was 7 days (range 0–311). 41 patients (75.9%) died after first stroke, 9 (16.7%) were inpatient strokes and 7 (13.0%) were thrombolysed, 4 (7.4%) subjects underwent cardiac arrest calls and 9 (16.7%) deaths occurred in ICU/HDU. There were clear statements recorded in 26 (48.1%) that patients were dying and death was thought to be due primarily to extent of brain injury in 24 (44.4%). Palliative needs identified included dyspnoea 21 (38.9%), pain 17 (31.5%), respiratory secretions 17 (31.5%), agitation 14 (25.9%) and psychological distress 1 (1.9%). Symptoms were predominantly due to pre-morbid diseases in 6 (11.1%).

**Conclusions:** Dyspnoea, pain and respiratory secretions were identified as main palliative care needs. Palliative needs are complex following stroke and skills in assessing appropriateness and delivering such care are essential.

### ESOC-0277

#### 15. Risk Factors for Stroke/Prognosis Is intracranial arterial stenosis found in cannabis related stroke due to intimal hyperplasia?

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There is now considerable evidence that habitual cannabis smoking is associated with stroke and intracranial stenosis on angiography is a common associated finding. Histological evidence of the nature of intracranial stenosis in these subjects is lacking. It has been reported that in Giant Cell Arteritis, hyperplasia of the intima is associated with increased neuro-ophthalmologic events.

**Methods:** We present three cases of cryptogenic cerebral infarction in regular, longstanding cannabis smokers where arterial biopsy confirmed evidence of intimal hyperplasia.

**Results:** A 37 year old woman with a history of recurrent stroke and cannabis related psychosis. Initial investigation revealed areas of arterial stenosis on duplex ultrasound, including in her right internal carotid artery (ICA). Temporal artery biopsy (TAB) revealed extensive arterial intimal hypertrophy. She continued to smoke cannabis and suffered a

large right middle cerebral artery distribution infarct. Angiogram showed progression of flow limitation and stenosis in her right ICA.

A 32 year old man suffered a right M1 distribution haemorrhagic infarct. Angiography revealed stenosis of his left ICA. He died at 14 days of a large pulmonary embolism and necropsy revealed that the stenosis was caused by a grossly hypertrophic arterial intima without evidence of dissection, cardiac thrombus or significant arteriosclerosis.

A 28 year old man was admitted with a right M1 occlusion with evidence of occlusion on angiogram. TAB performed after other investigations proved unrevealing showed intimal hypertrophy.

**Conclusion:** Intracranial stenosis in cannabis related stroke may result from intimal hypertrophy. TAB may be a useful investigation in cannabis smokers with cryptogenic stroke.

## ESOC-0447

### 15. Risk Factors for Stroke/Prognosis Prevalence of dysnatremias and their implication on outcome during acute ischemic stroke and transient ischemic attack: A cross-sectional analysis

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**Aim:** Hypo- and hypernatremia are the most common electrolyte disorders in hospitalized patients. Their impact on outcome has been described in patients with cerebral hemorrhage. However, data in patients with ischemic stroke and transient ischemic attacks (TIA) are scarce. We aimed to assess the prevalence of dysnatremias in stroke and TIA patients and to investigate the impact of dysnatremias on outcome.

**Methods:** In this cross-sectional analysis we included all patients with acute ischemic stroke (1807) and TIA (157) admitted to the department of Neurology between 01 January 2004 and 31 March 2012 with a measurement of serum sodium at baseline. Clinical data on admission (NIHSS score, Charlson comorbidity index, etiology, cardiovascular risk factors), data on therapy (conservative versus thrombolysis) and outcome at 3 months were assessed prospectively.

**Results:** One hundred sixty-one of 1964 patients (8%) included in the study had hyponatremia and 56 (3%) hypernatremia. Median serum sodium concentration on admission was 140 mmol/L (138 to 141). 219 patients (11%) died during the observation period. Patients with dysnatremias had higher mortality rates. Patients with serum sodium <140 mmol/L had a significantly lower survival probability (85% vs. 90%,  $p = 0.0022$ ). Moreover, in specific multivariate logistic regression models, serum sodium <140 mmol/L, higher age and higher NIHSS score on admission were predictors of an increased mortality.

**Conclusions:** Hypo- and hypernatremia are common in patients with an acute ischemic stroke or TIA, with associated higher mortality rates in these patients. Serum sodium <140 mmol/L was predicting mortality 3 months after acute ischemic stroke or TIA.

## ESOC-1274

### 15. Risk Factors for Stroke/Prognosis Prediction models for the risk of intracranial haemorrhage or major bleeding in patients on antiplatelet therapy: A systematic review of the literature

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**Background and purpose:** Antiplatelet therapy is widely used in secondary prevention after TIA or ischaemic stroke. Bleeding is the main adverse effect of antiplatelet therapy and is potentially life-threatening. Identification of patients at increased bleeding risk may target antiplatelet therapy. This study sought to identify existing prediction models that predict the risk of intracranial haemorrhage or major bleeding in patients on antiplatelet therapy.

**Methods:** We systematically searched PubMed and Embase for existing prediction models up to December 2014. Methodological quality of the included studies was assessed with the CHARMS checklist. We investigated model performance and predictors used in the included models.

**Results:** Five prediction models were identified, of which two were developed in patients with previous cerebral ischaemia. One study assessed intracerebral haemorrhage, all others studied major bleeding. None of the studies met criteria of good quality, three were of moderate quality, one of low quality, one was only published as an abstract and provided insufficient information for proper quality assessment. External validation was performed in three studies with an area under the curve (AUC) ranging from 0.64 to 0.72. Frequently used predictors were age, hypertension, renal failure and use of anticoagulants.

**Conclusion:** A limited number of prediction models is available that predict intracranial haemorrhage or major bleeding in patients with a previous stroke. Methodological quality of the studies varied, but was generally low. In order to reliably predict the risk of bleeding in patients on antiplatelet therapy, development of a prediction model according to current methodological standards is needed.

## ESOC-0911

### 15. Risk Factors for Stroke/Prognosis Drops in barometric pressure is a risk factor for deep but not lobar intracerebral hemorrhage

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**Background:** The effects of changes in barometric pressure on the incidence of intracerebral hemorrhage (ICH) remain unclear.

**Methods:** Primary ICH patients admitted over the last 5 years were included. Patients transferred from other geographical regions and patients with cerebellar ICH were excluded. We analyzed the relationship between the incidence of spontaneous ICH and averaged daily atmospheric air pressures and outdoor temperatures.

**Results:** Of 219 cases of ICH included, 147 had a deep ICH, 59 patients had a lobar ICH and 13 had a cerebellar ICH. Patients with deep ICH were younger (mean age 76.6 and 70.3,  $p = 0.001$ ) and more often had diabetes mellitus, smoking and previous lacunar strokes ( $P < 0.01$  for all). We identified high-risk ICH days as days on which 2 or more patients with ICH were admitted. On multivariate analysis a drop in the mean recorded air pressure 2 days prior to the ictus was a significant predictor of high risk

( $P < 0.04$ ) in the deep ICH patients but was found to have no impact on lobar ICH patients.

**Conclusions:** Lobar and deep ICH are differently affected by changes in barometric pressure. A drop in the daily atmospheric pressure may be a trigger for deep ICH but not for lobar ICH.

## ESOC-1527

### 15. Risk Factors for Stroke/Prognosis MIDNOR TIA – a prospective cohort study of 586 patients, baseline data from a subgroup of 363 patients examined with mr diffusion-weighted imaging

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**Background:** MR diffusion-weighted imaging (DWI) is sensitive to ischemic changes. The aim of this part of the study was to evaluate risk factors and clinical characteristics in DWI positive versus negative patients with TIA (transient ischemic attack).

**Method:** DWI was performed in 363 patients (61,9%). Chi-square test was performed for significance levels. All study subjects have signed written informed consent.

**Results:** Acute ischemic lesions on DWI were found in 86 patients (23,7%). Baseline characteristics of the DWI positive and negative patients, respectively, were: Mean age 69,3 vs 68,4. Men 50% vs 58,7% ( $p = 0,15$ ). A former diagnosis of TIA, stroke and myocardial infarction 12,8% vs 15,9% ( $p = 0,56$ ), 12,8% vs 13,4% ( $p = 0,84$ ) and 16,3% vs 9,0 ( $p = 0,13$ ), respectively. Known or currently diagnosed atrial fibrillation 14,0% vs 7,6% ( $p = 0,15$ ). Diabetes mellitus 7,0% vs 11,2% ( $p = 0,11$ ). 40,7% vs 44,8% ( $p = 0,51$ ) received blood pressure lowering medication and 36% vs 35,4% ( $p = 0,91$ ) lipid lowering medication prior to the current TIA. 16,3% vs 17,3% ( $p = 0,84$ ) were current smokers. Aphasia and/or dysarthria was reported by 46,5% vs 44% ( $p = 0,69$ ), hemiparesis of arm 40,7% vs 30,7% ( $p = 0,09$ ), hemiparesis of leg 23,3% vs 18,1% ( $p = 0,29$ ), hemisensory loss 15,1% vs 25,6% ( $p = 0,04$ ), hemiparesis of face 26,7% vs 15,9% ( $p = 0,02$ ), hemianopsia 3,5% vs 8,7% ( $p = 0,11$ ), amaurosis fugax 3,5% vs 4,0% ( $p = 0,84$ ), diplopia 3,5% vs 4,3% ( $p = 0,73$ ).

**Conclusion:** There were significantly more reports of hemiparesis of face and significantly fewer of hemisensory loss in DWI positive versus negative patients. No other significant differences in clinical characteristics or risk factors were found.

## ESOC-1099

### 15. Risk Factors for Stroke/Prognosis Current control status of dyslipidemia and the prevalence of residual risk in patients with ischemic stroke

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**Objectives:** We investigated the control status of dyslipidemia and the prevalence of residual risk in patients with ischemic stroke.

**Methods:** Patients who were hospitalized due to acute ischemic stroke within 7 days in two referral hospitals were enrolled retrospectively. Patients without follow-up lipid battery between 1 month and 1 year after discharge were excluded. Individual target LDL level was determined using fasting lipid battery and risk factors during admission according to 2011 AHA/ASA guideline for secondary prevention. Residual risk was determined as 1) high TG ( $>200$  mg/dL) or 2) low HDL ( $<40$  mg/dL) or 3) high Non-HDL ( $\geq 130$  mg/dL) in follow-up lipid battery between 1 month and 1 year after discharge.

**Results:** Among the 1919 patients, a total of 951 (49.6%) patients had follow-up lipid battery. Target LDL goal was achieved in 664 (69.8%) patients. Diabetes mellitus, hyperlipidemia and atherothrombotic subtype were more frequent in not achieved 287 patients, while atrial fibrillation and discharge statin prescription were less prevalent. Residual risk was observed in 507 (53.3%) patients. Male gender, diabetes mellitus, hyperlipidemia, smoking, fasting blood glucose and initial NIHSS score were more frequent or higher in patients with residual risk, while discharge statin prescription was less prevalent. Among target LDL goal achieved population, 319 (48.0%) patients showed residual risk.

**Conclusions:** Target LDL goal achievement rates in ischemic stroke patients needs to be improved. Residual risk was observed almost half of the ischemic stroke patients irrespective of LDL goal achievement.

## ESOC-1353

### 15. Risk Factors for Stroke/Prognosis Temperature change, short- and long-term handicap in acute ischemic stroke

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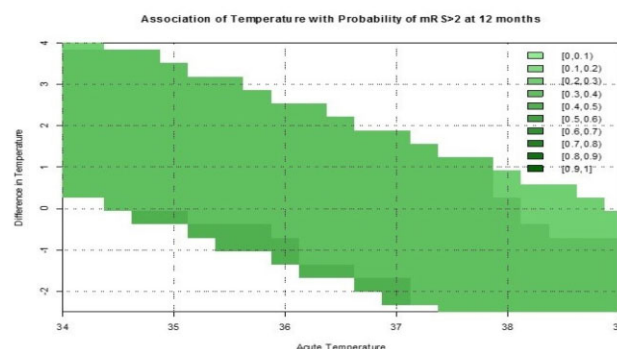
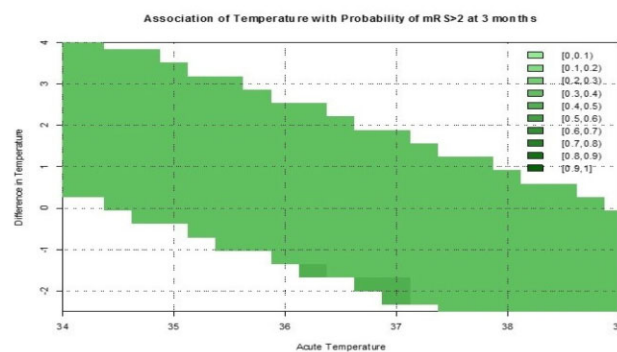
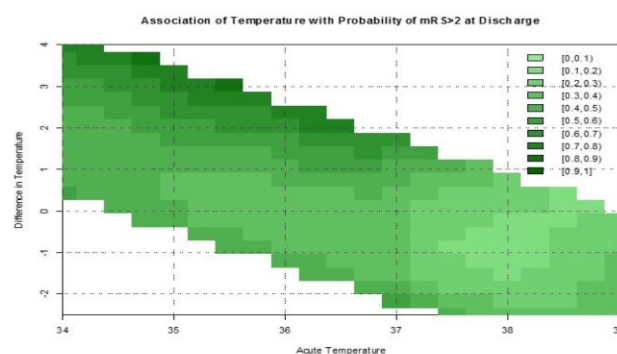
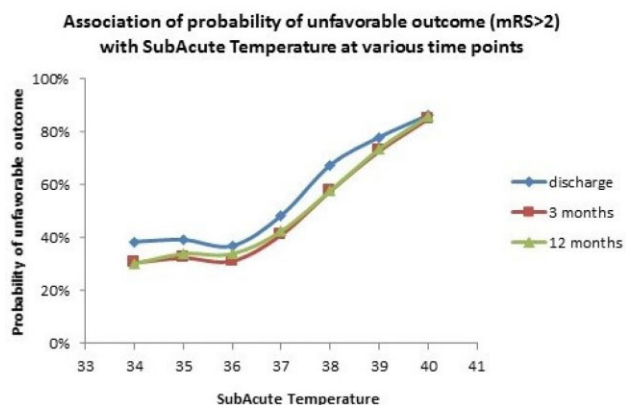
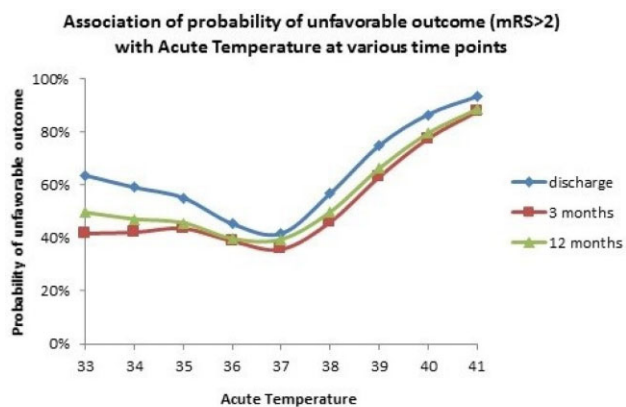
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**Aim:** The aim of the study is to explore the association between baseline temperature (T) levels, T change during the first 24 hours, and functional outcome in a representative acute ischemic stroke (AIS) population.

**Methods:** All patients registered in the Acute Stroke Registry and Analysis of Lausanne (ASTRAL) between 2003 and 2013 were analyzed ( $n = 2,555$ ). Unfavorable outcomes at 7 days, 3 and 6 months were defined as modified Rankin scores  $> 2$ . A local polynomial surface algorithm was used to assess the effect of T values on the three outcomes.

**Results:** Acute and sub-acute normothermia, but not hypothermia, was associated with less unfavorable short- and long-term outcome. Low or normal admission temperatures followed by a T increase over 24 hours were associated with a worse prognosis, whereas a mild baseline T increase followed by a decrease was associated with better outcome at 7 days. These dynamic associations with handicap disappeared after 3 and 12 months.

**Conclusions:** Elevated body temperature in AIS is associated with a worse functional outcome, but initial hypothermia does not seem to be protective. These insights may help to adapt individual treatment decisions and to plan future therapeutic studies.



ESOC-0612

**15. Risk Factors for Stroke/Prognosis**  
**Class I recommendations for secondary prevention of stroke**

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*Background:* Worldwide, Stroke is the second most common cause of death. The risk of recurrent stroke among the patients who survived previous stroke is about nine times the risk of stroke in the general population. Many studies were conducted on the secondary prevention of stroke.

*Methods:* The literature on Evidence-based recommendations for the secondary prevention of stroke was reviewed to get to Class I recommendations. According to the AHA/ASA estimate of certainty, the Class I recommendations are the procedures/treatments that should be performed/administered as they have the evidence and/or general agreement for their beneficial effect.

*Results and conclusions:* Class I recommendations include procedures/treatments for blood pressure reduction, glycemic control and adjustment of the lipid profile along with proper management of the metabolic syndrome, symptomatic extracranial carotid disease, extracranial verte-

brobasilar disease, intracranial atherosclerosis, atrial fibrillation, acute myocardial infarction, prosthetic heart valves, inherited thrombophilias and Fabry disease. Also, the stroke patients are recommended to stop smoking, reduce their alcohol consumption and take antiplatelet agents and/or oral anticoagulants.

## ESOC-1363

### 15. Risk Factors for Stroke/Prognosis Early post-stroke infections and their impact on hospital mortality: Changes from 1995 to 2013

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**Background:** Infectious complications of stroke are considered to associate with poor outcome. Our aim was to investigate changes in the occurrence of early post-stroke infections and their impact on hospital mortality in Poland from 1995 to 2013.

**Material and methods:** It is a retrospective registry-based analysis of consecutive acute stroke patients from a highly urbanized area (Warsaw, Poland) admitted to a single stroke centre between 1995 and 2013. A total of 4770 patients were divided to four time periods: 1995–1999 (n = 637), 2000–2004 (n = 1501), 2005–2009 (n = 1575) and 2010–2013 (n = 1057). Odds ratios (OR) for hospital death were calculated after adjustment for pre-existing disability, stroke type, age and baseline neurological deficit.

**Results:** Over time there was a clear decrease in occurrence of pneumonia (19%, 21%, 11% and 11%, respectively), urinary tract infection (31%, 20%, 25% and 18%) and fever (20%, 19%, 15%, 11%). There was no significant change in the use of antibiotics (34% to 39%). Pneumonia and fever strongly predicted hospital death in years 1995–1999 (OR 5.5 and 3.2, respectively) and 2000–2004 (OR 5.2 and 2.8), to lesser extent in 2005–2009 (OR 3.5 and 1.7), and lost significance in 2010–2013 (OR 1.5, p = 0.39 and OR 2.1, p = 0.14). Risk of death was increased in patients requiring antibiotics until 2005 and never by urinary tract infection.

**Conclusion:** Over the last 20 years infectious complications of acute stroke became less frequent and their impact on hospital mortality was significantly reduced. It may be an indirect marker of gradual improvement in stroke unit care.

## ESOC-0935

### 15. Risk Factors for Stroke/Prognosis The relationship between the size of patent foramen ovale and the risk of paradoxical cerebral embolism

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**Background and objectives:** Patent foramen ovale (PFO) is known to be a risk of paradoxical embolism. We have also accidentally experienced cryptogenic stroke (CS) patients who have PFO. We clarify the relationship between the size of PFO and the risk in the cryptogenic stroke patients.

**Methods:** We ascertained the presence and measured the size of PFO using transesophageal echocardiography in 119 patients with acute ischemic stroke. We also divided PFO size into three groups by the number of micro bubbles; small size group ( $\leq 5$ ), moderate size group (5–25) and large size group ( $\geq 26$ ). We compared with clinical features (age, gender, subtype of stroke, size of stroke, the risks of paradoxical embolism [RoPE] score) and embolic risk factors; atrial fibrillation, smoke-like echo, atrial septal aneurysm (ASA), left atrial thrombus, and aortic plaque lesion.

**Result:** PFO was presented in 56 patients (47.0%). Embolic stroke events were more frequently seen in the large size PFO group than in the small

size PFO group (72.0% vs 83.3%, p < 0.05). In the paradoxical embolism patients, large size PFO (OR 6.00, 95% CI 1.21–29.74 : p < 0.05), RoPE scores < 6 (OR 5.31, 95% CI 1.06–26.49 : p < 0.05) were independent risk factors for paradoxical embolism by multivariable logistic regression.

**Conclusions:** The large size PFO and lower RoPE score (<6) are independent risks of paradoxical embolism, and these are meaningful to determine the treatment of anticoagulation and PFO closure.

## ESOC-0173

### 15. Risk Factors for Stroke/Prognosis Acute ischemic stroke associated with nephrotic syndrome: Prevalence and significance

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**Background:** Ten cases of Arterial ischemic stroke (AIS) with nephrotic syndrome (NS) are reported, and the prevalence and clinical characteristics of this combination are discussed.

**Methods:** Patients having both albumin <3 g/dL and serum cholesterol >250 mg/dL were retrospectively identified from 11,161 cases of stroke. From among these patients, furthermore, ischemic stroke patients showing heavy proteinuria were selected. The extent of atherosclerosis was evaluated by magnetic resonance angiography of intracranial and extracranial arteries, by ultrasonography for carotid arteries and lower extremity arteries, and by measurement of the ankle-brachial index. Clinical characteristics, laboratory findings, and pathogenesis of NS were investigated.

**Results:** Ten cases (3 definite and 7 probable cases) were diagnosed as having AIS with NS, accounting for 0.09% of all kinds of stroke and 0.12% of AIS cases. This was also 5 times more common than cerebral venous thrombosis (CVT), because we experienced 2 cases having CVT with NS during the same period. Their subtypes were 6 large-artery atherosclerosis, 3 small-vessel occlusion, and 1 cardioembolism. Overall, 80% of cases showed severe stenosis and/or occlusion of intracranial and extracranial arteries. Peripheral arterial disease was suspected in 63% of the cases examined. The pathogenesis of NS was due to diabetic nephropathy in 8 cases (80%).

**Conclusions:** AIS with NS accounted for 0.12% of all cases of AIS and was 5 times more common than CVT with NS. Type 2 diabetes mellitus might be the most important risk factor for AIS with NS, especially in the Japanese population.

## ESOC-1144

### 15. Risk Factors for Stroke/Prognosis The inflammatory serum markers in patients with a recent history of stroke and myocardial infarction

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**Background:** Current evidence strongly supports the role of inflammation in the process of atherosclerosis. It has been also suggested that infection with common pathogens and the initiation of immune complex formation may be involved.



**Methods:** This is a prospective study of inflammatory markers in patients with clinical signs of atherosclerosis. It includes 96 patients with the history of ischaemic stroke and 41 patients with documented myocardial infarction (3–12 months before the study), and 111 control patients with no cardiovascular events (matched for sex and age). Serum concentrations of conventional inflammatory markers, such as C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), white blood count (WBC) and marker of bacterial infections – procalcitonin (PCT), immune complexes (IC), endothelial markers (ICAM-1, von Willebrand factor, E-selectin) were measured and correlated with atherosclerotic changes in carotid arteries (intima media thickness, IMT; the presence of plaques and the degree of stenosis).

**Results:** Patients with the history of stroke and myocardial infarction had increased CRP, ESR, WBC, ICAM-1, E-selectin levels and IC level compared with the control group. The levels of CRP and IC correlated with IMT >1 mm and with the presence of plaques in patients with stroke and myocardial infarction. We also found that increased expression of *Herpes simplex virus-1* and *Helicobacter pylori* antigens in IC of both study groups correlated with the presence of unstable plaques.

**Conclusion:** Our study shows that active inflammation is present during the process of atherogenesis and suggests that ICs might be involved in unstable plaque formation.

#### ESOC-0134

### 15. Risk Factors for Stroke/Prognosis Renal dysfunction is associated with deep cerebral microbleeds but not white matter hyperintensities in patients with acute intracerebral hemorrhage

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**Background and purpose:** Kidney disease is a risk factor for cerebral microangiopathy and spontaneous intracerebral hemorrhage (ICH). We aimed to determine the association of renal dysfunction (RD) with MRI correlates of different cerebral microangiopathies including cerebral microbleeds (CMB) and white matter lesions (WML) in patients with ICH.

**Methods:** In a prospectively collected, single center cohort of ICH patients, glomerular filtration rate (eGFR) was estimated using the Modification of Diet in Renal Disease equation. We classified the renal function in five categories: category 1 (eGFR ≥ 90 mL/min/1.73 m<sup>2</sup>), category 2 (eGFR 60–89), category 3 (eGFR 30–59), category 4 (eGFR 15–29), and category 5 (eGFR < 15) and dichotomized at an eGFR of 60. Number, location, and extent of CMB and WML were measured on MRI. ICH and CMB locations were classified as lobar or deep.

**Results:** Ninety-seven ICH patients with MRI (mean age 65.9 ± 13.9 years) were included. Intracerebral hemorrhage was lobar in 52.6%. Median eGFR was 85.8 mL/min/1.73 m<sup>2</sup> (IQR 34.3). Renal dysfunction was present in 12.4% of the patients. At least one CMB was present in 57.7% of patients, WML were even more frequent (97.7%). Age and impaired renal function were factors independently associated with the presence of CMB. The presence of CMB was independently associated with the number and extent of WML.

**Conclusion:** RD is a frequent comorbidity in patients with ICH. Associations of RD with hypertension and with CMB in deep location suggest a

predominant impact of renal dysfunction on deep arteriolar lipohyalinosis rather than on cerebral amyloid angiopathy.

#### ESOC-1235

### 15. Risk Factors for Stroke/Prognosis Prevalence of arterial and venous thrombophilia in TIA or ischaemic stroke patients with a patent foramen ovale, with or without an inter-atrial septal aneurysm

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**Introduction:** Data are limited on the prevalence of abnormalities on **comprehensive, simultaneous arterial and venous thrombophilia screening** in TIA/stroke patients with patent foramen ovale (PFO) +/- an inter-atrial septal aneurysm (IASA).

**Methods:** Prospectively-collected data on TIA/ischaemic stroke patients with a PFO, IASA or both who attended our Vascular Neurology Service were analysed. All patients underwent trans-oesophageal echocardiography, and testing for anti-nuclear, anti-cardiolipin and anti-beta-2 glycoprotein I antibodies; rheumatoid factor, lupus anticoagulant, protein C&S, anti-thrombin, factor VIII activity, activated protein C resistance, Factor V Leiden, prothrombin gene and MTHFR-C677T mutation screening. ENA and homocysteine were assessed in the latter part of the study. Abnormal 'non-genetic' thrombophilia tests were repeated >12 weeks later.

**Results:** Eighty-two patients were recruited. Mean follow-up was 47.3 months (maximum: 6 years). Twenty-five patients (30.5%) had ≥1 abnormality on thrombophilia screening. Three patients (3.7%) had primary anti-phospholipid syndrome with positive anti-cardiolipin/anti-beta 2 glycoprotein I antibodies, two of whom had recurrent TIAs necessitating anti-coagulation with warfarin. Six patients (7.3%) had elevated Factor VIII activity, three had protein S deficiency (3.7%; one developed a DVT); one (1.2%) had a Factor V Leiden mutation, and three (3.7%) had dual abnormalities on thrombophilia screening. Six (7.3%) had elevated homocysteine levels, and four (4.9%) a C677T-MTHFR mutation. The incidence of recurrent TIA/stroke was similar in patients with and without underlying thrombophilia (12% vs. 7%; P = 0.67).

**Discussion:** Comprehensive thrombophilia screening is positive in an important proportion of TIA/stroke patients with a PFO, facilitates individualized anti-thrombotic therapy, and may help select patients warranting endovascular closure.

#### ESOC-1589

### 15. Risk Factors for Stroke/Prognosis Hyperacute levels of high sensitivity C-reactive protein and changes of metalloproteinase 2 improve the accuracy of outcome prediction in acute ischemic stroke

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**Objectives:** Complex biochemical processes occur as part of the early response to cerebral ischemia. We sought to evaluate whether hyperacute plasma concentration of biomarkers of inflammation, tissue damage, and oxidative stress predict short-/long-term functional outcome and mortality in patients with acute ischemic stroke (AIS).

**Methods:** We prospectively and serially measured plasma F2-isoprostanes, urinary 8-oxo-7,8-dihydro-2'-deoxyguanosine, plasma

Oxygen Radical Absorbance Capacity assay (ORACTOT, ORACPCA), high sensitivity-C reactive protein (hs-CRP), MMP-2 and 9, homocysteine in AIS patients presenting within 9h of symptom onset. Outcome measures were early neurological deterioration (END) (worsening of presenting symptom with an increase of  $\geq 4$  points at NIHSS or death) at 48 hours, 90-day modified Rankin Scale (0–2 and 3–6 as favorable and unfavorable outcome, respectively), and death.

**Results:** We enrolled 489 subjects, mean age 70 (SD 15), median NIHSS 6 (IQR 3–13), 43% female, 41% underwent IV t-PA. After adjustment for all the confounding variables in multivariate binary logistic regression models, baseline MMP-2 were an independent predictor of END (OR 1.005, 95%CI 1.001–1.009;  $p = 0.013$ ). Elevated 48 h hs-CRP independently predicted death (1.014, 1.002–1.027;  $p = 0.026$ ), whereas hs-CRP level at baseline was an independent predictor of 90-day mRS (1.043, 1.004–1.084;  $p = 0.032$ ). Change in MMP-2 from baseline to 48 h showed a trend towards statistical significance (0.995, 0.990–1.0,  $p = 0.038$ ). Adding hs-CRP and MMP-2 changes to NIHSS improved accuracy of 90-day outcome prediction increasing the Nagelkerke pseudo R square from 0.480 to 0.515 and 0.542 respectively.

**Discussion:** Hyperacute levels of hs-CRP and changes of MMP-2 improve the accuracy of outcome prediction in AIS.

**ESOC-1590**

**15. Risk Factors for Stroke/Prognosis  
Mismatch salvage volume up to 24 h from stroke onset predicts favorable outcome in acute ischemic stroke**

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**Objectives:** Advanced neuroimaging techniques may provide fundamental data with regard to brain tissue viability in acute ischemic stroke (AIS). We sought to evaluate whether the volume of mismatch salvaged ischemic tissue was predictive of clinical outcome.

**Methods:** Patients enrolled in a multicenter biomarker study with at least a baseline magnetic resonance imaging (MRI) and a follow-up MRI or CT performed within 24 h and 24–96 h of symptom onset, respectively, were included in the analysis. Imaging were analyzed using semi-automated volumetric method. Mismatch was defined as baseline mean transit time (MTT) volume on PWI minus DWI volume. A percent mismatch cut-off of 20% was considered clinically significant. Mismatch salvaged volume was the region not overlapped by final infarction and calculated according

to the following formula [(mismatch volume – final infarct volume)]. Outcome was the dichotomized 90-day modified Rankin Scale (0–2 and 3–6 as favorable and unfavorable outcome, respectively).

**Results:** One hundred forty-three patients [mean age 68.8 (SD 15), median NIHSS 8 (IQR 4–14), 43% female, 53.5% underwent IV t-PA] were included in the analysis. After adjustment for all the confounding variables in multivariate binary logistic regression models, NIHSS (OR 0.781, 95% CI 0.701–0.871;  $p < 0.001$ ), and mismatch salvaged volume (OR 1.012, 95% CI 1.001–1.022;  $p = 0.026$ ) were independently associated with 90-day favorable outcome. Adding mismatch salvage volume to NIHSS improved accuracy of 90-day outcome prediction increasing the Nagelkerke pseudo R square from 0.434 to 0.497.

**Discussion:** Salvage of mismatch up to 24 h from symptom onset is independently associated with improved clinical outcome, although the effect is small.

**ESOC-1163**

**15. Risk Factors for Stroke/Prognosis  
Dyslipidemia as the possible risk factor for arterial ischemic stroke in young**

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**Background:** Huge number of diseases can cause arterial ischemic stroke (AIS) in young. Dyslipidemia seems to be the risk factors of AIS in this age group.

**Methods:** Type of study: case series. Inclusion criteria: 66 male or female under the age of 45 y.o. with AIS's debut confirmed by brain CT(MRI) scan; slavic origin; informed consent form. We identified cholesterol, HDL, Triglycerides, LDL, VLDL and KA in AIS acute period (during first 2 days).

**Results:** Half of patients had deviations of lipid metabolism. The most common findings were the high level of cholesterol and the low level of HDL (table). In 9 cases we identified isolated hypo- $\alpha$ -cholesterolemia, in 8 – IIa, in 17 patients – IIb, in 8 – IV Fredrickson phenotype. Only 8 patients had stenosis of the brachiocephalic vessels more than 70% (ultrasound data). There were no correlations between any lipids level and those stenosis' degree.

**Conclusion:** We assume dyslipidemias to have diagnostic value in early life AIS's debut. The maximum possible set of lipid and lipoproteins must be assigned. Detection of dyslipidemia and their reasons may become a starting point for therapy and secondary prevention in those patients.

Table. Average level of lipid and lipoproteins in young patients with AIS

	Triglycerides	Cholesterol	HDL	LDL	VLDL	KA
without dyslipidemia						
M $\pm$ m, mmol/l	1,22 $\pm$ 0,07	4,14 $\pm$ 0,13	1,88 $\pm$ 0,07	2,91 $\pm$ 0,11	0,60 $\pm$ 0,03	2,1 $\pm$ 0,10
Cases, n	52	48	17	59	53	33
with lipid metabolism deviations						
M $\pm$ m, mmol/l	3,28 $\pm$ 0,27	6,10 $\pm$ 0,22	0,98 $\pm$ 0,04	4,65 $\pm$ 0,23	1,58 $\pm$ 0,12	4,48 $\pm$ 0,19
Cases, n	14	18	49	7	13	33

## ESOC-1415

## 15. Risk Factors for Stroke/Prognosis

## TIA clinic diagnoses and subsequent mortality:

## Data from the Scottish Stroke Care Audit

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Early specialist review of suspected stroke or TIA outpatients is recommended, and results in a broad range of patients being seen with many having another diagnosis.

**Aims:** Using data from the Scottish Stroke Care Audit linked to routinely collected mortality data, to look at recurrent in patient or outpatient stroke events and death based on initial clinic diagnosis.

**Methods:** SSCA data were linked to SMR01 and General Records Office mortality data.

**Results:** Of 27369 outpatients (mean age 67.4 ± 13.2 years, 49.6% males), 23042 (84.2%) had one outpatient entry in the stroke audit, while 2626 (9.6%) had a recurrent inpatient (5%) or outpatient (4%) stroke or TIA event, or both (0.6%) within one year. Of those with just one recorded event, 927 (4%) had died by one year.

Diagnosis at clinic Primary cause of death	Stroke (5554)	TIA (7454)	Other (6869)	Retinal/ SAH/SDH (1515)
Cerebrovascular	40 (0.7%)	26 (0.3%)	21 (0.3%)	6 (0.3%)
Cardiovascular	48 (0.8%)	56 (0.7%)	35 (0.5%)	11 (0.7%)
Cancer	78 (1.4%)	93 (1.2%)	121 (1.7%)	13 (0.8%)
Brain cancer	10 (0.1%)	7 (0.09%)	54 (0.7%)	0 (0%)

**Conclusions:** In this population, mortality rates at one year are similar regardless of the clinic diagnosis. There are as many deaths recorded from cardiovascular causes as stroke related causes, and cancer deaths are commoner in all groups. Further exploration of these data is warranted.

## ESOC-1395

## 15. Risk Factors for Stroke/Prognosis

## Understanding stroke and cancer relationship:

## A challenge

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**Background:** While cancer and its treatment might increase stroke risk, the nature of the "hypercoagulable state" of cancer remains elusive. Finding imaging and laboratory markers to predict occult cancer in stroke patients is pressing. The aim of this study was to investigate risk factors, stroke pattern, aetiology and outcome measures in stroke patients with and without active cancer and assess the ability of imaging and laboratory markers to identify cancer-related stroke.

**Methods:** Retrospective review of stroke patients with active cancer admitted to our stroke unit during a 5-year period compared with age and gender-matched non-cancer stroke patients.

**Results:** The distribution of tumour types in our stroke population (n = 43) was not proportional to its prevalence in the general population. The prevalence of vascular risk factors and stroke aetiologies was not

different between groups. Time between cancer diagnosis and stroke showed a median of 3 months and death within 30 days of stroke was higher in the cancer group (78,6% vs. 44,4%,  $p = 0,019$ ). In non-hematologic cancer patients with ischemic stroke, the odds of a conventional stroke aetiology were 50% that of non-cancer patients (OR 0,510). For the cancer population, the RR of a C-reactive protein (CRP) level >20,6 mg/dl was 2,512.

**Discussion:** Given the distribution of tumour type and timing of stroke, our study suggests the existence of cancer-specific mechanisms of stroke. The relative risk of non-conventional stroke aetiology in our cancer group advocates for the search for occult cancer in these patients. CRP level might play a role in raising the suspicion.

## ESOC-0747

## 15. Risk Factors for Stroke/Prognosis

## Fibrinogen concentration and factor X activity – predictors of cognitive function in 14 day disease in ischemic stroke patients

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**Introduction:** Recently appeared on the hemostasis factors in the pathogenesis of dementia and cognitive disorders.

**Aims:** We hypothesized that the fibrinogen concentration and X factor activity in first hours of ischemic stroke was determine cognitive function level on 14th day.

**Methods:** We included 72 patients with first-ever ischemic stroke in whom plasma fibrinogen level and factor X activity was measured at admission.

**Results:** On admission concentration of fibrinogen was 2,98 ± 0,1 g/l, the activity of factor X – 102,44 ± 3,35%. On the 14th day of treatment average on the MMSE was 22,4 ± 4,9 points. Cognitive functions were not violated in 27 (37.5%) patients (26,4 ± 2,4 points) in 17 (23.6%) – reported cognitive decline (23,5 ± 2,4 points), 8 (11.1%) – light, in 17 (23.6%) moderate, and 3 (4.2%) – post-stroke dementia expressed (21,2 ± 1,3 points, 17,7 ± 1,9 points and 8,7 ± 2,5 points, respectively). Cognitive functions better recovery responded significantly lower initial fibrinogen levels ( $p = 0,001$ ) and a lower activity of factor X ( $p = 0,024$ ). It was established that 39.4% of patients predictor MMSE score is the concentration of fibrinogen ( $R = -0,639$   $D = 39,4\%$   $p < 0,001$ ) and 12.3% of patients – factor X activity ( $R = -0,313$   $D = 12,3\%$   $p < 0,001$ ).

**Conclusion:** We have shown that fibrinogen concentration and activity of coagulation factor X was measured at admission may be predictors of MMSE score on the 14th day of the ischemic stroke.

## ESOC-0126

## 15. Risk Factors for Stroke/Prognosis

## Insulin resistance in asymptomatic carotid stenosis and atherothrombotic stroke

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**Background/aims:** Decreased insulin sensitivity (IS) with compensatory hyperinsulinemia plays a crucial role in the pathogenesis of atherosclerosis, but their role in ischemic stroke (IST) has not yet been elucidated. Study was aimed to analyze IS and plasma insulin (PI) levels and dyslipidemia pattern in 100 patients with atherothrombotic IST- (group A), 100 patients with asymptomatic carotid stenosis ≥50%- (group B), 60 patients

with lacunar stroke (Group C) and 50 healthy controls- (group D). Patients with diabetes mellitus and ischemic heart disease were excluded. **Methods:** IS was determined by Homeostasis Assessment Model (HOMA-IR), PI levels by Radioimmunoassay. Total-, LDL- and HDL-cholesterol and triglyceride levels were measured in all groups. Central obesity was determined by waist circumference and hypercoagulable state was measured by plasminogen activator inhibitor (PAI-1) levels.

**Results:** IS was significantly lower in group A compared to group B, C and D (4.82 +/- 0.27 vs. 3.69 +/- 0.22,  $p < 0.05$ ; 4.82 +/- 0.27 vs. 2.71 +/- 0.21,  $p < 0.01$ , 4.82 +/- 0.27 vs. 1.50 +/- 0.19,  $p < 0.01$ ). PI levels were significantly higher in group A in comparison to group B, C and D (19.00 +/- 1.2 vs. 15.95 +/- 0.88,  $p < 0.05$ ; 19.00 +/- 1.2 vs. 11.12 +/- 0.19,  $p < 0.01$ , 19.00 +/- 1.2 vs. 7.12 +/- 1.08). Different patterns of dyslipidemia were observed in ACAS in comparison to IST. PAI-1 levels, and waist circumference were significantly higher in group A, B, and C in comparison to healthy controls ( $P < 0.01$ , respectively).

**Conclusion:** Our results indicate that all subtypes of ischemic stroke as well as ACAS are strongly associated with decreased IS and increased PI and PAI-1 levels. Different patterns of dyslipidemia between ACAS and IST were observed.

## ESOC-0943

### 15. Risk Factors for Stroke/Prognosis The relationship between polyunsaturated fatty acids status and platelet activating markers in patients with ischemic stroke

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**Purpose:** Lower  $\omega$ -3/6 polyunsaturated fatty acids (PUFAs) balance is considered as a residual atherosclerotic risk factor. On the other hand, the effects of PUFAs balance on pathological condition of atherosclerotic thrombosis. The purpose of this study is investigation of the relation between platelet activating markers as an indicator of atherosclerosis and  $\omega$ -3/6 PUFAs balance.

**Subjects and methods:** We enrolled 30 patients with asymptomatic or chronic ischemic stroke (mean age; 68 years old, male; 16 patients), undergoing anti-platelet therapy and adequate risk reduction therapy. We measured platelet activating markers (PAC-1, CD62P, leukocyte agglutination and platelet clump) and PUFAs (eicosapentaenoic acid [EPA], docosahexaenoic acid, arachidonic acid [AA], and  $\alpha$ -linolenic acid). We also divided these patients into two groups on the basis of EPA/AA ratio (high risk group [H group]; EPA/AA ratio  $< 0.60$ , low risk group [L group]; EPA/AA ratio  $\geq 0.60$ ) and made a comparison between two groups for platelet activating markers. In some cases, we followed EPA/AA ratio and platelet activating markers after  $\omega$ -3 supplementation.

**Results:** PAC-1 (H group: 13.76 vs L group: 21.77,  $P < 0.05$ ) and CD62P (H: 1.84 vs L: 4.02,  $P < 0.05$ ) were significantly lower in H group than L group. On the other hand, leukocyte agglutination and platelet clump were not significantly different among three groups. In H group, PAC1 was significantly reduced with  $\omega$ -3 supplementation (pre-supplementation: 29.67 vs post-supplementation: 12.05,  $P < 0.05$ ).

**Conclusion:** Treatment with  $\omega$ -3 supplementation or maintaining high level EPA/AA ratio may be effected the inhabitation of platelet activation.

## ESOC-0746

### 15. Risk Factors for Stroke/Prognosis Platelet biomarkers in asymptomatic and symptomatic atherosclerotic carotid stenosis: An updated detailed systematic review of the literature

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**Introduction:** Platelet biomarkers have the potential to improve our understanding of the pathogenesis of TIA or stroke and optimise outcome in patients with atherosclerotic carotid stenosis.

**Methods:** A detailed systematic review of the literature was performed (Pubmed, Medline, Ovid, Embase and Web of Science) to collate available data on *ex-vivo* platelet activation and platelet function/reactivity in patients with asymptomatic and symptomatic moderate to severe (50–99%) carotid stenosis or occlusion.

**Results:** 261 potentially relevant articles were identified; 41 met inclusion criteria for review. There are no clinically informative data from urinary or soluble blood markers of platelet activation in patients with symptomatic moderate to severe carotid stenosis or occlusion who might warrant intervention. Flow cytometry studies revealed increased platelet activation in the early, subacute or late phases after TIA or stroke in association with 50–99% carotid stenosis or occlusion (5 studies,  $P < 0.05$ ), and in asymptomatic 50–99% carotid stenosis patients vs. controls (3 studies,  $P < 0.05$ ). Furthermore, pilot data indicate that platelet activation is increased in recently symptomatic compared with asymptomatic moderate to severe carotid stenosis (4 studies,  $P < 0.05$ ), and 'high-on-treatment platelet reactivity on clopidogrel' may predict the risk of new MR-DWI lesions after carotid stenting (2 studies,  $P \leq 0.045$ ).

**Discussion:** There is increasing evidence of excessive platelet activation/hyper-reactivity that may contribute to the pathogenesis of first or recurrent TIA or stroke in patients with carotid stenosis. Larger longitudinal studies are warranted to assess the ability of platelet biomarkers to facilitate enhanced stroke prevention in asymptomatic and symptomatic carotid stenosis and to help risk-stratify patients undergoing carotid intervention.

## ESOC-1049

### 15. Risk Factors for Stroke/Prognosis Adherence to initially-prescribed intensive secondary prevention therapy at a rapid access stroke prevention clinic in Ireland

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**Introduction:** Consistent adherence to prescribed treatment is essential for effective secondary prevention following TIA/stroke. Representative data on treatment-adherence rates are lacking in Ireland.

**Methods:** Eligible TIA or ischaemic stroke patients attending our Rapid-Access Stroke Prevention (RASP) Clinic were recruited. Demographic and clinical data, and prescribed medication at the last clinic assessment were recorded from prospectively-collected electronic records. All patients received copies of letters containing treatment advice sent to their general practitioners. Patients were subsequently contacted by phone or interviewed in-person during clinic follow-up using a standardised *pro forma* to assess continuation rates, and overall adherence to antiplatelet therapy, statins and anti-hypertensives with a validated self-reporting tool (Morisky Scale). Recurrent vascular events during follow-up were recorded. Verbal informed consent/assent was obtained, and study approval secured from the Local Research Ethics Committee.

**Results:** One hundred fourteen patients were recruited; mean follow-up: 670 days (range: 165–1326 days). Patients were prescribed aspirin (69.3%) alone or in combination with dipyridamole MR (51.8%), clopidogrel (18.2%), warfarin (16.7%) statins (76.3%), or anti-hypertensives (51.8%). During follow-up, 93.7% were still taking their prescribed aspirin, 82.9% dipyridamole MR, 81% clopidogrel, 94.7% warfarin; 88.5% statins and 89.8% anti-hypertensives. Overall, 99.1% reported taking their medication the preceding day; 11.4% missed at least one medication over the preceding fortnight. Two patients (1.8%) had recurrent cerebrovascular events, and two (1.8%) had myocardial infarction during follow up.

**Discussion:** Data from this novel TIA/ischaemic stroke population in Ireland show high rates of medication-continuation and self-reported adherence with prescribed treatment, associated with a low incidence of recurrent vascular events.

## ESOC-0592

### 15. Risk Factors for Stroke/Prognosis

#### State of cytokine status and the neurological deficit in ischemic hemispheric stroke

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**Background and purpose:** The aim of our research is to study the pathological state of microglial cells, which are not recovered to the condition of functional rest and continued to support phlogosis reactions, producing one of toxic proinflammatory mediator-cytokines in ischemic hemispheric stroke (IHS) at different times of the acute period of the disease. **Methods:** In our observation were 35 patient with IHS, and aged were 34 to 94 years. Spontaneous produce of cytokines in the cerebrospinal fluid from patients determined using monoclonal antibodies.

**Results:** In patients with IHS on the first day of the disease showed a significant increase in tumor necrosis factor (TNF- $\alpha$ ) to  $32,8 \pm 5,2$  pg / ml, which is 356% of the benchmark.

By the third day of illness content TNF- $\alpha$  decreases slightly, amounting to  $25,5 \pm 3,7$  pg / ml (less than the first day of 28.7%).

By the tenth day of the disease the content of TNF- $\alpha$  is somewhat reduced, but still has not reached the level of individuals in the control group-  $17,9 \pm 2,5$  pg / ml. In 5 patients with IHS the third day of the disease level of TNF- $\alpha$  remained at the same level, and by the tenth day declined slightly.

**Conclusion:** The study of cytokines IHS showed the prevalence of the disease in the first day of the inflammatory cytokine TNF- $\alpha$ , which indicates the presence of an inflammatory response in the brain ischemic injury. Dynamic increase in proinflammatory cytokines indicates an increase in neurological deficit and worsening prognosis.

## ESOC-1104

### 15. Risk Factors for Stroke/Prognosis

#### Family history of CVD is associated with higher internal carotid IMT in the Norwegian Stroke in the Young Study (NORSYS)

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**Objectives:** Family history (FH) is a risk factor for cardiovascular disease (CVD). We aim to analyze the effect of FH on carotid intima-media thickness (cIMT) in young ischemic stroke patients.

**Methods:** FH of CVD in first-degree relatives (FDRs) was assessed using a standardized interview in patients  $\leq 60$  yrs with documented ischemic stroke. Using B-mode ultrasound, cIMT was measured in the common carotid artery (CCA), carotid bifurcation (BIF) and internal carotid artery (ICA). IMT measurements were compared between FH+ and FH- groups and regression analyses were performed to identify factors associated with IMT thickening. Analysis at age 30–45 excluded the youngest patients with little FH of CVD and the middle-aged patients with old parents and very high FH of CVD.

**Results:** During the study period 333 young stroke patients were enrolled, 228 (68%) were males and 206 (62%) reported FH of CVD in  $\geq 1$  FDRs. Mean age was 52.7 y and 43.8 y in the FH+ and FH- groups respectively. Mean IMT in the FH+ group was higher in all carotid segments (all  $p < 0.01$ ). Regression analyses adjusting for risk factors known to be associated with atherosclerosis revealed age as the most important predictor of IMT. Analyses within age categories showed FH of stroke (Coef: 0.39; SE0.1;  $p < 0.001$ ), was associated with higher ICA-IMT in patients aged 30–45 y ( $N = 51$ ).

**Conclusions:** FH+ is associated with higher ICA-IMT in the age group aged 30–45 y. FH+ of stroke is not associated with increased IMT in the CCA or BIF in any age group in this study.

## ESOC-1223

### 15. Risk Factors for Stroke/Prognosis

#### Main predictors of prosthetic valve thrombosis in the acute phase of the stroke

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**Background:** Prosthetic valve thrombosis (PVT) is a serious complication and rapid diagnosis and therapy is critical. The aim of our study is to evaluate the prevalence and main predictors of PVT in the acute phase of the stroke.

**Methods:** We studied consecutive acute stroke patients with prosthetic heart valve who underwent emergent ( $< 72$  h) TEE in order to detect PVT in a 4 years period. Two groups were created depending on the presence of valve thrombosis (confirmed PVT or non PVT). The age, sex, risk factor profile and stroke severity were recorded. TEE findings as the presence of left atria thrombosis, spontaneous echo contrast and mean valve gradient were analyzed. The international normalized ratio at stroke event (baseline INR) was compared as well. Follow up clinical visits and TEE control examinations were performed during 1 year.

**Results:** A total of 62 ischemic strokes from 56 patients were registered. PVT was diagnosed in 42% ( $n = 25$ ). There were no differences in the main baseline characteristics, the echocardiographic findings and the baseline INR between the groups. Most PVT occurred on the mitral valve

(76%, n = 13) vs 23%, n = 4) (p = 0.006). The stroke recurrence was 9% (n = 5), more frequently in the confirmed PVT group 18% (n = 4) vs 3% (n = 1) (p = 0.061). Twenty-one percent of patients with confirmed PVT died.

**Conclusions:** PVT occurs in nearly half of acute stroke and prosthetic heart valve. Therefore, emergent TEE should be performed independent of the INR level or the stroke severity. Those with mitral prosthetic valve are at higher risk of PVT.

## ESOC-1493

### 15. Risk Factors for Stroke/Prognosis Predictors of recurrence in ESUS patients with complex aortic arch atherosclerosis

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**Introduction:** The presence of complex atherosclerotic plaques in the aortic arch (cAA) is the occult etiology in almost 20% of patients with ESUS stroke. Arch trial described the prevalence and incidence of the stroke caused by cAA but the rate of recurrence was lower than expected. We aimed to describe the recurrence of CAA in our cohort of patients.

**Methods:** We studied patients from our prospective database of ischemic stroke patients who were studied with transthoracic echocardiography (TTEco) in the acute phase of the stroke. All patients with large plaques images ( $\geq 4$  mm) in aortic arch were selected. Two years follow up control visits and control TTEco were performed in order to evaluate the stroke recurrence and the evolution of the plaques. Two groups were created according the clinical recurrence event (Rec group and non-rec group). Echocardiographic findings as the grade of plaque calcification, the proximal or distal location to left common carotid artery and the number of plaques were compared.

**Results:** We selected 110 patients with CAA. The global rate of recurrence in our series was 19% (n = 21). The rate of recurrence related to CAA was 12.7% (n = 14). There were no differences in the baseline clinical characteristics (age, gender and vascular risk factors) between Rec group and Non- Rec group. We did not detect difference in the Echocardiographic findings.

**Conclusions:** The rate of recurrence in ESUS related CAA was remarkable. Predictors of recurrence are needed to improve the treatment prevention.

## ESOC-0362

### 15. Risk Factors for Stroke/Prognosis Heme oxygenase-1 gene promoter microsatellite polymorphism is associated with progressive atherosclerosis and incident cardiovascular disease

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**Objective:** The enzyme heme oxygenase-1 (HO-1) exerts cytoprotective effects in response to various cellular stressors. A variable number tandem repeat (VNTR) polymorphism in the HO-1 gene promoter region has previously been linked to cardiovascular disease. We examined this association prospectively in the general population.

**Approach and results:** Incidence of stroke, myocardial infarction, or vascular death was registered between 1995 and 2010 in 812 participants of the Bruneck Study aged 45 to 84 years (49.4% males). Carotid atherosclerosis progression was quantified by high-resolution ultrasound. HO-1 VNTR length was determined by polymerase chain reaction. Subjects with  $\geq 32$  repeats on both HO-1 alleles compared with the rest of the population (recessive trait) featured substantially increased cardiovascular disease risk (hazard ratio [95% confidence interval], 5.45 [2.39, 12.42];  $P < 0.0001$ ), enhanced atherosclerosis progression (median difference in atherosclerosis score [interquartile range], 2.1 [0.8, 5.6] versus 0.0 [0.0, 2.2] mm;  $P = 0.0012$ ), and a trend toward higher levels of oxidized phospholipids on apolipoprotein B-100 (median oxidized phospholipids/apolipoprotein B level [interquartile range], 11364 [4160, 18330] versus 4844 [3174, 12284] relative light units;  $P = 0.0554$ ). Increased risk in those homozygous for  $\geq 32$  repeats was also detected in a pooled analysis of 7848 participants of the Bruneck, SAPHIR, and KORA prospective studies (hazard ratio [95% confidence interval], 3.26 [1.50, 7.33];  $P = 0.0043$ ).

**Conclusions:** This study found a strong association between the HO-1 VNTR polymorphism and cardiovascular risk confined to subjects with high repeat numbers on both HO-1 alleles and provides evidence for accelerated atherogenesis and decreased antioxidant defense in this vascular high-risk group.

## ESOC-1552

### 15. Risk Factors for Stroke/Prognosis Prognosis after embolic stroke of undetermined source (ESUS): Comparative survival analysis

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**Introduction:** Embolic stroke of undetermined source (ESUS) is a subgroup within cryptogenic stroke, with unknown recurrence risk. We report event-free survival comparing with other etiologies.

**Methods:** In a hospital-based stroke cohort, we conducted a prospective study, recording vascular events/death. ESUS was defined by Cryptogenic Stroke/ESUS International Working Group, and etiologies by ASCOD grade I. We present rates and recurrence risk by Kaplan-Meier curves with LogRank (LR) and Cox regression with Hazard Ratio (HR), along with 95% confidence intervals (95%CI).

**Results:** In 460 patients (64.3% male, median age 66), 16.3% fulfilled ESUS criteria. Main etiologies were: atherothrombosis 26.8%, small-vessel disease 22.2%, cardioembolism 31.7%.

In a median follow-up of 2.6 years, stroke recurrence was ESUS 6.7%, atherothrombosis 10.2%, small-vessel disease (SVD) 3.3%, and cardiac pathology 7.4%. ESUS and SVD had no fatal vascular events, atherothrombosis had 1.0%, and cardioembolism 9.8%. We didn't identify predictors of ESUS recurrence.

ESUS had fewer vascular events but event-free survival was comparable. A composite vascular events/deaths endpoint favoured ESUS against cardioembolism (LR  $p = 0.0161$ ; adjusted HR 5.9, 95%CI 2.5–14.1). Survival until vascular death is higher in ESUS (LR  $p = 0.005$ ).

ESUS have lower overall mortality than atherothrombosis (LR  $p = 0.025$ ) and cardioembolism (LR  $p < 0.001$ ). Events/deaths were similar in ESUS and SVD.

Atrial fibrillation was further diagnosed in 9.3% ESUS, without different outcome.

**Conclusion:** Stroke recurrence after ESUS was similar to previous cryptogenic stroke studies.

Analysis including vascular death discloses a 6-fold risk in cardioembolism versus ESUS, clearly separating their prognosis.

Ongoing clinical trials will define the anticoagulation's role on ESUS recurrence.

## ESOC-0880

### 15. Risk Factors for Stroke/Prognosis Long-term predictors of stroke in middle-aged, healthy Norwegian men. Results from Oslo Ischaemia Study (OIS)

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**Background:** The incidence and determinants of stroke in healthy, middle-aged people are not well known. We report results from long-term follow-up in the Oslo Ischaemia Study.

**Methods:** From 1972 to 1975, 2014 healthy Norwegian men aged 40–59 years underwent cardiovascular screening including a symptom-limited bicycle exercise test. Stroke was documented by scrutiny of medical records in all Norwegian hospitals. We used Cox regression analysis to identify baseline variables associated with long-term risk of stroke.

**Results:** During a median of 30 years of follow-up, 276 men (13.7%) had a stroke (Table 1). Age, systolic blood pressure, maximal systolic blood pressure during exercise and PQ interval in ECG were identified as predictors of stroke in multivariable analyses ( $p$ -values  $< 0.01$ ).

**Conclusion:** Age, systolic blood pressure, maximal systolic blood pressure during exercise and PQ interval were significant predictors of stroke during 35 year's follow-up of middle-aged healthy men.

## ESOC-0789

### 15. Risk Factors for Stroke/Prognosis Copeptin improves the prognostic models of early subsequent stroke after a transient ischemic attack

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**Background:** Although large artery atherosclerosis (LAA) and some clinical characteristics are associated with stroke recurrence (SR) among transient ischemic attack (TIA) patients, some biomarkers have been suggested to improve the prognosis of these patients. This study analyses the prognosis value of different biomarkers to be used in addition to ABCD2 score and TIA aetiology to predict SR.

**Methods:** Serum levels of copeptin, adiponectin, neopterin, neuron-specific enolase, high-sensitivity C-reactive protein, IL-6, N-terminal pro-B type natriuretic peptide, S100 $\beta$ , tumor necrosis factor-alpha and IL-1 $\alpha$  as well as clinical characteristics were assessed on TIA patients during the first 24 h of the onset of symptoms. The etiologic subtype was established in all patients. Recurrence end points were at 7 and 90 days.

**Results:** Two hundred thirty-seven consecutive TIA patients were included. 12 patients (5%) had a stroke within 7 days and 15 (6%) within 90 days. Among all candidate biomarkers analysed only copeptin was significantly increased in patients with SR within 7 days ( $p = 0.026$ ).

When added to LAA aetiology, copeptin levels  $\geq 13.8$  pmol/L presented the best SR prediction at 7 and 90 days (Hazard Ratio 7.8, 2.5–24.7,  $p = 0.002$  and HR 5.6, 1.9–16.5,  $p = 0.006$ ). Moreover, this cutoff was associated with a great negative value (97.4%) and the association with a diagnostic accuracy of 90.3%

**Conclusions:** Serum copeptin levels could be an important prognostic biomarker to guide management decisions among TIA patients. Therefore, TIA patients with copeptin levels below 13.8 pg/L have an insignificant risk of stroke recurrence and could be managed as outpatient basis.

## ESOC-0154

### 15. Risk Factors for Stroke/Prognosis Acute pontine infarction with development of progressive motor deficits is associated with worse functional outcome

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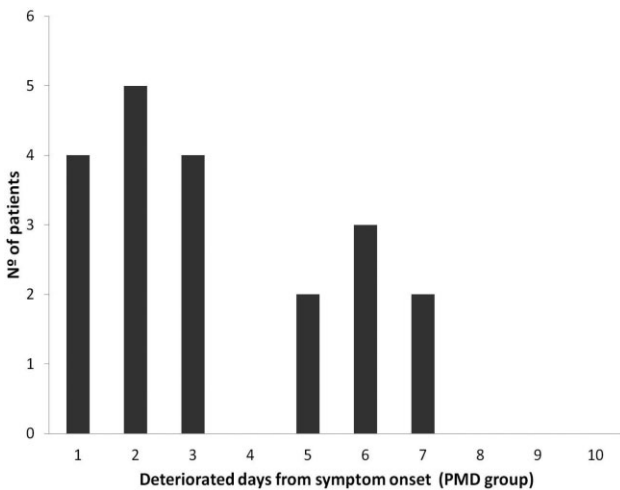
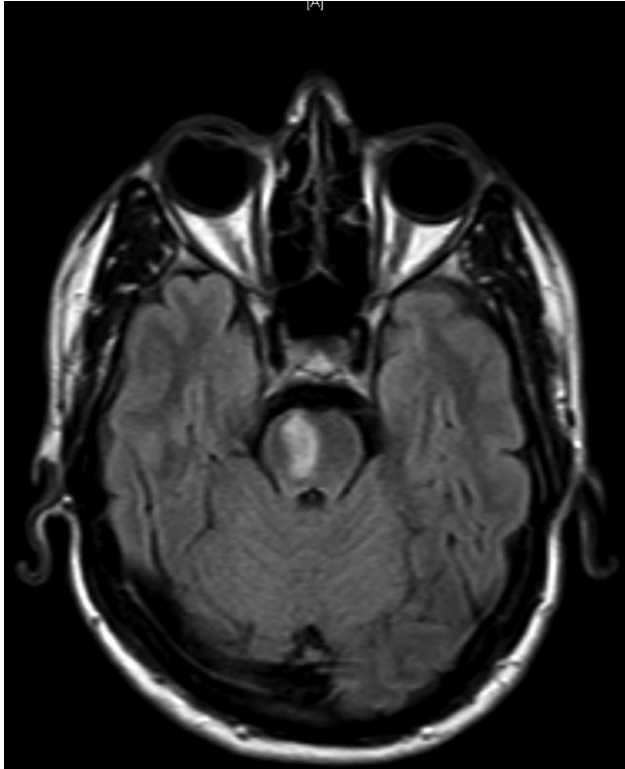
**Background:** The study aimed to prospectively observe the prognosis at three months of unilateral pontine infarction (figure) with and without progressive motor deficit (PMD).

**Methods:** We studied a cohort of patients with unilateral pontine base infarction. Neurologic progression was defined as increased NIHSS score by  $>2$  during hospital stay. Clinical outcome was dichotomized as good and poor according to the modified Rankin Scale (mRS) and Index Barthel (IB) at 3 month after stroke onset. To define the predictors of PMD in these patients, clinical and neuroimaging variables were investigated.

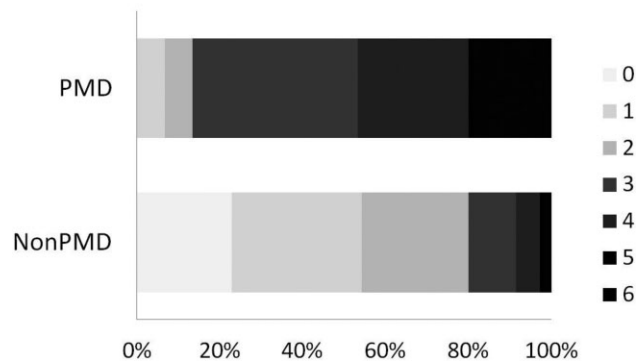
**Results:** A total of 51 patients (32 men and 19 women; age, 67.8 SD 11.1 years) were studied prospectively. Fifteen patients (29.4%) had PMD, and 36 patients were assigned to the stable motor deficit group without PMD. In the PMD group, 13 patients deteriorated within the first 4 days (median, 3; range, 1–7 days) (figure). There was no difference in admission NIHSS between the 2 groups (mean 4.1 vs. 4.4;  $p = 0.662$ ). The NIH

maximum (mean, SD) in PMD group was 9.5, 1.6. The mean length of hospital stay was significantly longer in the PMD group than without PMD group (14.9 versus 9.7 days;  $p = 0.016$ ). And more PMD patients were transferred to the Department of Rehabilitation than the non-PMD group (100% versus 33.3%,  $p < 0.001$ ). Functional outcome after three months was worse in PMD group (IB < 90: 93.3 vs. 48.6,  $p = 0.003$ ; mRS > 2: 86.7% vs. 20.0%,  $p < 0.001$ ) (figure).

**Conclusions:** The motor weakness progression is relatively common in acute unilateral pontine infarction and associated with increased functional disability.



**Modified Rankin Scale at 90 days**



**ESOC-0260**

**15. Risk Factors for Stroke/Prognosis**

**Simple prediction scores predict good and devastating outcomes after stroke more accurately than physicians**

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**Introduction:** There is growing evidence of the utility of the five simple variables (FSV) score and models to predict outcome after stroke. This study aimed to test the FSV and also PLAN scores compared to physician informal prediction for predicting good (modified Rankin [mRS] score 0–2) and devastating outcome (mRS 5–6) following stroke.

**Methods:** Data were collected on consecutive patients with ischaemic or haemorrhagic stroke between November 2012 and December 2013 at our hospital. Demographic and clinical variables were collected with follow-up at 6 months using mRS. Area under the receiver operator curve (AUC) was used to establish performance of prediction scores.

**Results:** Five hundred seventy-five patients were included; 46% female, median age 76 years, and 88% ischaemic stroke. Six months post stroke 47% of patients had a good outcome, 26% a devastating outcome and 19% had died. FSV based scores and the PLAN score was superior to physician prediction (AUCs of 0.823–0.863 vs. 0.773–0.805,  $p < 0.0001$ ) for good and devastating outcomes (mRS 5–6). The FSV score was slightly superior to the PLAN score to predict good outcomes and vice versa for devastating outcomes. Clinical variables 24 hour post thrombolysis improved prediction of good, but not devastating outcomes, compared to baseline variables. The FSV score was superior to physician estimation of outcome, particularly for less experienced physicians.

**Conclusion:** The FSV and PLAN scores are validated in this population for outcome prediction post stroke, including thrombolysed patients. The FSV score is the most parsimonious of score and can inform physician prediction.



## ESOC-1474

### 15. Risk Factors for Stroke/Prognosis

#### Fatal stroke – an analysis of the early predictive elements for the poor outcome in stroke

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The stroke remain one of the first four causes of all deaths in the world. In eastern European countries, the stroke is even more aggressive keeping the third's place for general mortality. The actual study is aimed to find potential predictor factors for poor outcome in the first 24 hours after admission in hospital.

*Material and method:* We analyse all fatalities from 2013 and 2014 in Neurology department – personal cases – and compare them with a control group formed by successive stroke patients from the same clinic, between 2013 and 2014. The study is an observational, retrospective, case controlled. We mostly use descriptive statistics.

*Results:* In the SCJUT (Emergency General Hospital), the general mortality rate is 3.73%. In Neurology department, the general mortality rate is 9.13%. In two years we registered 49 deceased patients from 530 (9.24%). From all cases of death, 81.63% are stroke cases (40/49). Between stroke causalities, 25% are haemorrhagic stroke (4/40).

*Conclusions:* The main risk factor for poor outcome apart from GSC, stroke dimensions and stroke aetiology is presence of the Atrial Fibrillation, high heart rate, presence from the beginning of an infectious context (leucocytosis) and high glycaemia. Even if the patient develop in an ulterior stage a kidney failure, the values of the basal BUN and creatinine are not relevant for poor outcome in the first 24 hours.

## ESOC-0285

### 15. Risk Factors for Stroke/Prognosis

#### Correlation between laboratory markers and occurrence of new brain ischemic lesions in patients undergoing carotid stenting – prospective study

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*Background:* New brain ischemic lesions can be detected in about 50% of patients undergoing carotid artery stenting (CAS). Aim was to assess correlation between selected laboratory markers and new brain infarctions occurrence after CAS.

*Methods:* All consecutive patients 1) with internal carotid artery stenosis >70%, 2) indicated to CAS, 3) with signed informed consent were enrolled to the prospective study during 25 months. All patients used dual antiplatelet therapy (acetylsalicylic acid [ASA] 100 mg + clopidogrel 75 mg per day) at least 7 days before CAS. Neurological examination and brain magnetic resonance imaging (MRI) were performed before and 24 h after CAS in all patients. Blood samples were collected within 24 h before CAS in all patients: hematology + reticulocytes, selected coagulation and genetic markers, Multiplate (ASA and clopidogrel resistance test). Blood samples for anti-Xa assessment were collected during CAS. Mann-Whitney U-test, Fisher test and Kruskal-Wallis test were used for statistical evaluation.

*Results:* The set consisted of 81 patients (53 males; mean age  $67.3 \pm 7.2$  years). New ischemic brain infarctions on follow-up MRI were found in 35 (43.2%) patients. No statistically significant correlation was found between laboratory markers and occurrence of new brain infarctions. Only 1 (1%) patient with resistance to ASA and 6 (11.6%) patients with resistance to clopidogrel were detected.

*Conclusion:* In the presented study, no correlation was found between selected laboratory markers and occurrence of new brain ischemic lesions in patients undergoing CAS.

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## ESOC-0300

### 15. Risk Factors for Stroke/Prognosis

#### Microembolic signals detected with transcranial doppler sonography as a predictors of acute stroke and TIA

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*Background:* Cerebral embolism is the common stroke etiological mechanism and microembolus monitoring has been widely used for ischemic cerebrovascular disease and heart sources of embolism. Although the presents of microemboli in the cerebral blood flow correlates with the potential stroke risk the real clinical significance of microembolic signals (MES) remains unclear.

The aim of our research was to evaluate of MES in predicting ischemic stroke and TIA in patients with arterial and cardiogenic sources of embolism.

*Methods:* Cerebral microemboli were detected from 145 asymptomatic and 122 symptomatic patients. The cohort was divided into three groups: the 1st patients group (n = 89) with atherosclerotic stenosis of extracranial arteries; the 2nd patients group (n = 95) with atrial fibrillation; and the 3rd group (n = 83) with prosthetic heart valves. TCD monitoring was performed at the baseline, after 10 days, 6 months and 1 year period to find out whether the presence of embolic signals predicted risk of TIA and stroke.

*Results:* The frequency of MES was significantly higher in the symptomatic group than in the asymptomatic group (49/122 vs 10/145,  $p < 0.01$ ). However, the frequency of MES was correlated with TIA and stroke only in patients group with atrial fibrillation and prosthetic heart valves ( $p < 0.05$ ); the value of MES as the predictor of acute cerebrovascular complications in the carotid stenosis patients group was not statistically confirmed.

*Conclusion:* MES detection by TCD is a sensitive technique and may be used to access the potential risk of cardiogenic sources of embolism such as atrial fibrillation and prosthetic heart valves.

## ESOC-0553

### 15. Risk Factors for Stroke/Prognosis

#### Aortic dissection causing embolic stroke – a difficult case

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*Introduction:* Aortic dissection is a rare and potentially fatal disease, which produce a wide range of symptoms. Typical symptoms are chest or back pain and hypotension.

Neurological symptoms occur due to occlusion of carotid, vertebral and spinal arteries.

*Case Report:* 78 yrs old patient with a background of hypertension and peripheral vascular disease presenting with left sided facial and limb weakness with incidental findings of blood pressure difference in both arms  
 CT Angiogram of Aorta- Dissection extends into all three branches of aortic arch with occlusion of left renal artery, dissection extends into both iliac common arteries.

*CT Head:* Multiple areas of low attenuation involving right parietal and frontal lobes.

*Conclusion:* The case demonstrates the diagnostic challenges of differentiating stroke from aortic dissection, especially when thrombolytic agents are being considered in a narrow time frame but at a risk of haemorrhagic complications.

The case reveals a patient with a dual diagnosis of an extensive aortic dissection from the left carotids to iliac arteries as well as an acute ischemic stroke.

Cerebral ischemic events are reported to occur in up to 30% cases of aortic dissection whilst neurological symptoms have been reported to occur in up to 40% as a result of vessel occlusion or hypotension. The case highlights the importance of having a high index of suspicion of aortic dissection in those who present with variable neurology and being mindful of a possible accompanying diagnosis of ischemic stroke.

## ESOC-0556

### 15. Risk Factors for Stroke/Prognosis

#### The complex relationship between cancer and cerebral vascular accidents

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*Introduction:* Cancer and Stroke both carry a high burden of morbidity and mortality in the United Kingdom. Malignancy can predispose a patient for stroke via mechanisms unique to the disease; in particularly hypercoagulable state, venous-to-arterial embolism, non-bacterial thrombotic endocarditis, direct tumour compression of a vessel, tumour embolism, hyperviscosity, angiogenesis leading to arterial embolism, post-radiation vasculopathy and chemotherapy.

*Case report:* A 37-year-old lady who presented with profound expressive dysphasia. Her medical history included a hysterectomy 2 years previously for menorrhagia, with previous endometrial ablation. She was non smoke and to family history of stroke or venous thromboembolism.

*CT Head* on admission confirmed an acute left middle cerebral artery infarct.

ECG and carotid dopplers were unremarkable.

The patient re-presented on three subsequent occasions over the next 11 months with focal neurological symptoms. At each admission a new infarct was confirmed. She was extensively investigated for thromboembolic causes of stroke including thrombophilia, infection, auto-immune screen, test for fabry's disease, homocystin level- all negative. 7 day ECG, Trans-oesophageal ECHO, bubble study, CSF study MRV, MRA were negative.

Later that year she developed a right leg deep vein thrombosis. A CT abdomen demonstrated an 8 cm solid mass in the right ovary, subsequent pathology demonstrated ovarian adenocarcinoma.

In our discussion we recognise occult cancer is an important missed diagnosis in cryptogenic stroke. We recommend screening for malignancy for the sub-group of patients where no cause is accounted for. This allows for rapid detection and treatment for both the malignancy and secondary stroke prevention.

## ESOC-0565

### 15. Risk Factors for Stroke/Prognosis

#### Infectious complications in critically ill stroke patients

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Infections have significant impact on outcome in critically ill neurological patients. To estimate the structure of nosocomial infections in stroke patients in intensive care setting we analyzed 47 cases of severe stroke (20 males, 27 females, median age 42 years).

*Results:* nosocomial infections were identified in 55.3% patients. The most common nosology was pneumonia followed by urinary tract infections and catheter-associated bloodstream infections, and sinusitis (96.2%, 50.0%, 50.0% and 26.9%, respectively). Combination of at least two infections was found in 65.4% patients. Nosocomial infections were associated with increased duration of ICU stay from median 14 days in patients without infection to 27 days in patients with at least one infection, and to 113 days in 4 infections. Similar results were shown for mechanical ventilation: patients with 0 or 1 complication were ventilated for median 8 or 9 days, respectively, while patients with 2 or more infections required respiratory support for median 50 days. Mortality was similar for no or one or two types of nosocomial infections (14.3% vs. 22.7% and 16.7%, respectively,  $p > 0.05$ ), while all patients with 3 types of infection survived and among patients with 4 infections 50% died. However, infectious complication was never considered as an immediate cause of death.

*Conclusion:* about half of ICU stroke patients are at risk of infectious complications that may double the length of stay and aggravate the need for mechanical ventilation. The most harmful effect has the often seen combination of several types of infections.

## ESOC-0220

### 15. Risk Factors for Stroke/Prognosis

#### Carotid plaque lipid content on MRI is associated with plaque instability

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*Background and aim:* The composition of a carotid plaque is thought to be important for plaque vulnerability and stroke risk. The main aim of this study was to assess the level of agreement between MRI assessment of plaque components with cerebrovascular symptoms, carotid plaque ultrasound echogenicity and histological assessments of plaques removed at endarterectomy.

*Methods:* Thirty-four consecutive patients with  $\geq 70\%$  carotid stenosis scheduled for carotid endarterectomy underwent a clinical neurological

examination, Colour Duplex ultrasound, 3T MRI with an 8 channel carotid coil and blood tests. All examinations were performed less than 24 hours prior to surgery. Plaques were assessed histologically following endarterectomy. Plaques were defined as symptomatic when associated with ipsilateral cerebral ischemic symptoms within 30 days prior to inclusion. The level of agreement between the size of the lipid-rich necrotic core (LRNC) and calcification on MRI to the histological estimation of the same tissue components, plaque echolucency and symptoms was assessed.

**Results:** In this study we found an inverse correlation between time from last symptom and the size of LRNC on MRI. The size of the LRNC increased as the interval (days) from the last symptom got shorter ( $p = 0.013$ ). The LRNC size on MRI was correlated to the percentage of lipid on histological assessment ( $p = 0.001$ ) and to the echogenicity on ultrasound ( $p = 0.004$ ).

**Conclusion:** Shorter time intervals from last symptom correlated to prevalence of a larger lipid-rich necrotic core on MRI supporting a role for MRI in the assessment of carotid plaque instability and stroke risk.

## ESOC-0775

### 15. Risk Factors for Stroke/Prognosis Molecular and clinical markers for personalized diagnostics of atherothrombotic stroke

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**Background:** Nowadays there are no established criteria of advanced atherosclerosis. Our study aimed to investigate molecular and clinical markers in patients with atherosclerotic carotid artery stenosis (ACAS) in the ischemic stroke acute phase to influence treatment decisions in these patients with high stroke risk.

**Methods:** Thirty patients in the acute phase of atherothrombotic stroke or TIAs with 50–99% ACAS comprised group 1. 51 patients with ACAS without history of vascular events during one month before enrollment were included for group 2, including symptomatic and asymptomatic subgroups according to history of previous vascular events. 16 healthy volunteers comprised the control group. All participants were aged between 50–80 years and didn't have any non-atherothrombotic stroke risk factors (atrial fibrillation). Examination of patients included history taking, duplex ultrasound, biomarkers serum level measurement (Erythropoietin(EPO), CiliaryNeurotrophicFactor(CNTF), Brain-derivedNeurotrophicFactor(BDNF), Insulin-likeGrowthFactor(IGF) 1 and 2, Insulin-likeGrowthFactorBindingProtein-3(IGFBP-3), Glial-FibrillaryAcidicProtein(GFAP), PhosphorylatedAxonalNeurofilament (PNF-H), Lipoprotein-associatedPhospholipaseA2(LP-PLA2), Pregnancy-associatedPlasmaProteinA(PAPP-A), AsymmetricDimethyl-arginine(ADMA), highsensitivityC-reactiveProtein(hsCRP) and blood lipid profile). Differences between groups were accessed by Mann-Whitney, Kruskal-Wallis tests and Data Mining.

**Results:** ADMA and hsCRP levels were significantly higher in acute stroke phase compared with other groups. IGF-1 and IGFBP-3 levels in symptomatic ACAS subgroup were significantly smaller than in control and asymptomatic ACAS subgroups. Other biomarkers didn't show any significant differences between groups. Data Mining has found that neither stenosis degree nor a vascular events history were associated with stroke. **Conclusion:** ADMA and hsCRP serum levels increase during the acute phase of atherothrombotic stroke. Low IGF-1 and IGFBP-3 levels in ACAS patients might be expected to indicate an additional stroke risk.

## ESOC-0594

### 15. Risk Factors for Stroke/Prognosis Is elevated mean platelet volume associated with large artery atherosclerosis in acute ischemic stroke patients?

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**Introduction:** Platelets are involved in atherosclerosis. Previous studies suggested that mean platelet volume (MPV) could be a marker of platelet activation in stroke patients. The aim of this study was to investigate if there was a correlation between MPV levels and large artery atherosclerosis (LAA) with acute ischemic stroke.

**Methods:** We reviewed the charts of 554 patients who were admitted with acute ischemic stroke between the dates January 2011 and August 2014. LAA was defined as any large artery stenosis > 50% on cerebrovascular imaging. The demographic data, NIHSS scores, platelet counts, MPV at admission and mRS scores in follow-up period were recorded. We determined etiologic stroke subtypes using the automated Causative Classification System (CCS).

**Results:** A total of 162 (29.2%) patients with LAA (106 males [65.4%] and 56 females [34.6%]; mean age,  $68.41 \pm 12.37$  (38–98) years) were included in the study. Male was more prevalent in LAA ( $p < 0.001$ ). The mean NIHSS score was  $5.49 \pm 4.22$  (0–26) at admission. The etiologic stroke subtypes was LAA ( $n = 140$ , 86.4%) and undetermined-unclassified ( $n = 22$ , 13.6%). The median mRS was 2 (0–6) in follow up period and it was significantly lower than other ( $p < 0.001$ ). The mean platelet account was  $241.9 \pm 76.0$  (93–466) and the MPV was  $8.85 \pm 1.08$  (7–12). There were not any significant difference for platelet account and MPV between LAA and others. Recurrent stroke was higher in LAA group, but not significantly ( $p = 0.6$ ).

**Conclusion:** In the present study, we did not find a significant association between MPV and LAA with acute ischemic stroke.

## ESOC-1489

### 15. Risk Factors for Stroke/Prognosis Smoking cessation and quality of life 6 years after stroke

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**Background:** Tobacco is a stroke risk factor that diminishes on stopping smoking after stroke. Nevertheless, more than half of patients continue smoking after suffering a stroke. Stopping smoking is associated with better perceived health.

**Objective:** To reveal the perception of health in a cohort of smokers depending on whether they had given up smoking 6 years after suffering a stroke.

**Methodology:** A longitudinal observational study of a cohort of smokers diagnosed with stroke between 2005 and 2007 who were followed for 6 years. Sociodemographic variables, stroke characteristics, tobacco cessation and quality of life (EuroQol-5D scale) were studied. Bivariate statistical analysis was performed using the Chi-squared test and the Mann-Whitney U test.

**Results:** The cohort consisted of 88 people, 84.1% men, average age 60.9 (SD 10.9), median NIH scale 0 (0–1), median Rankin scale 0 (0–2), median Barthel Index 100 (100–100). Six years after stroke, 33 subjects

(37.5%) had given up smoking, 41.9% of the men and 14.3% of the women ( $p = 0.05$ ). No differences were observed with respect to age, neurological scales and functions depending on tobacco cessation. Patients who stopped smoking had a better perception of health (median 80 (60–85)) than active smokers (median 62.5 (50–80)) ( $p = 0.021$ ). No differences were found between the two groups with regards to mobility problems, self-care, daily living activities, the presence of pain and of anxiety or depression ( $p > 0.05$ ).

**Conclusions:** Patients who did not stop smoking had a worse perception of health than those who did manage to give up after suffering from stroke.

## ESOC-0347

### 15. Risk Factors for Stroke/Prognosis Coexistent large-artery disease can not aggravate dynamic cerebral autoregulation impairment in patients with small-vessel disease

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**Background:** Cerebral autoregulation may become impaired after stroke. However, the underlying mechanisms of how these cerebrovascular diseases affect dCA still be controversy. And it might be different among different subtypes of stroke. In this study, we aim to explore the difference pattern of dCA among large-artery disease (LAD), small-vessel disease (SVD) and small-vessel disease accompanied by large-artery disease using transfer function analysis (TFA).

**Methods:** Consecutive ischemic stroke patients within 7 days of symptom onset were enrolled. Non-invasive continuous cerebral blood flow velocity and arterial blood pressure were recorded simultaneously from each subject. TFA was applied to derive autoregulatory parameters, gain, phase difference (PD).

**Results:** Forty-one patients and 12 nonstroke controls were enrolled. In patients with LAD, PD in affected hemisphere was  $22.00 \pm 34.93$ , which is significantly lower than the unaffected hemisphere ( $41.00 \pm 34.52$ ,  $P < 0.05$ ), and the control ( $66.75 \pm 30.20$ ,  $P < 0.05$ ). However, PD is similar in the unaffected hemisphere and control ( $P > 0.05$ ). In the SVD, no difference of PD between two hemisphere ( $27.67 \pm 36.31$  vs  $27.62 \pm 39.31$ ,  $P > 0.5$ ), and both sides were significantly lower than the control (all  $P < 0.05$ ). In patients with coexistent LAD and SVD, no difference between two hemisphere ( $P > 0.05$ ). And both sides were significantly lower than the control (all  $P < 0.05$ ). PD of affected side is significantly lower in the group which pulsatility index is larger than 1.20 ( $10.56 \pm 42.29$ ,  $P < 0.05$ ).

**Conclusion:** The impairment of dCA is different among subtypes of stroke. And patients with large artery disease can not aggravate dCA impairment in patients coexistent with small-vessel disease.

## ESOC-0278

### 15. Risk Factors for Stroke/Prognosis Clinical features of patients with multiple transient ischemic attacks: The PROMISE-TIA registry

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**Purpose:** In a subanalysis of the PROspective Multicenter registry to identify Subsequent cardiovascular Events after TIA (PROMISE-TIA registry), we clarified the features of patients with multiple transient ischemic attacks (TIAs).

**Methods:** The study subjects were 1353 patients (873 men,  $69.5 \pm 12.4$  years) within 7 days of TIA onset between June 2011 and December 2013 from a prospective register in 58 hospitals. The subjects were classified into two groups; the multiple TIA (mTIA) and single TIA (sTIA) group based on the presence or absence of TIA within 90 days before index TIA.

**Results:** Out of 1353 patients, 318 patients (23.5%) were included in the mTIA group. In regard to characteristics of multiple TIAs in the mTIA group, 228 patients (71.7%) had same symptoms, 195 patients (61.7%) had same severity and 191 patients (60.3%) had same durations of symptoms. As compared to sTIA patients, mTIA patients were younger ( $66 \pm 13$  years vs.  $71 \pm 12$  years,  $p < 0.001$ ), and more frequently had extracranial stenosis (19.7% vs. 14.5%,  $p = 0.037$ ) and intracranial stenosis (42.8% vs. 29.7%,  $p < 0.001$ ), and less frequently had atrial fibrillation (7.9% vs. 18.9%,  $p < 0.001$ ) and index TIA of duration  $\geq 60$  minutes (22.6% vs. 44.4%,  $p < 0.001$ ). There was no difference in incidence of subsequent ischemic stroke within 90 days after index TIA between the mTIA and sTIA group (7.3% vs 5.0%,  $p = 0.138$ , log-rank).

**Conclusions:** One-fourth of TIA patients presented multiple TIAs. As compared to sTIA patients, mTIA patients were younger, more likely to have stenotic lesions in cervicocephalic arteries and less likely to have atrial fibrillation.

## ESOC-0250

### 15. Risk Factors for Stroke/Prognosis Incidence and predictors of subsequent ischemic stroke after transient ischemic attack by 1-year follow-up data of a multicenter prospective study

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**Background and purpose:** Data were scarce on the incidence and predictors of ischemic stroke for 1 year after transient ischemic attack (TIA) onset. The present study was carried out to clarify them by using data of a prospective multicenter registration.

**Methods:** The study subjects were TIA patients within 7 days of TIA onset from a prospective register in 57 hospitals. The primary endpoint was ischemic stroke after registration.

**Results:** Of consecutive 1353 patients, 1158 (86%) patients (747 men,  $69.4 \pm 12.2$  years) were followed for 1 year after TIA onset. Ninety-eight patients (8.5%) had ischemic strokes during the follow-up, although the 90-day risk was 6.3%. The 1-year risk of ischemic stroke increased significantly with the increase in ABCD2 score ( $p = 0.005$ ); being 5.8% in 0–3 points of ABCD2 score, 7.6% in 4–5 points, and 12.9% in 6–7 points. Cox hazard model showed that men (HR: 1.62; 95%CI: 1.05–2.59,  $p = 0.016$ ), hemiparesis (HR: 1.83; 95%CI: 1.11–3.20,  $p = 0.044$ ), and systolic blood pressure at presentation (HR: 1.10; 95%CI: 1.02–1.19, per 10 mmHg,  $p = 0.014$ ) were independently associated with the primary endpoint events. The leading subtype of ischemic strokes after the 90 days of TIA onset was cardioembolic stroke (36%) followed by atherothrombotic

brain infarction (ATBI) attributable to intracranial artery disease (IAD) (28%), whereas that within the 90 days was small-vessel disease (44%) followed by ATBI attributable to IAD (21%).

**Conclusions:** We clarified the incidence and predictors, and etiology of ischemic stroke for 1 year after TIA onset.

## ESOC-1410

### 15. Risk Factors for Stroke/Prognosis Is urea : creatinine ratio a predictor of outcome in ischaemic stroke?

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**Background:** Dehydration during admission is common in stroke patients. It is associated with an increased risk of venous thromboembolism and poor outcomes on discharge. It can be detected biochemically by calculating the urea:creatinine ratio (UCR).

**Aim:** We hypothesise that dehydration on admission is a factor in determining post-stroke mortality and functional outcome.

**Methods:** A retrospective chart review was performed using a random sample of patients, where blood results were available, admitted with ischaemic stroke between September 2012 and August 2014. Dehydration was defined as UCR > 80.

**Results:** Of 289 patients (54.5% males), 34 (11.7%) died. Median age was 75.9 years, 33.5% were aged 85 or older. 160 (55.2%) were discharged home and 67 (23.1%) were transferred to inpatient rehabilitation facilities. Older age did not associate with discharge destination or mortality. In patients with a UCR > 80 the median age was 82, versus 78 years with a UCR < 80 ( $p < 0.001$ ). 55.7% of patients aged  $\geq 85$  had a UCR > 80 ( $p = 0.002$ ). Of the 34 that died, 23.5% had UCR of >80. Patients discharged to further inpatient rehabilitation ( $n = 67$ ) had a mean UCR 83.6 compared to 71.4 in patients discharged home ( $p = 0.006$ ).

**Conclusion:** In this population of stroke patients, admission bloods indicating dehydrated state were associated with longer inpatient stays. Older patients ( $\geq 85$ ) did not experience higher mortality or worse functional outcome despite having higher UCR.

Dehydration was a factor in predicting discharge destination after stroke and further exploration of the predictive value of UCR in patients of all age groups is needed.

## ESOC-1007

### 15. Risk Factors for Stroke/Prognosis Prognostic significance of a clinical diagnosis of stroke or TIA in patients with acute neurological symptoms: Long-term follow up of ~6,000 patients

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**Background:** The ability of the clinical diagnosis of TIA or minor stroke to stratify patients with neurological symptoms into high and low risk of future ischaemic stroke or MI is unclear in routine practice, and confidence may be wavering.

**Methods:** We recorded diagnoses made prior to investigation in patients with suspected TIA or minor stroke presenting to a rapid access clinic. We

used three overlapping sources to ascertain subsequent ischaemic stroke or MI. We estimated the ability of clinical diagnosis to identify patients at high and low risk with hazard ratios.

**Results:** Between 2004 and 2013, we saw 5,997 patients. From 0–90 days after symptoms, patients with a clinical diagnosis of TIA or minor stroke had three times the hazard of stroke or MI relative to patients with a diagnosis of mimic (HR 2.83 95%CI: 2.13–3.76); from 90 days to 8 years, this hazard ratio declined (1.52, 1.25–1.86). There was no evidence that this hazard ratio varied with clinician, the patient's gender, presenting symptom, or atrial fibrillation, though the hazard ratio from 90 days to 8 years was greater in patients who were younger, and less in patients with a history of previous MI or stroke.

**Conclusions:** The clinical diagnosis of stroke or TIA in patients presenting with minor or transient neurological symptoms identified high and low risk of recurrent vascular events up to 90 days, though was less discriminating in the longer term. The clinical diagnosis, even without advanced technology, is an effective means of identifying patients at risk of MI or stroke.

## ESOC-1008

### 15. Risk Factors for Stroke/Prognosis Migraine prevalence in patients with unruptured intracranial aneurysms: A case control study

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**Background and purpose:** Migraine is a suggested risk factor for aneurysmal subarachnoid hemorrhage (aSAH). An increased risk of aSAH in migraineurs may be explained by an increased rupture risk or an increased prevalence of unruptured intracranial aneurysms (UIA). We performed a case-control study to compare lifetime migraine prevalence in patients with UIA, patients with a history of TIA or stroke and controls.

**Methods:** Patients with UIA were recruited from two university hospitals. Data on patients with TIA/stroke were retrieved from a previous study. Partners of patients with UIA or TIA/stroke were included as controls. Migraine history was assessed via a telephone interview based on the ICHD 3 beta criteria. We calculated odds ratios (OR) for migraine with univariable and multivariable logistic regression analyses, adjusted for age, sex, hypertension and smoking.

**Results:** We included 172 patients with UIA, 221 patients with TIA or stroke and 164 controls. In UIA patients, migraine prevalence was 24.4% compared with 14.6% in controls (UIA versus controls; OR 1.9; 95% CI 1.1–3.5) and 22.2% in TIA/stroke patients (UIA versus TIA/stroke; OR 1.1; 95% CI 0.7–1.8). After adjustments, the OR for migraine in UIA patients versus controls was 1.7 (95% CI 1.0–3.1) and 0.9 (95% CI 0.5–1.0) versus TIA/stroke. Results were comparable for migraine with and without aura.

**Conclusions:** Migraine prevalence seems to be increased in patients with UIA compared with controls and comparable with the prevalence in patients with TIA or stroke. Further studies are needed to confirm our findings and to investigate the underlying pathophysiology

## ESOC-1435

## 15. Risk Factors for Stroke/Prognosis

## Essential thrombocytosis and ischemic stroke

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Essential thrombocytosis is a rare myeloproliferative disorder of unknown etiology, which is characterized by hyperplasia of the bone marrow megakaryocytes. Their excessive proliferation leads to increased platelet counts. Its incidence is approximately 2–3 cases/100,000/year and mainly affects adults 50–60 years old. The most common symptoms accompanying essential thrombocytosis are thrombotic (usually from the CNS) or hemorrhagic events.

In the report two patient cases are described; both are male, aged 49 and 65, with no cardiovascular disease history. They were admitted to our department with left-sided hemiparesis due to recent ischemic infarcts, in the lower part of the left segment of the medulla and in the right temporoparietal area, respectively. Increased platelet counts were observed (>450,000 for the 49-years-old and >600,000 for the 65-years-old) and both were diagnosed with splenomegaly. Bone marrow tissue was collected via biopsy from both patients. Examination of the tissue taken from the 49-years-old showed large megakaryocytes with multilobular nuclei. Histological study of both samples revealed the occurrence of primary myelofibrosis. Both were heterozygous for the JAK2 V617F mutation. None of the other tests conducted (brain MRA, carotid ultrasound etc.) yielded abnormal results.

Essential thrombocytosis is a rare hematological disorder often associated with manifestations of the CNS, such as signs and symptoms of headache, TIA, transient amaurosis, stroke etc. The systematic and thorough investigation of the causes of ischemic stroke among middle-aged adults, with no risk factors for cardiovascular events, can reveal diseases which significantly affect the welfare of the patients, but are amenable to continuous treating.

## ESOC-0427

## 15. Risk Factors for Stroke/Prognosis

## Autonomic dysfunction as measured by Ewing's battery test predicts poor outcome after acute ischemic stroke

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**Background and objectives:** Central autonomic dysfunction is frequent in ischemic stroke. Its presence increases the risk of mortality after stroke. We aimed to investigate whether the severity of autonomic dysfunction as classified by Ewing's battery test can predict poor outcome after acute ischemic stroke.

**Methods and patients:** Consecutive ischemic stroke patients within 7 days of symptom onset were enrolled. Autonomic function was assessed by Ewing's battery tests. We dichotomized the severity of autonomic dysfunction into two groups: severe (definite, severe or atypical) and minor (normal or early). Modified Rankin Scale (mRS) (good outcome: mRS 0–2; poor outcome: mRS 3–6) was evaluated 3 months after index stroke.

**Results:** Forty-nine patients were recruited (mean age, 63.8 ± 10.7 years; 87.5% males). From Ewing's battery of autonomic function tests, minor autonomic dysfunction was identified in 14 patients (28.6%) and severe autonomic dysfunction was identified in 35 patients (71.4%), respectively. There were no significant differences in baseline characteristics and current drugs use between the minor and severe autonomic dysfunction groups (all  $P > 0.05$ ). At month 3, a poor functional outcome was found in

37.1% of severe group patients compared to 7.1% in the minor group ( $P = 0.042$ ).

**Conclusions:** The severity of autonomic dysfunction as measured by Ewing's battery test predicts poor clinical functional outcome after acute ischemic stroke.

## ESOC-1157

## 15. Risk Factors for Stroke/Prognosis

## Which parameters of beat-to-beat blood pressure variability predict clinical outcome after acute ischemic stroke?

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**Background and objectives:** Visit-to-visit and day-to-day variability in systolic blood pressure (SBP) are associated with an increased risk of stroke. However, it is uncertain whether ultrashort-term BP recording assessing BP variability (BPV) has a similar predictive role. We aimed to study beat-to-beat measure of BPV in the acute phase of ischemic stroke to determine whether any of them predicted clinical outcome.

**Methods and patients:** Consecutive ischemic stroke patients within 7 days of symptom onset were enrolled. The frequency components of BPV by means of power spectral analysis [very low frequency (VLF; <0.04 Hz); low frequency (LF; 0.04–0.15 Hz); high frequency (HF; 0.15–0.40 Hz); power spectral density (PSD; <0.40 Hz) and LF/HF ratio] were used as parameters of BPV from 10-minute recordings of beat-to-beat BP on admission. Outcome was assessed at 3 months after stroke onset as good or poor by modified Rankin Scale (mRS) (good outcome, mRS ≤ 2).

**Results:** Seventy-five patients were recruited (mean age, 64.6 ± 9.9 years; 89.3% males). Univariate analysis showed that HF-SBP and PSD-SBP were significantly higher in poor group compared with those in good group [2.97 (1.35–6.59) vs 1.59 (0.92–2.62) mmHg<sup>2</sup>,  $P = 0.005$ ; 20.69 (10.08–45.90) vs 13.61 (6.12–28.65) mmHg<sup>2</sup>,  $P = 0.045$ ]. After adjusting for confounding factors, multivariate logistic regression showed that only HF-SBP (OR 1.338; 95% CI, 1.062–1.685;  $P = 0.013$ ) was independently correlated with poor functional outcome.

**Conclusions:** This study shows that ultrashort-term highly variable SBP on admission in the acute stage of ischemic stroke may predict poor functional outcome at 3 months after stroke onset.

## ESOC-0963

## 15. Risk Factors for Stroke/Prognosis

## Management of antithrombotic agents during surgery or other kind of medical procedures with bleeding (MARK study)

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**Background:** Management of antithrombotic agents during surgery has not been established yet. We performed a prospective, multicenter, observational study regarding management of antithrombotic agents during surgery or kinds of medical procedures with bleeding (MARK study).

**Methods:** We conducted the study at 58 National Hospital Organization institutions in Japan and enrolled 9,992 patients (72.9 ± 9.7 years old, men 68.8%), in whom medical procedure with bleeding was thereafter conducted in 9,783. We analyzed for the 9,783 patients, the details of the procedure, method of perioperative management of antithrombotic agents, and occurrence of thrombosis, embolism, bleeding complications, and death between two weeks before and four weeks after the procedure.

**Results:** With respect to perioperative management of antithrombotic agents, they were continued in 3,584 (36.6%, continuation group) and discontinued in the other 6,199 (63.4%, discontinuation group). Thromboembolic events and death in the continuation group were more frequently observed in the discontinuation group than in the continuation group (17.9% vs. 6.5%,  $p < 0.01$  and 0.81% vs. 0.42%,  $p < 0.05$ , respectively). Hemorrhagic events were also more frequently recorded in the discontinuation group than in the continuation group (5.65% vs. 1.70%,  $p < 0.01$ ). Heparin bridge was performed in 1,953 patients in the discontinuation group, being related to hemorrhagic complication more than in other 4,246 patients without (6.9% vs. 5.1%,  $p < 0.01$ ).

**Conclusion:** It seems that discontinuation of antithrombotic agents is a risk for thromboembolic events and death, that the discontinuation group has higher risk of hemorrhagic complication than the continuation group, and that heparin bridge is related to hemorrhagic events.

## ESOC-1176

### 15. Risk Factors for Stroke/Prognosis

#### Aspirin resistance in patients with ischemic stroke

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**Objectives:** Ischemic stroke is one of the most common causes of disability and death all over the world. Aspirin is the basic agent in antithrombotic treatment. However several patients do not respond to treatment and due to these patients aspirin resistance term has been used recently. Recent studies have shown that aspirin resistance incidence is between 3–85% among cerebrovascular disease patients. In this study, we aimed to determine the frequency of aspirin resistance in cerebrovascular disease patients and their relationship with demographic characteristics, risk factors, and stroke types were evaluated.

**Method:** In a 6 months period, 163 (106M-57F; mean age:  $64.51 \pm 13.85$  years) acute ischemic stroke patients followed-up in our clinics and treated with aspirin (100 mg–300 mg daily) were evaluated. Aspirin resistance was measured by a Multiplate® platelet analyser. Etiology of cerebrovascular disease was determined according to the TOAST classification. Correlation between aspirin resistance and age, sex, hypertension, diabetes mellitus, hyperlipidemia, height, weight, fasting blood glucose level, history of cerebrovascular disease, smoking and alcohol were analyzed.

**Results:** Aspirin resistance was found in 25 (15,34%) of 163 patients. No statistically significant relationship was observed between aspirin resistance and any of the clinical parameters investigated.

**Discussion:** Since aspirin is an important agent in stroke, to predict aspirin resistance will develop in which patients would help us. We could not find any relationship with demographic findings or risk factors. The wide range of aspirin resistance incidence makes us to think the personal or genetic predisposing factors. This shows a need for further studies.

## ESOC-1180

### 15. Risk Factors for Stroke/Prognosis

#### Evaluation of inflammatory markers (neutrophil to lymphocyte ratio and other markers) in ischemic cerebrovascular diseases

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**Objectives:** Neutrophil lymphocyte ratio (NLR) is a marker of systemic inflammation that can be easily measured. In this study, the relationship

between NLR to stroke subtypes, risk factors, other markers of inflammation and prognosis in patients with stroke or TIA was evaluated.

**Material-methods:** Data of 464 stroke or TIA patients, followed-up in 2013, were evaluated retrospectively. Patients (n = 172) with diseases that might affect the values of NLR were excluded. Patients were classified in three subgroups; hemorrhagic (HS), ischemic stroke (IS) and TIA. NLR, leukocyte, neutrophil, lymphocyte, platelet count, mean platelet volume, GGT, sedimentation rate, CRP values were compared between subgroups.

**Results:** The mean age of 292 patients (114F:178M) was  $66.3 \pm 13.3$  years. There was no significant differences of lymphocytes, platelets, MPV, CRP, sedimentation rate, GGT levels between subgroups, in the HS subgroup the mean leukocyte, neutrophil counts and NLR was significantly high ( $p = 0.001$ ,  $p = 0.006$ ). There were significant differences of mean NLR between HS subgroup and IS and TIA subgroups, respectively ( $p = 0.038$ ,  $p = 0.005$ ), but not between IS and TIA subgroups ( $p = 0.180$ ).

**Conclusion:** Many studies have shown increased leukocytes, neutrophil and NLR values in stroke patients. In this study, NLR was significantly higher in the HS subgroup. This might be an indicator of the inflammatory response following the damaged cerebrovascular autoregulation secondary to bleeding. Another explanation might be related to the lack of a control group and comparison of the values only between subgroups. Still there is need for larger studies, to investigate the relationship between NLR and other inflammatory markers in stroke.

## ESOC-1090

### 15. Risk Factors for Stroke/Prognosis

#### Effect of statin on symptomatic basilar artery disease

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Patients with symptomatic basilar artery stenosis are at risk for recurrence of stroke. There are limited data on appropriate medical therapy to this. We aimed to examine the influence of statin therapy on natural history of basilar artery stenosis with acute ischemic stroke. We retrospectively studied 153 patients with acute ischemic stroke with basilar artery stenosis between April 1, 2003 and December 31, 2013. All patients were performed MR angiography on first hospital day, and the day of clinical event or 1 year later. The extent of stenosis of basilar artery was divided to mild (signal reduction <50%) and severe stenosis (signal reduction >50%). The clinical endpoint was recurrent ischemic stroke and other composite vascular events. Mean follow-up time was  $14.597 \pm 5.825$  months. 114 (74.5%) patients were treated by statin after index stroke and 56 (36.6%) patients were administered high-dose statin. During the follow-up period, there were 31 (20.3%) ischemic strokes and 38 (24.8%) composite cardiovascular outcomes. Stroke recurrence (14.9% vs 35.9%) and composite vascular event (18.4% vs 43.6%) were more common in patients who were not administered statin. The patients who took high-dose statin were shown good mRS after 3 months. Stroke recurrence (10.7% vs 25.8%) and composite vascular events (14.3% vs 30.9%) were lesser than who were not treated. Among the patients with administration of statin, 26 (22.8%) were regressed and 8 (7.0%) were progressed while untreated patients were observed 6 (15.4%) of regression and 11 (28.2%) of progression. Our study suggests statin can improve prognosis and degree of stenosis in patients with symptomatic basilar artery disease.

## AF & Cardioembolism

### ESOC-1456

#### 16. AF & Cardioembolism

##### The Norwegian Atrial Fibrillation and Stroke Study (the NOR-FIB Study)

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Approximately 1 in 5 of all ischemic strokes with known etiology are caused by atrial fibrillation (AF), which is also often suspected in cryptogenic strokes. The clinical significance of very brief episodes of AF is, however, uncertain.

Information regarding acute revascularization treatment in patients with anticoagulation and secondary prevention with direct oral anticoagulants is limited.

The NOR-FIB Study is an on-going trial, which involves six principal fields of investigation:

- (1) To assess sex differences and clinical risk factors in ischemic stroke due to AF.
- (2) Acute revascularization treatment and outcomes in patients with ischemic stroke due to AF compared with findings in patients with ischemic stroke due to carotid atherosclerosis.
- (3) Secondary stroke prevention with anticoagulation: safety, efficacy and compliance
- (4) Biomarkers, which can be used to assess stroke risk and etiology.
- (5) Arrhythmia-detection in patients who present with cryptogenic strokes.
- (6) Assessment of the significance of very brief episodes of AF.

NOR-FIB is a prospective observational multi-center national study, which is collecting data from patients admitted with cardioembolic stroke due to AF, atherosclerotic or cryptogenic stroke. Estimated numbers of enrollment are: 500 patients with AF related stroke and 500 patients with cryptogenic stroke. The control group with atherosclerotic stroke is already included in the NORSTROKE Study in ECRI – a large thematic cerebrovascular study containing several multi-center studies.

### ESOC-1446

#### 16. AF & Cardioembolism

##### Pre-event CHA2DS2-VASc score and severity of acute stroke in patients with atrial fibrillation: Findings from the RAF study

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**Background:** Current guidelines recommend CHA2DS2-VASc score to assess the risk of stroke in patients with atrial fibrillation (AF). The association between pre-event CHA2DS2-VASc score and the severity of acute stroke has never been defined.

**Aim:** We investigated the association between CHA2DS2-VASc score and the severity of acute stroke in a prospective multicentre study which enrolled consecutive patients with acute stroke and AF (RAF study).

**Methods:** Severity of stroke was evaluated on admission by the National Institute of Health Stroke Scale (NIHSS) score, that was considered both as a continuous and dichotomized variable (severe stroke = NIHSS > 10). Correlations between severity of stroke and pre-event CHA2DS2-VASc were evaluated using multiple logistic regression after adjustment for other risk factors.

**Results:** Of the consecutive patients enrolled in the study, 598 patients had an admission NIHSS score greater than 10 and 399 patients lower than 10. The median NIHSS scores for CHA2DS2-VASc score of 0–8/9 were: 5.18, 8.30, 8.31, 8.86, 9.12, 9.67, 9.70, 10.30, 12.09, respectively. A linear correlation was found between severity of stroke and CHA2DS2-VASc score ( $r^2$  0.010,  $p = 0.001$ ). On multivariate analysis, CHA2DS2-VASc score correlated with the severity of stroke (OR 1.084,  $p = 0.041$ , for each point increase).

**Conclusions:** In patients with AF, CHA2DS2-VASc score is a predictor of severity of stroke in addition to be a predictor of risk of stroke. This observation increases the value of the assessment of CHA2DS2-VASc score when considering the use of anticoagulant treatment.

### ESOC-0895

#### 16. AF & Cardioembolism

##### Occult atrial fibrillation detected by auto-triggered loop recorder screening in a community-based population

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**Introduction:** Atrial fibrillation is the most frequent source of cardiac emboli in patients with ischemic stroke. The majority of atrial fibrillation events are underdiagnosed, as it is often asymptomatic or intermittent and, therefore, may not be detected on standard 12-lead ECG or even 24-hour ECG recording (Holter). We have evaluated the frequency of atrial fibrillation (AF) by using an auto-triggered external loop recorder (ELR) in a community-based population.

**Methods:** We enrolled 48 participants, 65 years of age or older, with no history of AF (normal ECG), stroke or transient ischemic attack (TIA) from 3 retirement facilities and 1 community clinics in Edmonton city. The primary outcome was to detect any AF event ( $\geq 3$  seconds) during the monitoring period.

**Results:** The median ELR monitoring duration was 19 (IQR 15.5–20) resulting in an AF detection rate of 27% (13/48), of which 77% (10/13) were  $< 30$  seconds but  $> 3$  seconds, and the remaining 23% (3/13) were  $\geq 30$  seconds. Paroxysmal atrial tachycardia was detected in 50% (24/48) of participants, of which 37.5% (9/24) occurred with the same participants who have atrial fibrillation.

**Conclusion:** There is a high rate of occult atrial fibrillation (mostly  $< 30$  seconds) detected by auto-triggered external loop recorder in the community population. The use of external loop recorders to evaluate for AF or PAT may be considered in patients at high risk for stroke.



## ESOC-1280

## 16. AF &amp; Cardioembolism

### Left atrium enlargement predictive of paroxysmal atrial fibrillation detected by continuous electrocardiographic monitoring after acute ischemic stroke

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**Introduction:** Paroxysmal atrial fibrillation (PAF) is a common cause of ischemic stroke, often undetected and challenging to diagnose. The aim of this study was to investigate the relationship between left atrial size and PAF, diagnosed using continuous stroke unit electrocardiographic monitoring (CEM), in patients with acute cerebral ischemia.

**Material and methods:** All transient ischemic attack and stroke consecutive patients admitted in our stroke unit department without any history of atrial fibrillation were considered. Patients with determined cause of stroke as dissection or known cardioembolism were excluded. During hospitalization patients underwent CEM and transthoracic echocardiography. PAF was defined as an AF period of at least 30 seconds.

**Results:** Fifty-five out of 515 patients (10, 7%) had a new-onset PAF during hospitalization. Median time of CEM duration was 6 days. Patients with PAF during CEM were more likely female ( $p = 0.04$ ), older (76, 2 vs. 63, 9 years;  $p < 0.05$ ), presented a higher NIHSS score (12, 1 vs. 6, 9;  $p < 0.05$ ) and higher levels of CRP ( $p < 0.05$ ) at onset. An enlarged left atrium at echocardiographic examination was found in 81, 8% of PAF patients with respect to 26.1% of non PAF patients ( $p < 0.05$ ).

**Conclusions:** In accordance with previous studies our data emphasize the utility of morphological echocardiographic characteristics in stratifying the risk of new-onset PAF in acute ischemic stroke patients. The identification of risk markers for atrial fibrillation during hospitalization may help to identify patients who may benefit from a prolonged ECG monitoring during and after hospitalization.

## ESOC-1057

## 16. AF &amp; Cardioembolism

### Observation of cardiac rhythm in TIA patients: Evaluation of prolonged rhythm monitoring in TIA patients at a community based hospital

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**Background:** Atrial fibrillation (AF) is considered as a strong risk factor in the development of cerebral ischemia. Prolonged ECG monitoring may lead to improved detection of paroxysmal AF. Therefore, since March 2013 TIA screening at a community based hospital in Apeldoorn, The Netherlands (160.000 inhabitants) has been extended from 9 to 24 hours of observation. Objective of this analysis was to evaluate the effect of prolonged observation.

**Methods:** By means of nursing recordings of the TIA screening was determined how often AF de novo was caught on ECG/ monitor before and after the introduction of the 24 hours registration period.

**Results:** From December 2010 until March 2013 277 patients with a definite TIA were screened. No AF de novo was seen during a 9 hours registration period.

From March 2013 up to December 2014 237 TIA patients were admitted for 24 hours. In 3 patients AF de novo was discovered at admission. In another 2 patients AF revealed itself on the monitor later on (0.84% of all

TIA patients). One patient was transferred to the cardiology ward because of an unknown cardiac arrhythmia on the monitor. No other types of arrhythmia were detected. Possible impact on health care costs will be discussed.

**Conclusion:** Prolonged rhythm observation has led to an increased detection of AF de novo, although to a small extent. A registration period in a larger group of TIA but also minor stroke patients is required before concrete statements concerning (cost) effectiveness can be made.

## ESOC-1198

## 16. AF &amp; Cardioembolism

### Clinical practice with rivaroxaban in secondary stroke prevention

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**Background:** Rivaroxaban has been approved for stroke prevention in nonvalvular atrial fibrillation. Most data regarding efficacy and safety is driven from clinical trials; information from clinical practice in secondary stroke prevention is lacking.

**Methods:** We prospectively included patients starting rivaroxaban for secondary stroke prevention at our hospital from October 2012 to July 2014. Clinical, efficacy, and safety variables were registered.

**Results:** Eighty-one patients were included, mean follow-up of 10 months (range 1–24). Forty-one were female (50.6%), mean age 79.5 (range 54–96, SD 9.3), median CHADS2 4 (range 2–6), CHA2DS2-VASc 5 (range 3–8), and HAS-BLED 2 (range 1–4). Indication for rivaroxaban was ischemic stroke in 77 patients (45.5% anticoagulation naïve and 54.5% previously on warfarin), and intracranial hemorrhage (IH) due to warfarin in 4 (4.9%). Rivaroxaban 20 mg was prescribed in 56 cases (69.1%), and 15 mg in the remaining. Two patients received concomitant antiaggregation due to vascular disease. Seven patients (8.6%) suffered events during follow-up. Ischemic events (4), one transient ischemic attack, and 3 ischemic strokes (1 disabling). Hemorrhagic events (3) lead to rivaroxaban discontinuation in 1 patient, and were lower gastrointestinal bleeding (1), and haematuria(2), none required blood transfusion. No IH were detected during follow-up. All patients with history of IH remained uneventful. Three patients died (pneumonia and sepsis in two cases) and 4 were lost during follow-up.

**Conclusions:** In our cohort most ischemic events were non-disabling. During follow-up there were no IH. Rivaroxaban was safe and efficacious in an unselected cohort of old patients with high CHADS score.

## ESOC-1203

## 16. AF &amp; Cardioembolism

### Are direct oral anticoagulants safe in patients with previous intracranial hemorrhage?

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**Background:** Direct oral anticoagulants (DOACs) have demonstrated a 50% reduction in intracranial hemorrhage (IH) compared to warfarin in patients with non valvular atrial fibrillation (NVAf) at high risk of stroke. However, data regarding safety in patients with previous history of IH are lacking as this type of patients were excluded from DOACs pivotal trials.

**Methods:** We prospectively included since 3/2010 to 9/2014, NVAf patients (CHADS2 > 1) with a previous history of IH, in which treatment with DOACs was initiated. Age, time of follow-up, CHADS2, CHA2DS2-VASc, HAS-BLED, type of IH, embolic and hemorrhagic complications were recorded during follow-up.

**Results:** Twenty-five patients were included, 13 (52%) had previous ischemic stroke. Eighteen were male (72%), mean age 77.9 (range 59–89, SD

7.3), median CHADS2 4 (range 2–5), CHA2DS2-VASc 5 (range 3–7), and HAS-BLED 3 (range 2–4). Fifteen (60%) received acenocumarol. IH was classified as intracerebral hemorrhage (20), subarachnoid hemorrhage (3) and subdural hematoma (2). Seventeen patients were treated with dabigatran, 4 with rivaroxaban and 4 with apixaban. Time from IH to DOACs was >2 years in eight patients (32%), in the remaining median time was 2.5 months (range 0.23–9). Mean follow-up was 17.9 months (range 3–55). None were lost in follow-up. Only 2 patients suffered events, one gastrointestinal hemorrhage which required transfusion and the other suffered an intracerebral hemorrhage after 3 years of treatment, which lead to death. No embolic events were recorded

**Conclusions:** DOACs seem safe in patients with NVAf at high risk of stroke with a previous history of IH.

## ESOC-0816

### 16. AF & Cardioembolism

#### Factors associated with paroxysmal atrial fibrillation diagnosis in embolic stroke of undetermined source with serial 24-hours holter monitoring

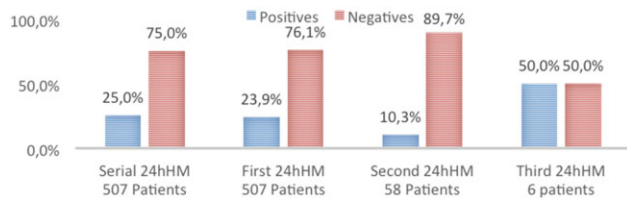
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**Objective:** To assess the utility serial 24-hours ECG Holter Monitoring (24 h-HM) for the diagnosis of paroxysmal atrial fibrillation (PAF) in patients with an embolic stroke/transient ischemic attack of undetermined source (ESUS).

**Methods:** Observational study of patients with ESUS admitted at a Stroke Center (2009–2013). A first 24 h-HM was performed in all cases and, if it was negative, a second or even a third HM was performed. Variables analysed: demographic data, vascular risk factors (VRF), clinical data, presence of carotid plaques by duplex ultrasound, left atrial enlargement by echocardiography. Multivariate models were preformed to identify those factors associated with the PAF detection.

**Results:** Overall 507 patients were diagnosed with an ESUS, mean age 70.28 years old (SD 12.8), 58% of them male. The 24 h-HM results are shown in Figure 1. Multivariate analysis showed that, for the first 24hHM, older age (OR 1.033, CI 95% 1.013–1.054) and left atrial enlargement (OR 2.012; CI 95% 1.289–3.143) were the factors associated to the presence of PAF. For the second and third 24hHM, the multivariate analysis showed that left atrial enlargement (OR 13.333; CI 95% 1.539–115.548) was the only factor related to the PAF diagnosis.

**Conclusions:** Serial 24hHM detect PAF in more than 25% of patients with ESUS. Age and left atrial enlargement are the factors more strongly associated with the PAF diagnosis.



**Fig. 1** PAF diagnosis by serial 24 h holter monitoring.

## ESOC-0855

### 16. AF & Cardioembolism

#### Proposal of a score to predict paroxysmal atrial fibrillation in patients with ischemic stroke based on clinical and echocardiographic findings

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**Objective:** To identify clinical and echocardiographic conditions associated to atrial fibrillation (AF) in patients with ischemic stroke (IS) and to develop a score to predict the diagnosis of paroxysmal atrial fibrillation (PAF) in these patients.

**Methods:** Retrospective observational cohort study of IS patients admitted to a Stroke Unit between 2010 and 2014, selecting patients with cerebral infarction and without previously known AF. An urgent ECG, first 24–48 h ECG monitoring was performed in all patients, and additional 24 h Holter ECG in selected patients. An echocardiogram was performed in all patients, including left atrial area or diameter, and measures for left atrial filling pressure. Demographic data, vascular risk factors, clinical variables and PAF diagnosis were recorded for analysis. Multivariate models were built to evaluate the impact of these parameters on the presence of PAF.

**Results:** Three hundred thirty patients were included in the study. 58,5% men, mean age (SD) 67,7 (14,6) years. 132 Holter-ECG were performed. 77 (23%) patients were diagnosed with AF, 31 (28%) of them by Holter. Age  $\geq 75$  years, severe stroke, left atrial dilation, and elevated left atrial filling pressure were independently associated with underlying PAF. PAF risk scale scores for these factors were built, showing high sensibility (92%) and negative predictive value (94%) for diagnosis of PAF in presence of any these factors.

**Conclusions:** A PAF risk score based on age, stroke severity, left atrial filling pressure and left atrial dilation has high sensitivity and negative predictive value. Future studies are needed to demonstrate its external validity.

## ESOC-1401

### 16. AF & Cardioembolism

#### Extended automatic analysis of continuous ECG monitoring (ACEM) substantially improves the identification of patients with newly diagnosed atrial fibrillation during hospitalization for acute ischemic stroke

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**Background and purpose:** Atrial fibrillation accounts for approximately 20% of all ischemic strokes. Anticoagulation is highly effective in stroke prevention in these patients. However, early detection of AF after stroke remains challenging. Recent observational studies and RCTs promote prolonged ECG-monitoring for the detection of AF. The present study aimed at estimating the role of extended automatic analysis of continuous ECG monitoring (aCEM) for detecting AF already during hospitalization.

**Methods:** Six hundred and eighty consecutive patients with ischemic stroke or TIA admitted to our Stroke Center in 2014 were included in this analysis. Generally, they received an ECG on admission, followed by standard continuous ECG monitoring (CEM) during their stay on our stroke unit (SU), and finally portable aCEM (Apoplex medical, SRAclinic) on the early rehabilitation unit. Out of these 680 patients, 105 did not undergo CEM but received portable aCEM directly.

**Results:** A total of 151 patients were discharged with the diagnosis of AF, which was already known on admission in 97 (64%) and newly diagnosed in 54 (36%). From the latter group, ECG on admission identified 27 with AF (18% from total of 151), CEM 14 (9%) and portable aCEM detected an additional 11 patients (7%). One patient with implanted ECG-recorder showed AF-episodes at read-out and another patient fainted during hospitalization and demonstrated AF on the concomitantly written ECG. **Conclusions:** Portable aCEM considerably contributed to identifying stroke patients with paroxysmal AF, most likely due to an extended monitoring period. It might serve to reduce stroke recurrence by optimizing secondary stroke prevention.

## ESOC-0832

### 16. AF & Cardioembolism

#### Predictive value of copeptin after atrial fibrillation-related TIA or stroke: population-based study

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**Background:** Despite proven effectiveness of Warfarin in secondary prevention after TIA/ischemic stroke with atrial fibrillation, many patients are untreated. Copeptin, the c-terminal-portion of pro-vasopressin, is a useful prognostic marker in patients after myocardial infarction and heart failure and might enable better risk prediction after TIA/stroke. We analysed the predictive value of Copeptin in relation to warfarin treatment.

**Methods:** We measured Copeptin-levels in consecutive patients with AF-related TIA/stroke in a population-based study (Oxford Vascular Study) recruited from 2002–7 and followed-up to 2014. A raised Copeptin-level was defined as above the 90th percentile of levels measured in 401 age- and sex-matched controls. Associations with risk of recurrent vascular events (stroke, myocardial infarction, systemic embolism and vascular death) on follow-up were determined by Kaplan-Meier curves and by Cox regression stratified according to Warfarin treatment.

**Results:** During about 1300 patient-years follow-up in 365 patients with cardioembolic TIA/stroke there were 155 recurrent vascular events. In those not treated with Warfarin, risk of recurrent vascular events at one year was 42% (95%CI 34–51) for those with high Copeptin levels (n = 132) and 14% (9–22; n = 107) for those with normal levels. In Warfarin-treated patients, these risks were 10% (6–16; n = 60) and 6% (2–15; n = 66) respectively. After age/sex adjustment, the relative predictive value of high Copeptin for long-term risk of vascular events was similar for patients on Warfarin (HR = 2.64, 1.40–4.96, p = 0.003) and without Warfarin (2.84, 1.85–4.37, p < 0.0001).

**Conclusions:** A raised Copeptin level predicts risk of vascular events in patients with AF-related TIA/stroke and might be useful for patient counseling about oral anticoagulation.

## ESOC-1314

### 16. AF & Cardioembolism

#### Predictive features for detection of embolic arrhythmia by holter-ecg 24 h monitoring after acute ischemic stroke or transient ischemic attack

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**Objectives:** Atrial fibrillation (AF) is the major cause of brain ischemic events. Our objective is to identify the patient's features associated with

higher probability of targeting embolic arrhythmia (EA) by Holter-ECG 24 h monitoring.

**Patients and methods:** Retrospective study over a prospective database of patients submitted in our Stroke Unit during the period January 1st 2011–June 30th 2012. We monitored patients with cryptogenic stroke or under the neurologist in charge criteria. We considered two groups of patients, those with AF or Flutter detected during Holter-ECG 24 h monitoring – embolic arrhythmia (EA) – and non embolic arrhythmia (NEA) patients.

**Results:** We included 581 patients with acute ischemic stroke (IS) and 197 with transient ischemic attack (TIA). 247 patients (31.7%) were monitored by Holter-ECG 24 h. EA was detected in 28 patients (11.3%): 23 AF, 2 Flutter and 3 patients with both. Statistical differences were found between the two groups for age (EA 79.04 +/- 6.32, NEA 71.04 +/- 13.1, p = 0.001), hypertension (EA 82.1%, NEA 59.4%, p = 0.022) and left atrial dilatation (LAD) (EA 64.3%, NEA 32.4%, p = 0.001). No differences were found for previous history of stroke (EA 7.1%, NEA 21%, p = 0.125). The multivariate study showed that age (OR 1.068, CI 95% 1.007–1.133), hypertension (OR 3.183, CI 95% 1.101–9.201) and LAD (OR 2.639, CI 95% 1.093–6.372) were independent predictors of EA.

**Conclusions:** Our detection rate is slightly higher than previously described. Age, hypertension and LAD are associated with higher probability of targeting EA by Holter-ECG 24 h monitoring. Further studies are needed to improve the diagnostic yield of Holter-ECG 24 h monitoring.

## ESOC-1556

### 16. AF & Cardioembolism

#### Prevalence of renal dysfunction and chronic kidney disease in ischaemic stroke and TIA: A population-based study

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**Objectives:** Renal dysfunction has important implications for selection and dosing of Direct Oral Anticoagulants in stroke associated with Atrial fibrillation (AF-Stroke). We aimed to determine the prevalence of impaired renal function in ischaemic stroke and TIA patients within the North-Dublin Population-Based Stroke Study (NDPSS).

**Methods:** NDPSS is a prospective population-based, cohort study of frequency and outcome of stroke and TIA in North-Dublin city (population 294,529). Ascertainment included "hot" and "cold" pursuit with multiple overlapping sources according to Gold standard Criteria.

Estimated Glomerular Filtration rates (eGFR) at presentation and 3 months were calculated using the Modification of Diet in Renal Disease (MDRD) and Chronic Kidney Diseases Epidemiology (CKD-EPI) method. Renal dysfunction was defined as eGFR < 60 mL/min/1.73 m<sup>2</sup> and Chronic Kidney Disease (CKD) was defined as persistent renal dysfunction ≥ 3 months.

**Results:** In 639 patients (mean age 71.4, 71% Stroke, 29% TIA) renal dysfunction was present in 48.2% by CKD EPI and 41% by MDRD method, while CKD was present in 34.5% (CKD EPI) and 27.8% (MDRD).

Renal dysfunction at presentation was more common in AF-patients, OR = 1.8; P = 0.005 (55.2 vs. 40.7%)(CKD EPI) and OR = 1.7; P = 0.014 (46.9 vs. 34.5%)(MDRD). A trend towards higher rates of CKD was also observed in patients with AF, OR = 1.6; P = 0.07 (32.3 vs. 23.5%) (MDRD) and OR = 1.5; P = 0.08 (39.2 vs. 30.2%) (CKD EPI).

**Conclusions:** In a population based study of unselected ischaemic stroke and TIA patients we found high rates of both renal dysfunction and CKD, with highest rates among AF-Stroke. Our findings may have implications for choice and dosing of renally-excreted anticoagulants for AF.

## ESOC-1557

### 16. AF & Cardioembolism

#### Renal dysfunction in mild-to-moderate ischaemic stroke patients with and without atrial fibrillation: A prospective cohort study

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**Background:** Renal dysfunction is a key factor in the selection and dosing of direct oral anticoagulants (DOAC) in secondary prevention of stroke associated with atrial fibrillation (AF-Stroke). We aimed to determine the prevalence of impaired renal function in those most likely eligible for secondary prevention with DOACs.

**Methods:** In BIOSTROKE, a multi-centre prospective biomarker study of patients with mild-to-moderate ischaemic stroke (Rankin  $\leq 3$ ), we measured estimated Glomerular Filtration rates (eGFR) using the Modification of Diet in Renal Disease (MDRD), CKD EPI and Cockcroft-Gault method. Renal dysfunction was defined as eGFR

**Results:** In 493 patients (mean age 67.4, mean NIHSS 2.5) renal dysfunction was present in 25.7% (CKD-EPI), 21.4% (MDRD) and 30.4% (Cockcroft-Gault) at presentation, while CKD at  $\geq 3$  months was present in 19.2% (CKD-EPI), 15% (MDRD) and 22.2% (Cockcroft-Gault).

Resolution of renal dysfunction during follow up was observed in 19.2% (CKD-EPI), 21.7% (MDRD) and 15.7% (Cockcroft-Gault).

Compared with non-AF stroke, patients with AF-Stroke were more likely to have renal dysfunction at presentation; OR = 3.1; P

**Conclusion:** We found high rates of impaired renal function in mild-to-moderate ischaemic stroke patients, with highest rates in those with AF-Stroke. Renal dysfunction resolved at follow-up in approximately one fifth of patients overall. Our findings may have important implications for the selection and dosing of renally-excreted anticoagulants after AF-Stroke.

## ESOC-1558

### 16. AF & Cardioembolism

#### Renal dysfunction and chronic kidney disease in TIA patients: A prospective cohort study

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**Background:** Chronic Kidney Disease is associated with increased risk of ischaemic stroke. Renal dysfunction is a key factor in the selection and dosing of direct oral anticoagulants (DOAC) in stroke prevention after atrial fibrillation-related TIA (AF-TIA). We aimed to determine the prevalence of impaired renal function in AF-TIA patients, the group most likely eligible for DOAC use.

**Methods:** In BIOTIA, a multi-centre prospective study of patients with Stroke-physician confirmed first-ever TIA, within 72 hours of onset we measured estimated glomerular Filtration rates (eGFR) using the Modification of Diet in Renal Disease (MDRD), CKD-EPI and Cockcroft-Gault method. Renal dysfunction was defined as eGFR  $< 60$  mL/min/1.73 m<sup>2</sup> and Chronic Kidney Disease (CKD) was defined as persistent renal dysfunction  $\geq 3$  months.

**Results:** In 329 patients (mean ABCD2 4.2, mean ABCD3i 4.9) renal dysfunction was present in 24.4% (Cockcroft-Gault), 23.9% (CKD-EPI) and 17.9% (MDRD) of patients, while CKD at  $\geq 3$  months was present in 18.5% (Cockcroft-Gault), 16.2% (CKD-EPI) and 12.8% (MDRD).

Resolution of renal dysfunction during follow up was observed in 4.8% (Cockcroft-Gault), 20% (CKD-EPI) and 16.7% (MDRD) of patients.

Compared with non-AF TIA, patients with AF-TIA were more likely to have renal dysfunction at presentation, OR = 2.9; P = 0.024 (34 vs. 15%)(Cockcroft-Gault), OR = 2.1; P = 0.035 (33.3 vs. 19.2%)(CKD-EPI), but not by MDRD OR = 1.8; P = 0.15 (23.3 vs. 14.7%).

**Conclusion:** We found high rates of impaired renal function in patients with TIA, with highest rates in those with AF-TIA. Renal dysfunction resolved at follow-up in up to one-fifth of patients overall. Our findings may have important implications for the selection and dosing of renally-excreted anticoagulants after AF-TIA.

## ESOC-1568

## 16. AF &amp; Cardioembolism

## Temporal trends in anticoagulant prescribing in patients with mild-to-moderate atrial fibrillation related stroke

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**Background:** International guidelines recommend anticoagulation for prevention of stroke in Atrial Fibrillation (AF). Despite this anticoagulation rates remain suboptimal. We aim to determine temporal changes in anticoagulation prescribing in those patients most likely eligible for anticoagulation post AF-Stroke.

**Methods:** NDPSS is a prospective population-based, cohort study of frequency and outcome of stroke and TIA in North-Dublin city from 2005–2006 (population 294,529). Ascertainment included “hot” and “cold” pursuit with multiple overlapping sources according to Gold standard Criteria. BIOSTROKE, a multi-centre prospective biomarker study of patients with mild-to-moderate ischaemic stroke (Rankin  $\leq$  3) from 2007–2012.

**Results:** 173 patients with mild-to-moderate AF-Stroke were recruited across both studies (31.2% NDPSS and 68.8% BIOSTROKE). There were no significant differences in mean age 72 years vs 74.2;  $P = 0.2$ , female sex 54.6% vs 47.1%;  $P = 0.1$ , renal dysfunction 35.9% vs. 43% (CKD-EPI) and 32.1% vs. 35.5% (MDRD) or pre-event rankin; ranksum  $P = 0.7$  between patients in NDPSS and BIOSTROKE studies. NIHSS scores were higher for those patients from NDPSS 3.5 vs 2.4;  $P = 0.002$ .

There were no differences in pre-event prescribing of antiplatelet agents 48.2% vs. 52.9%;  $P = 0.6$ , anticoagulants 20.4% vs 20.2%, antihypertensives 64.8% vs. 76.5%;  $P = 0.1$  or statins 42.6% vs. 39.5%;  $P = 0.7$ .

Post-event anticoagulant prescribing was higher in BIOSTROKE 76.1% vs. 48%;  $P < 0.0001$ . Patients in NDPSS remained less likely to receive anticoagulation after adjusting for stroke severity OR = 0.30;  $P = 0.002$ .

**Conclusion:** Allowing for differences in study methodology, our results suggest significant improvements over time in anticoagulation prescribing in mild-to-moderate AF-Stroke patients.

## ESOC-1361

## 16. AF &amp; Cardioembolism

## Predicting atrial fibrillation in cryptogenic stroke

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**Introduction:** Atrial fibrillation (AF) is a well-recognised risk factor for stroke. Studies have shown that early diagnosis and anticoagulation in patients with subclinical AF can reduce stroke risk. Prolonged ECG monitoring increases the detection and diagnosis of subclinical AF and facilitates early anticoagulation. The aims of this research study were to identify rates of subclinical AF on 3 and 5 day ECG holter monitors in a population with cryptogenic stroke and scrutinise relevant risk factor profiles.

**Methods:** A retrospective study (from 01/08/2011 to 31/08/2014) of 3 and 5 day ECG holter monitors from the Beaumont Hospital Stroke and Cardiology Services was conducted.

**Results:** A total of 103 ECG holter monitors were reviewed. Male patients predominated ( $n = 56$ , 54%). Median age was 70 years. 16% of holters detected AF ( $n = 16$ ). 75% of these detection were in males ( $n = 56$ ). Data for 86 patients with no AF detected was available for analysis. 56% ( $n = 48$ ) had hypertension, 53% ( $n = 46$ ) dyslipidaemia, 8% ( $n = 7$ ) Diabetes Mellitus, 19% ( $n = 16$ ) ischaemic heart disease (IHD), 30% ( $n = 26$ ) were active or ex-smokers, and 9% ( $n = 8$ ) had left atrial enlargement (LAE). In the AF positive group 56% ( $n = 9$ ) had hypertension, 69% ( $n = 11$ ) dyslipidaemia, 25% ( $n = 4$ ) Diabetes Mellitus, 63% ( $n = 10$ ) IHD, 56% ( $n = 9$ ) active or ex-smoker, and 38% ( $n = 6$ ) LAE.

**Conclusion:** Prolonged ECG holter monitoring in a cryptogenic stroke population had a 16% detection rate for subclinical AF. Male gender, IHD, LAE, and smoking had the strongest positive predictive value. This may help identify those patients who may benefit from prolonged ECG monitoring.

## ESOC-1503

## 16. AF &amp; Cardioembolism

## Determinants of intracranial hemorrhage in patients with atrial fibrillation

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**Background:** Available tools to predict the risk of intracranial hemorrhage in patients with atrial fibrillation on antithrombotic therapy are largely criticized for the lack of sensitivity, specificity, and validity. We evaluated the predictive value of several clinical, radiological and laboratory parameters.

**Methods:** We conducted a case-control study on all patients with atrial fibrillation and intracerebral hemorrhage admitted to the Avezzano Hospital, Central Italy, between January 2012 and December 2013. A random sample of subjects with atrial fibrillation without ischemic or hemorrhagic stroke that were admitted to the same hospital in the same period was selected for the control group, with a ratio of two controls per case. All patients underwent the same evaluation protocol. Patients without neuroimaging exams were excluded.

**Results:** During the period of the study we identified 37 subjects with atrial fibrillation and intracerebral hemorrhage and 74 controls. Among cases 57.3% were female and the mean age was of 83.3 years. Patients with intracerebral hemorrhage were more often on anticoagulant therapy (75.7%), compared with controls (45.9%;  $P = 0.0002$ ). On CT scans, cases had a greater severity of leukoaraiosis at the Blennow scale ( $P < 0.0001$ ), and a higher frequency of lacunar infarcts ( $P = 0.006$ ). No significant association was found between MRI parameters or the HASBLED score and the occurrence of intracerebral hemorrhage.

**Conclusion:** CT scan, but not MRI, is more useful than the HASBLED score to predict intracerebral hemorrhage in patients with atrial fibrillation on antithrombotic therapy.

## ESOC-1534

## 16. AF &amp; Cardioembolism

## Embolic strokes of undetermined sources: Data from a stroke unit registry

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About 25% of all ischaemic strokes are cryptogenic. Most of them can be embolic stroke of undetermined source and a new clinical construct

(ESUS) related to minor-risk covert cardiac sources or non-occlusive plaques in the aortic arch or in the cerebral arteries has been proposed. In our SU precordial echocardiography, 72 hs cardiac monitoring and cervical duplex ultrasonography are routinely performed. Transcranial doppler ultrasonography and/or CT angiography follow when indicated. We retrospectively reassessed 372 patients admitted to our SU in 30 months from May 2010. Out of them 102 (27.6%) had cardioembolic stroke and 91 (24.5%) were discharged as cryptogenic. 74 (81.3%) of cryptogenic strokes had in-patient precordial echocardiography and conditions compatible with minor-risk cardiac sources were found in about 35%. About 70% of cardioembolic where prescribed VKA. All patients with cryptogenic stroke were discharged with antiplatelet therapy. In a 2 years follow-up (mean 25,13 months), 5 new cerebrovascular events occurred both in cardioembolic and cryptogenic strokes (incidence respectively of 2.5% and 2,62% per year). In cryptogenic strokes the recurrences were embolic in 2 patient, both without minor-risk cardioembolic sources at index time, and depended on paroxysmal AF+auricular thrombus (1) and on myocardial infarction (1). Two patients with slight-to-moderate atrial enlargement had a recurrence of cryptogenic stroke. A patient with mitral-annular-calcification and moderate atrial enlargement had a vertebral-basilar TIA while assuming double antiplatelet therapy. Only large clinical trials or the analysis of large SU registries can evaluate the cost-effectiveness of extensive diagnostic research and of anticoagulation in ESUS.

**ESOC-1573**

**16. AF & Cardioembolism**

**Distribution of CHADS2 and CHAD2S2VASc scores in nonvalvular atrial fibrillation-associated ischemic stroke: A population-based study**

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*Background:* CHADS2 and CHAD2S2VASc scores predict stroke risk in patients with nonvalvular atrial fibrillation (NVAF). Most NVAF patients have low CHADS2/CHAD2S2VASc scores. Despite lower stroke risk, this group may predominate amongst stroke patients because of its demographic weight. Anticoagulation is recommended in NVAF patients with a score  $\geq 2$ .

*Methods:* We retrospectively reviewed the Ontario Stroke Registry's database (2003–07 to 2008–03) to determine the CHADS2 and CHAD2S2VASc scores from baseline characteristics of NVAF patients hospitalized for ischemic stroke. Antithrombotic therapy at presentation was documented.

*Results:* Tables 1 shows the proportion of CHADS2 scores among 2577 study subjects.

CHADS2	Number (proportion) with NVAF known prior to stroke	Number (proportion) with NVAF diagnosed follo-wing stroke	Total number (proportion)
0	83 (4.2%)	45 (7.6%)	128 (5.0%)
1	289 (14.6%)	155 (26.1%)	444 (17.2%)
2	601 (30.3%)	192 (32.4%)	793 (30.8%)
3	375 (18.9%)	92 (15.5%)	467 (18.1%)
4	391 (19.7%)	72 (12.1%)	463 (18.0%)
5	203 (10.2%)	32 (5.4%)	235 (9.1%)
6	42 (2.1%)	5 (0.8%)	47 (1.8%)

18.8% of patients with known NVAF had a CHADS2 score  $< 2$  (4.2% CHAD2S2VASc  $< 2$ ) and only 28.2% had preadmission anticoagulation. Of those with known NVAF and CHADS2  $\geq 2$ , 46.8% were anticoagulated prior to admission.

*Conclusion:* An important proportion of NVAF patients have CHADS2 scores  $< 2$  prior to ischemic stroke. This is less marked with CHAD2S2VASc. Anticoagulation based on CHAD2S2VASc rather than CHADS2 scores  $\geq 2$  may help preventing stroke in NVAF patients.

**ESOC-1486**

**16. AF & Cardioembolism**

**Serial measurements of BNP in acute stroke: dynamics of plasma level and correlation to atrial fibrillation**

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*Introduction:* Atrial fibrillation (AF) is the underlying cause of stroke in 1 of 4 patients. Failure to detect AF results in inadequate therapy. A plas-matic biomarker for AF would help to select patients for early introduction of anticoagulation. Our aim was to further investigate the correlation of Brain Natriuretic Peptide (BNP) and AF in stroke.

*Methods:* Acute stroke patients were included. Serial measurements of BNP was done on day 1, 3 and 5. Exclusion criteria were cardiac insufficiency and severe renal impairment. Patients had a complete workup (MRI, angiography, echocardiography and long-duration ECG recording).

*Results:* Eighty-three patients were included. Eighteen had stroke from cardio-embolic etiology with documented AF and 65 from other origins according to TOAST. The baseline BNP was significantly higher in AF patients (321 vs. 96 ng/l,  $p < 0.0001$ ). Respectively, high BNP values identified AF patients very well in a ROC curve analysis (best-criterion  $> 151$ , sensitivity 89%, specificity 86%, AUC 0.896,  $p < 0.0001$ ).

Analysis of serial measurements revealed that AF patients reduced their BNP values by 47% from day 1 to 5 vs. 2.8% in patients with other determined etiologies ( $p = 0.05$ ). Of all patients with abnormal BNP values ( $> 100$ ,  $N = 38$ ) at baseline, 22 normalized their levels by day 5 (58%). The latter were patients with AF ( $N = 5$ ) or unknown etiology ( $N = 17$ ).

*Discussion:* This study further helps to validate measurement of BNP as a biomarker for AF. Dynamics of plasmatic BNP suggest that the peak level is near stroke onset. BNP should be measured in all stroke patients and early.

**ESOC-1147**

**16. AF & Cardioembolism**

**Early outcomes of stroke patients associated with atrial fibrillation in Vietnam**

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*Background:* To provide information on the outcomes of people with first-ever stroke associated with atrial fibrillation in Viet Nam, mortality and functional status was assessed 3 months after stroke among a cohort of patients discharged from a stroke unit in Ho Chi Minh City, Vietnam.

*Method:* Consecutive stroke patients were diagnosed with atrial fibrillation by electrocardiogram when admitted to a stroke unit from May to December 2013 and were assessed for socio-demographic information, co-morbidity, lifestyle risk factors and functional status. Face-to-face interviews were conducted in patient's homes 3 months after stroke, and functional status was again assessed by modified Rankin Scale.

**Result:** Among the patients with acute ischemic stroke ( $n = 3561$ ) admitted to the People's 115 hospital in Vietnam, there were 236 (6.63%) (mean age 67.93 years, 54.3% female) with documented atrial fibrillation. The oral anticoagulation use was varied from 17.3% prestroke and 62.1% poststroke and to 68.2% at three-months respectively. Three-month case-fatality was 33.8%. At 3-month follow-up, 7% had least severe disability (mRS = 0–1), 32% had intermediate disability (mRS = 2–3) and 27.2% had most severe disability (mRS = 4–5).

**Conclusion:** These data indicate oral anticoagulation use is suboptimal in stroke patients with atrial fibrillation in Vietnam. Strokes that occur in patients with atrial fibrillation are generally severe and are associated with high mortality and morbidity. The dependency burden was providing evidence for pressure on the healthcare system and society.

## ESOC-0894

### 16. AF & Cardioembolism

#### Development of atrial fibrillation after embolic stroke of undetermined origin (ESUS): A follow-up study

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**Introduction:** Atrial fibrillation (AF) is a major cause of embolic stroke and its prevalence increases with age. In stroke patients, newly diagnosed AF in the follow-up raises the question of non-thorough initial evaluation versus new incidental AF. Recently, embolic stroke of undetermined etiology (ESUS) was defined. We investigated the risk of new AF after ESUS. **Methods:** In a hospital-based stroke cohort, we conducted a prospective observational study, analysing newly diagnosed AF after complete workup. ESUS was defined as by the Cryptogenic Stroke/ESUS International Working Group. Stroke etiology was ascertained by ASCOD grades 1–2. We present rates and recurrence risk by Kaplan-Meier curves with LogRank (LR) and Cox regression with Hazard Ratio (HR), along with 95% confidence intervals (95%CI).

**Results:** We included 460 patients (64.3% male, median age 66), 20.9% thrombolysed, with median NIHSS 5 (interquartile range 7). Stroke etiology was 26.8% atherothrombosis, 22.2% small-vessel disease, 31.7% cardiac pathology, 2.4% other causes, and 2.8% dissection. 26.5% remained without determined etiology. ESUS criteria were fulfilled in 16.3%.

Prior to index stroke 12.0% had known AF and on discharge 22.7%.

In a median follow-up of 2.6 years there were 10 (2.2%) new AF, with higher rate in ESUS than other non-AF patients (9.3% vs 0.9%, LR  $p < 0.001$ ; adjusted HR = 8.0, 95%CI 2.0–31.5%). Among undetermined strokes, AF was higher in ESUS (9.3% vs 0%, LR  $p = 0.08$ ).

**Conclusion:** Even without intensive search, new AF diagnosis on follow-up isn't uncommon. Its higher occurrence in ESUS justifies their inclusion in clinical trials of anticoagulation as secondary stroke prophylaxis.

## ESOC-1276

### 16. AF & Cardioembolism

#### Global survey of the frequency of AF-associated stroke and its detection

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**Background:** Atrial Fibrillation (AF) is recognized to be a frequent cause of ischemic strokes that is likely to increase as populations age. We undertook an international survey to characterize the frequency of AF-associated strokes and methods of its detection.

**Methods:** Consecutive patients with recent ischemic stroke were retrospectively surveyed at 19 stroke research centers in 19 different countries to identify those with AF-associated stroke. Countries were separated into World Bank global regions.

**Results:** We identified a total of 2145 consecutive ischemic stroke patients among which 28% had AF. Among those with AF only 9% was detected by cardiac rhythm monitoring, which is only 3% of 1606 of ischemic stroke patients without known AF or AF on ECG.

	Overall		Europe and Central Asia (9 sites)		North America (2 sites)		Latin America (3 sites)		East Asia and Pacific (5 sites)	
	N	%*	N	%*	N	%*	N	%*	N	%*
Ischemic strokes	2145	100%	911	100%	292	100%	385	100%	557	100%
Total AF <sup>†</sup>	590	28%	298	33%	103	35%	67	17%	122	22%
History of AF prior to current stroke	332	15%	163	18%	70	24%	27	7%	72	13%
AF on any EKG but no history of AF prior to the current stroke	207	10%	105	12%	28	10%	33	9%	41	7%
AF on cardiac rhythm monitoring, but no AF on EKG and no history of AF prior to current stroke (i.e. detected only by monitoring)	51	2%	30	3%	5	2%	7	2%	9	2%

<sup>†</sup> Atrial fibrillation (AF): History of AF prior to current stroke, AF on any ECG, AF documented on cardiac rhythm monitoring.

\* Percent of all ischemic strokes.

Table 1: Identification of Atrial Fibrillation among consecutive ischemic stroke patients

Ischemic stroke patients in Latin America and East Asia/Pacific and significantly younger ( $p < 0.001$ ) than those in other 2 regions.

**Conclusion:** The fraction of ischemic stroke associated with AF is substantial through out the world, averaging about 30% and, varying with the mean age of the stroke population. The older the mean age of the ischemic stroke cohort, the higher the frequency of AF. Most AF (90%) is evident by history or captured by ECG's. The yield of conventional cardiac rhythm monitoring for detection of AF is about 2%.

Recent studies support that more extensive monitoring is likely to increase the fraction of AF-associated stroke further.

## ESOC-1388

## 16. AF &amp; Cardioembolism

## Cryptogenic stroke with embolic pattern: Common phenotype with high risk of restroke

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**Background:** Cryptogenic stroke with embolic pattern (CSEP) in neuroimaging is a common phenotype. Among those are patients meeting the diagnostic criteria for embolic stroke of undetermined source (ESUS): nonlacunar stroke, no cervical atherosclerosis causing relevant  $\geq 50\%$  stenosis, no atrial fibrillation in  $\geq 24$  h continuous ECG, no intracardiac thrombus, and no other specific cause. We compared CSEP with cardioembolism from known source (CEKS) and non-cardioembolic stroke (NCES). Within CSEP, comparison was done between ESUS(-) and ESUS(+).

**Methods:** Consecutive ischemic stroke patients admitted to Helsinki University Central Hospital (6-month inclusion period, follow-up 21 months). Primary endpoint was nonfatal/fatal restroke. Cox proportional hazards model adjusted for CHA2DS2VASc score was constructed to assess whether CSEP stands for prognostically relevant characteristic (reference: NCES).

**Results:** Of the 540 patients, 229 (42.4%) had NCES, 184 (34.1%) had CEKS, and 127 (23.5%) were classified as CSEP (79.9% of all cryptogenic strokes). Compared with NCES, CSEP patients had less often diabetes mellitus and prior TIA, but more severe symptoms. Compared with CEKS, CSEP cases were younger, had less frequently heart failure and lower CHA2DS2VASc, and less severe symptoms. In Cox regression, CSEP associated with higher risk of restroke (HR 2.36, 95% CI 1.02–5.49;  $P = 0.046$ ). ESUS(+) patients ( $n = 46/8.5\%$ ) were younger, had less often hypertension and cancer, and lower CHA2DS2VASc than ESUS(-) cases ( $n = 81/15\%$ ), but restroke occurred in similar proportions for both (9.9% and 8.7%;  $P = 0.659$ ).

**Conclusions:** Despite their younger age and more favorable risk factor profile compared with other phenotypes, CSEP – including cases meeting the ESUS criteria – experienced poor early prognosis.

## ESOC-1166

## 16. AF &amp; Cardioembolism

## Impact of patent foramen ovale in the pathogenesis of stroke recurrence: A cohort study

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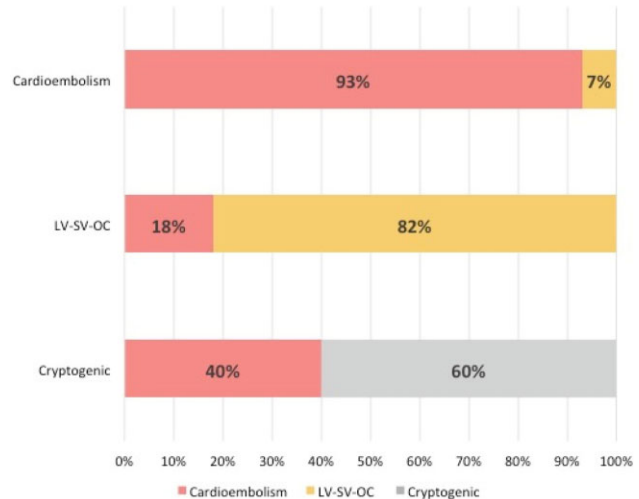
**Introduction:** although the prevalence of patent foramen ovale (PFO) is greater in cryptogenic stroke and AHA guidelines suggest antiplatelet therapy for secondary stroke prevention in patients with PFO, the therapeutic indications in these patients are still controversial.

**Materials and methods:** from our stroke database we selected a cohort of 364 patients who underwent trans-esophageal echocardiography. Demographic and clinical features of index stroke were analysed according to PFO presence. Etiopathogenesis of index and recurrent stroke were classified with TOAST.

**Results:** etiopathogenetic groups of index stroke had a similar proportion of PFO ( $p = 0.12$ ). Overall the annual rate of stroke recurrence was 3.2%

(2.6% in patients with PFO and 3.5% in patient without PFO). Etiopathogenesis of recurrent stroke was similarly distributed regardless of PFO status ( $p = 0.837$ ). While the proportion of cardioembolic stroke significantly increased in recurrent stroke by 18.8% ( $p = 0.02$ ), the proportion of cryptogenic stroke decreased by 11.9% ( $p = 0.12$ ). Patients with cryptogenic index stroke had the greatest proportion of different etiology at recurrent stroke (Fig. 1).

**Conclusion:** these data suggest that at least some cryptogenic stroke might be cardioembolic and anticoagulant therapy should be considered in secondary prevention.



## ESOC-1467

## 16. AF &amp; Cardioembolism

## Early detection of atrial fibrillation in embolic stroke of unknown origin (ESUS)

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**Background:** Since most cryptogenic strokes are of thromboembolic origin the concept of ESUS has recently been introduced. Atrial fibrillation (AF) is the most prevalent cause of this stroke subtype. Current guidelines recommend at least 24 h-ECG monitoring to rule out underlying AF and longer monitoring for patients with high suspicion and negative findings. The CRYSTAL-AF trial detected AF in 8.9% of patients after 6 months of monitoring with an insertable cardiac monitor (ICM). The aim of our study is to analyze the rate of FA detection in current clinical practice after the availability of ICM

**Material and methods:** Descriptive, prospective study of patients  $\geq 60$  years admitted in our stroke unit fulfilling ESUS criteria after complete study: 12-lead ECG, 48 hours of ECG monitoring, transthoracic echocardiography, and arterial study of the aorta, cervical and intracranial arteries. Demographic data and vascular risk factors were recorded. An ICM with home monitoring was implanted between 5–7th day after the stroke. **Results:** Since October 2013 to December 2014, 28 patients were included. Mean age was  $75.4 \pm 8.9$  years, 60.7% were men. Main associated vascular risk factors were hypertension (64.3%) and dyslipidemia (53.6%). Median time (IQR) of follow-up was 6(2–12) months. The rate of AF detection was 46.4%. The median time between implantation and FA detection was 12(10–21) days.

**Conclusion:** In daily clinical practice we achieved a higher rate of AF detection than previously reported in patients with ESUS using ICM with



home monitoring. Time to FA detection was very short outlaying the importance of early ICM implantation.

## ESOC-0794

### 16. AF & Cardioembolism prolonged monitoring of cardiac rhythm with wireless cardiophone for real time detection of atrial fibrillation after cerebral ischemic event (PEAAACE Study). The Edmonton Alberta experience

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**Introduction:** Stroke is the leading cause of acquired disability. Strokes associated with atrial fibrillation (AF) tend to be more severe; however can be prevented.

**Objective:** Primary objective is to assess incidence of AF using wireless Cardiophone for 15 days in patients with stroke/TIA.

Secondary objective is to determine the reduction of time of AF diagnosis resulting in a prompt change in clinical management.

**Method:** This is an ongoing Cohort/Prospective study at the University of Alberta Hospital. Patients  $\geq 40$  years of age (without known AF on ECG/Holter) who had ischemic stroke or TIA within  $\leq 90$  days were eligible. Patients with symptomatic carotid artery disease or pacemaker devices were excluded. The signals from cardiophone were analyzed in real time at Canadian cardiac center in Windsor, Ontario. The incidence and time of onset of AF and change in medical treatment (anti-coagulation) was recorded.

**Results:** Out of 72 patients, 66 completed monitoring for more than 48 hours. Thirteen out of these 66 subjects ( $\approx 20\%$ ) were shown positive for AF. When compared with the incidence of 5% reported in historical controls wearing 24 hour holter, the difference was significant (chi square  $p = 0.004$ ) Mean time from onset of arrhythmia to report was  $\approx 48$  hours; shorter than the time for report with holter (10 days in Alberta). All 13 subjects were started on anti-coagulation therapies.

**Conclusion:** Prolonged cardiac monitoring increased the detection of AF 4 fold as compared to 24 hour holter. Cardiophone device also allowed faster detection of AF, and prompt change in medical treatment.

Correction added on 6 July 2015, after first online publication. The primary author's order list H Manosalva<sup>1</sup>, S Hasan<sup>1</sup>, A Mohammad<sup>1</sup>, D Hussain<sup>1</sup>, A Pervez<sup>1</sup>, W Tarhuni<sup>2</sup>, K Khan<sup>1</sup>, B Buck<sup>1</sup>, M Saqqr<sup>1</sup>, K Butcher<sup>1</sup>, S Hussain<sup>3</sup>, A Shuaib<sup>1</sup> has been changed to S Hasan<sup>1</sup>, A Pervez<sup>1</sup>, H Manosalva<sup>1</sup>, A Mohammad<sup>1</sup>, D Hussain<sup>1</sup>, H Kalashyan<sup>1</sup>, M Saqqr<sup>1</sup>, K Khan<sup>1</sup>, W Tarhuni<sup>3</sup>, B Brian<sup>1</sup>, K Butcher<sup>1</sup>, Y Hasan<sup>1</sup>, S Hussain<sup>2</sup>, A Shuaib<sup>1</sup>.

## ESOC-1398

### 16. AF & Cardioembolism The role of patent forame ovale in cryptogenic stroke

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**Background:** Although patent foramen ovale (PFO) is found in approximately 40% of Cryptogenic Stroke (CS) compared with 25% of adult population, the causal relationship between PFO and the occurrence of ischemic stroke has to be established.

**Aims:** Assess clinico-radiological features of patients with CS with and without PFO.

**Materials and methods:** From our stroke database we selected all patients with CS who underwent transesophageal echocardiography, admitted to our Stroke Unit from January 1st 2005 to January 1st 2013. We outlined a cardioembolic (CE) pattern assessing the acute lesions in 100 patients with ischemic stroke of known cause (60 CE stroke, 20 large vessels stroke and 20 small vessels stroke).

**Results:** PFO was detected in 70 (41.6%) of 168 CS patients. Lesions in multiple arterial territories, single cortical or cortico-subcortical lesions or lesion larger than 15 mm predicted a CE etiology (OR 3.5 [95%IC 1.9–6.5],  $p = 0.000$ ; sensitivity 86.7%, specificity 67.5%). The prevalence of CE pattern was comparable between CS with PFO and CS without PFO (67.1% in vs. 75.3%  $p = 0.250$ ). The proportion of CE pattern was higher in CS with PFO and atrial septal aneurism (ASA) (87.0% vs. 57.4% of PFO without ASA,  $p = 0.014$ ), but comparable to CS patients without PFO ( $p = 0.153$ ).

**Conclusions:** Our data shows that in 70% of CS patients the acute lesion fits a CE pattern regardless of PFO detection. On this ground it's reasonable to consider other CE sources. We suggest that CS patients may deserve prolonged ECG monitoring to disclose potential occult atrial fibrillation.

## ESOC-1448

### 16. AF & Cardioembolism The correlation of CES1 genotype and minimal plasmatic concentration of dabigatran in stroke patients

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**Introduction:** Dabigatran is direct thrombin inhibitor approved in the prevention of stroke in patients with atrial fibrillation. It was proven that genetic variants could contribute to interindividual variability in concentrations of the active metabolite of dabigatran and influence the safety and efficacy of treatment. Carriage of the *CES1* rs2244613 minor allele is associated with lower exposure to active metabolite and with a lower bleeding risk.

**Aim:** To determine the influence of gene *CES1* polymorphism rs2244613 on minimal plasmatic concentration (Cmin) of dabigatran in stroke patients.

**Methods:** DNA analysis of *CES1* gene was done with RFLP analysis. Cmin of dabigatran was quantified with liquid chromatography-tandem mass spectrometry (LC-MS/MS).

**Results:** Forty-one patients, mean age 71,5 (24–85), were enrolled. 13 (31.7%) were treated with 110 mg and 28 (68.3%) with 150 mg. 20 (48.8%) patients were in therapeutical range (50–200 ng/ml), their mean Cmin was 107.8 (63.8–177.6) ng/ml; 13 (31.7%) were subtherapeutical (mean 29.4, 6.5–44.3) and 8 (19.5%) suprathereutical (mean 298.1, 205.5–402.9). There was a statistically nonsignificant trend in minor allele carriers for subtherapeutical level compared to wildtype patients (46,2% vs. 30,8%). LC-MS/MS correlated with creatinine clearance ( $r = 0,468$ ,  $p = 0,003$ ) and with Hemoclot assay ( $r = 0,97$ ,  $p < 0,001$ ). There was no significant correlation with APTT, Quick or TT.

**Conclusion:** Minor allele carriers had only statistically nonsignificant trend for having subtherapeutical dabigatran level. Nevertheless 52.2% of our patients had dabigatran level outside the published range. Personalized dabigatran dosing based on pharmacogenetics and monitoring cmin should be studied in future trials.

## ESOC-1136

## 16. AF &amp; Cardioembolism

### Diagnostic yield of repeat 24-hour holter electrocardiography for detection of paroxysmal atrial fibrillation in patients with embolic stroke of undetermined source

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**Background and purpose:** A new clinical construct termed embolic stroke of undetermined source (ESUS) was recently introduced as a potential therapeutic relevant entity with a potential indication for anticoagulation. Specific criteria were proposed for the diagnosis of ESUS (including cardiac monitoring for  $\geq 24$  hours with automated rhythm detection) in contrast to the absence of standard diagnostic criteria for the definition of cryptogenic stroke. We sought to prospectively evaluate the diagnostic utility of repeat 24-hour electrocardiography for detecting paroxysmal (PAF) in patients with ESUS in a single-center pilot study.

**Subjects and methods:** The criteria proposed by the Cryptogenic Stroke/ESUS International Working Group were applied to consecutive acute ischemic stroke patients admitted to our tertiary care stroke center over the last 24 months to identify all cases with ESUS diagnosis. All ESUS patients underwent repeat ( $\geq 1$ ) 24-hour Holter electrocardiography. ECG recordings were analyzed by two blinded investigators using dedicated analysis software.

**Results:** A total of 81 patients were classified as ESUS (mean age  $57 \pm 13$  years, 73% men, median NIHSS-score 3 points, interquartile range 2–5). PAF during repeat 24-hour Holter electrocardiography (median number of repeat 24-hour Holter recordings 2, interquartile range 1–3) was detected in 9 cases (11%, 95%CI calculated by the adjusted Wald method: 6%–20%). Oral anticoagulation was initiated in all ESUS cases with PAF documentation on repeat 24-hour Holter monitoring.

**Conclusions:** Our preliminary findings underline the potential utility of repeat 24-hour Holter electrocardiography for the detection of PAF and confirming an indication for anticoagulation in patients with ESUS.

## ESOC-1124

## 16. AF &amp; Cardioembolism

### Plasma levels of dabigatran in acute cerebrovascular events

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**Objective:** Oral anticoagulation with dabigatran was shown to be effective for secondary prevention of stroke in patients with atrial fibrillation without the need of laboratory monitoring. However, a recent additional publication of RE-LY data reported, that ischemic stroke and bleeding outcomes are correlated with dabigatran plasma concentrations (DPC). Here, DPC was determined at a pre-specified time point and correlated with a cardiovascular event at any time during follow up. This might be problematic due to the known large variability of DPC inter alia

depending on renal function. We now report on plasma levels of dabigatran in temporal proximity to acute cerebrovascular events.

**Methods:** Patients with acute ischemic stroke (AIS) or acute intracerebral hemorrhage (ICH) while on dabigatran therapy and available DPC at admission were identified retrospectively. DPC was determined using the diluted thrombin time (HemoclotTM). Creatinine clearance was determined by measuring creatinine in plasma and 24-hour urine.

**Results:** Eleven patients suffering AIS and three patients suffering ICH were included. Mean DPC at admission was significantly higher when ICH occurred than at patients suffering AIS (170 ng/ml and 64.07 ng/ml respectively,  $p = 0.01$ ). Increased creatinine clearance was correlated with lower mean dose normalized DPC (0.40 ng/ml/mg vs. 1.45 ng/ml/mg at patients with normal creatinine clearance,  $p = 0.02$ ).

**Conclusions:** We found a notably higher DPC in patients with acute ICH than in patients with AIS in temporal proximity to the event. Not only decreased but also increased renal function seems to have an important influence on DPC.

## ESOC-1524

## 16. AF &amp; Cardioembolism

### Prevalence of subdiaphragmatic visceral infarct in ischemic stroke and atrial fibrillation

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**Background:** Occult atrial fibrillation (AF) may explain a part of cryptogenic stroke. A prevalence of 22% of subdiaphragmatic visceral infarctus (SDVI) has been reported among patients with stroke due to AF.

**Methods:** To assess the impact of abdominal MRI for determining etiology of strokes and the prevalence of SDVI, we compared magnetic resonance abdominal imaging (diffusion and T2-weighted imaging) in three groups: patients with atrial fibrillation and stroke (group A), patients with stroke of an other determined cause (Group B) and patients with atrial fibrillation without stroke (Group C).

**Results:** A total of 112 consecutive patients was included (45 in group A, 30 in group B and 34 in group C). The median time between the inclusion and abdominal MRI was 12,5 days.

SDVI was more frequent in group A ( $n = 10$ ; 22.2%), than in group B ( $n = 1$ ; 3.2%) and in group C ( $n = 2$ ; 5.9%),  $p = 0.03$ . The most frequent localisation was the kidney (50% in group A, 100% in groups B and C).

**Conclusion:** The prevalence of SDVI is more frequent among patients with stroke of cardioembolic cause. Further studies should assess the prevalence of SDVI among cryptogenic stroke and occult atrial fibrillation.

## ESOC-1082

## 16. AF &amp; Cardioembolism

### Vascular cell adhesion molecule-1 and atrial fibrillation – results from the Bruneck and Saphir Study

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**Background:** There is accumulating evidence suggesting a link between inflammation and the manifestation of atrial fibrillation (AF). Vascular

cell adhesion molecule-1 (VCAM-1), a biomarker for endothelial activation, has been implicated in the pathogenesis of several heart diseases, but its role in AF remains unclear.

**Methods:** This study uses data from the Bruneck Study, a prospective population-based survey with a 20 year follow-up and thorough ascertainment of AF. The study population comprised 909 men and women between 40–79 years old at the 1990 baseline examination. The Saphir Study from Salzburg served as a replication cohort.

**Results:** At baseline, 29 subjects (3.2%) had AF. Compared to subjects in sinus rhythm, subjects with paroxysmal and persistent AF had higher baseline soluble VCAM-1 levels (median [interquartile range], 609.6 [493.4–789.7] versus 813.3 [713.9–871.1] and 843.6 [677.2–1301.9];  $P < 0.001$ ). All subjects with low soluble VCAM-1 (bottom tertile group) were free of AF. During follow-up, 117 participants developed AF. The incidence rate (95%CI) of AF was 4.4 (2.7–6.3) in the lowest tertile compared to 9.5 (7.0–12.4) and 11.4 (8.5–14.5) in the middle and highest tertile of soluble VCAM-1 ( $P < 0.001$ ). In age/sex-adjusted and multivariable models, soluble VCAM-1 predicted an increased risk of future AF (hazard ratio for a 1-SD higher soluble VCAM-1 level (95%CI), 1.4 (1.1–1.6) and 1.4 (1.1–1.6);  $P = 0.0014$  and  $P = 0.0016$ ). The association was externally consistent in an independent population-derived cohort.

**Conclusion:** Level of soluble VCAM-1, a putative marker of atrial activation and inflammation, is a significant risk predictor of new-onset AF in the general community.

## ESOC-0160

### 16. AF & Cardioembolism

#### Underuse of oral anticoagulants (OAC) in atrial fibrillation (AF) in primary care in South Wales

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**Background:** Atrial fibrillation (AF) is associated with significant mortality and morbidity from Stroke. Many patients who are in AF are still not receiving the highly effective oral anticoagulant therapy (OAC) for stroke prevention.

The aim of this study was to estimate the percentage of people with AF in the community who are and are not on OAC therapy and to establish the reasons for not being offered the treatment.

**Methods:** We included 775 patients with AF from six primary care practices in South Wales. CHADS2 score was used to identify patients who were eligible for OAC therapy. The reasons for underuse of OAC in eligible patients were explored.

**Results:** The mean age was 76 [range 47–95 years] & 353 were females [45.5%]. 57.2% (443/775) were on OAC. The median TTR was 79.6% (range 73.4–85.5%; 18 patients had TTR < 60%). 5/443 (1.1%) had major haemorrhages requiring hospitalisation (none fatal). 42.8% patients in AF (332/775) were not on OAC (169/332 [50.9%] were high-risk on CHADS2 score). Reasons for not using OAC in eligible patients were previous haemorrhages, malignancy, patient refusal, poor compliance, low platelets, erratic INR. 96 eligible patients were denied OAC due to falsely perceived contraindications (e.g. old age, falls risk, dementia, active life style).

**Conclusions:** Our study confirms the underuse of OAC therapy for stroke prevention in AF & the results are comparable to previously reported studies<sup>1,2</sup>. There is a clear need for educating patients and clinicians to encourage appropriate use of OAC therapy to reduce the burden of stroke.

## ESOC-0499

### 16. AF & Cardioembolism

#### Quality of anticoagulation control with acenocoumarol and the risk of cerebrovascular events

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**Background:** The influence of the quality of previous anticoagulation control with vitamin K antagonists (VKAs) over the risk of transient ischemic attack (TIA), ischemic stroke (IS) or intracranial hemorrhage (ICH) remains unestablished. We decided to evaluate the quality of previous anticoagulation through the time in therapeutic range (TTR) and individual measurements of previous international normalized ratios (INR) in patients that suffered a cerebrovascular event.

**Methods:** We prospectively analyzed every consecutive patient admitted to our stroke unit (SU) while treated with VKAs to prevent thromboembolic events. We analyzed clinical and demographic variables, INR on admission, 7 previous INRs and TTR during the 6 months before the event.

**Results:** During one year 136 patients were admitted to our SU with the diagnosis of TIA (27), IS (85), ICH (24) while they were treated with VKAs. There were no statistically significant differences between the three groups in any of the 7 INR's previous to the event. Global TTR was 57 % (TIA: 62,7%, IS: 53,7 %, ICH: 66,3 %). There were statistically significant differences on INR on admission with infratherapeutic values in patients admitted due to TIA or IS and supratherapeutic in patients with ICH in patients anticoagulated because of atrial fibrillation (TIA: 1,96; IS: 1,7; ICH: 3,1) as well as in patients with mechanical prosthetic heart valves (TIA: 2,3; IS: 2,1; ICH: 4,15).

**Conclusion:** The risk of having a cerebrovascular event in our patients was not related to the quality of the chronic anticoagulation control but only to the INR on admission.

## ESOC-0615

### 16. AF & Cardioembolism

#### Long-term follow up of patients with cryptogenic stroke: NT-proBNP levels and diagnosis of atrial fibrillation or stroke/TIA recurrence

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**Background:** NT-proBNP showed good accuracy for the diagnosis of atrial fibrillation (AF) in the first six months after ischemic stroke initially considered cryptogenic. The cut-off point of 265.5 pg/mL showed high sensitivity (88.2%) and negative predictive value (95.1%). However, there is no data regarding its accuracy for AF diagnosis in the long-term.

**Aim:** To determine NT-proBNP accuracy to predict AF or stroke/TIA recurrence in patients with cryptogenic stroke during long-term follow-up (>6 months).

**Methods:** Consecutive patients that maintained the diagnosis of cryptogenic stroke after 6 months were prospectively followed during 48 months. NT-proBNP levels were determined immediately after ischemic stroke. To look for AF, 24 hour Holter monitoring was performed yearly. Annual appointments evaluated stroke/TIA recurrence. The National Platform of Health was also searched to look for these endpoints. The area under the curve (AUC) of NT-proBNP for the diagnosis of AF and/or stroke/TIA recurrence was determined.

**Results:** Seventy-one patients were included (median age 68 years). Patients were followed during a median time of 35 months. In 7 patients

(9.9%, 95%CI – 4.9–19%) AF was found and in 3 other patients there was a stroke recurrence. Median time for AF diagnosis was 24 months. The AUC for the diagnosis of AF was 0.55. The sensitivity of the cut-off point was 43% and negative predictive value was 91%. The AUC for the diagnosis of AF of stroke recurrence was 0.61.

**Conclusion:** NT-proBNP showed a low accuracy for the diagnosis of AF or prediction of stroke/TIA recurrence in the long-term follow-up of patients with cryptogenic stroke.

## ESOC-0269

### 16. AF & Cardioembolism

#### Opportunistic screening for atrial fibrillation in primary care in a rural area

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Atrial Fibrillation (AF) is a cause for up to 30% of strokes. There is debate as to whether opportunistic or organised screening is more effective in identifying cases. Previous studies of screening have typically been carried out in highly populated areas. In rural areas, organised screening and management of AF is more challenging because of reduced proximity and access to primary and secondary care resources and difficulty accessing specialist coagulation services. We performed a study of feasibility of AF screening in three predominantly rural counties in the West of Ireland.

**Methods:** Following a training course, 89 doctors in 37 General Practices participated in screening consecutive subjects >64 years over a 6-month period using pulse measurement supported with 12-lead ECG where arrhythmia was suspected. Screening was supported with an information package and management algorithm and a computerised data collection tool.

**Results:** Seven thousand two hundred sixty-two individuals were screened (male 45.3%, mean age 75.1 yrs). 916 (12.6%) had an irregular pulse. 55 (0.8%) had previously undiagnosed AF (49.1% male, mean 76.6 yrs) identified by pulse and confirmed on ECG. 17 (32.1%) had uncontrolled AF (HR > 110/min) and 27 (49.1%) were asymptomatic. CHA<sub>2</sub>DS<sub>2</sub>-VASc score was recorded for 39 subjects (70.9%), Median score was 3 and 37 (94.9%) had a score >1. 40 patients were referred to secondary care for follow up either acutely or to outpatients. 33 (60%) were eventually anticoagulated, 20 (60.1%) using a NOAC.

**Conclusion:** Opportunistic screening for AF is feasible and worthwhile in rural areas. 40% of subjects were not anticoagulated despite availability of NOACs.

## ESOC-0304

### 16. AF & Cardioembolism

#### Stroke prevention: extended, intermittent monitoring using a handheld ECG significantly increases the diagnosis of paroxysmal atrial fibrillation

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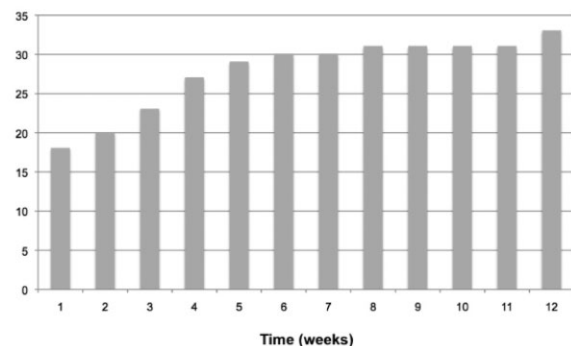
**Purpose:** Atrial fibrillation (AF) is the most common cardiac arrhythmia. Paroxysmal AF (PAF) comprises half of AF cases and confers an equivalent risk of stroke to sustained AF. However, PAF poses a diagnostic challenge given its variable frequency, potential brevity and frequent lack of symptoms. We aim to determine whether the extended, intermittent use of a handheld ECG monitor improves the diagnosis of PAF.

**Methods:** Patients meeting these criteria entered into the study: suspected PAF (palpitations or irregular pulse); aged ≥ 40 years; no previously documented AF. Participants wore an automated cardiac event recorder for 1-week (R Test Evolution 4, Novacor). They also used a handheld ECG monitor (OMRON® Portable ECG Monitor), recording 30-second segments twice-daily for 12 weeks.

**Results:** We recruited 143 participants (mean age 66 years; 63% female). 83% presented with palpitations and 17% with an irregular pulse. 90% of participants completed the study. Atrial arrhythmias were detected in 33 patients (23%): 27 were diagnosed with PAF, 5 with atrial flutter and 1 with atrial tachycardia. 24% of cases were identified using the cardiac event recorder, 45% using the handheld ECG and 30% with both ( $p = 0.32$ ). Significantly more PAF cases were detected over 12-weeks compared to 24-hours ( $n = 33$  vs 6;  $p = 0.0001$ , Fisher's exact test) and 1-week ( $n = 33$  vs 18;  $p = 0.015$ ).

**Conclusions:** The intermittent use of a handheld ECG monitor over 12-weeks significantly increases the diagnosis of PAF compared to standard investigations. We suggest that the duration of monitoring used in current practice is accordingly extended.

**Cumulative incidence of first episode of PAF**



## ESOC-0622

## 16. AF &amp; Cardioembolism

## Atrial fibrillation and stroke in Qatar insight from a 1-year prospective nation-wide registry

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**Background:** Atrial fibrillation (AF) related stroke is associated with increased morbidity and mortality. There is very limited data on AF related stroke from non-western regions of the world.

**Methods:** A prospective national stroke registry in Hamad Medical Corporation from 1st of January 2014 was searched for all case admitted with stroke and the diagnosis of AF. Demographic data, stroke-type, stroke severity, length of stay, and outcome were noted.

**Results:** Out of 852 entries, 57 cases (6.6%) had a diagnosis of AF. Twenty (35%) were new AF. Thirty-four (61%) were males. Mean age was 64.0 ± 16.6 years. Thirty-one (54%) were Arabs, 19(33%) Asians, 3 (5%) Africans and 4 (7%) Caucasian.

Strokes subtypes were: TACI 10(18%), PACI 16 (28%), LACI 12(21%), POCI 14 (24%) and 5(9%) TIAs. Nine (15.8%) received thrombolysis vs. 41 (5.2%) for non-AF stroke ( $p = 0.004$ )

The mean NIHSS score was 7.79 ± 6.8 vs. 6.3 ± 5.6 for non-AF stroke. Age, stroke-type and severity did not show statistical significant difference between AF and non-AF strokes. Mean length of stay was 15 ± 27 days (8 ± 15 days for non-AF). Mean modified Rankin scale (mRs) was 2.8 + 1.8 for AF stroke vs. 1.9 + 1.7 for non-AF stroke ( $p = 0.001$ ). Good outcome (mRs 0–3) was 61% vs. 82%; poor outcome (mRs 4–5) was 34% vs. 15% and death 5% vs. 4%. (All  $p = 0.001$ )

**Conclusion:** Prevalence and incidence of AF in patients presenting with stroke in Qatar is 6.6% and 2.4% consecutively. AF related stroke is associated with significantly higher percentages of thrombolysis, prolonged length of stay and poorer outcomes.

## ESOC-0735

## 16. AF &amp; Cardioembolism

## Atrial fibrillation detection in patients with an implantable loop recorder after acute embolic stroke of unknown source (ESUS)

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**Introduction:** The embolic stroke of unknown source (ESUS) concept was introduced as a more rigid analysis of patients with cryptogenic stroke representing a superselection of patients with cardioembolic stroke. Typically these patients are particularly candidates for intermittent atrial fibrillation (AF). Implantable loop recorders (ILR) in patients with ESUS may detect AF and establish the indication for oral anticoagulation. The aim of this study was to prospectively assess and predict AF occurrence in patients with ILR after ESUS.

**Methods:** In patients with ESUS (MR imaging, exclusion of structural cardiac stroke source by TEE, no AF detected by 72 h SU monitoring and 24 h holter ECG, exclusion of other causes such as SCAS) an ILR was implanted. We then analyzed the predictive value of different clinical and imaging characteristics for AF detection in ESUS.

**Results:** By daily remote monitoring over a period of 8 ± 5 months, AF was documented and manually confirmed in 19 of 115 patients (17%). In 19 patients (17%) first AF detection occurred on average after 88 ± 122 days of monitoring. Characteristics of patients are shown in the table.

Predictors of AF Detection post ESUS			
	Pts without AF detection (n=95)	Pts with AF detection (n=19)	p-value
Age	63±9 years	72±9 years	<0.001
Gender	63% male	50% male	0.21
CHADS2	3.2±0.7	3.6±0.8	0.095
CHA2S2VAS <sub>c</sub>	4.3±1.2	5.3±1.4	0.001
MCA infarction	62%	80%	0.20
Multiple territories	18%	30%	0.23
Bilateral occlusions	17%	20%	1.0
Modified Rankin score on admission	2.2±1.3	2.1±1.1	0.79
Modified Rankin score at discharge	1.5±1.2	1.4±0.9	0.62

**Conclusions:** Patients with ESUS and asymptomatic AF detected only by long-term continuous monitoring with an ILR were on average older and had a higher CHA2DS2-VASc score. Other clinical parameters and features of cerebral imaging in ESUS did not increase the probability of AF detection in these preselected patients with ESUS. Importantly, ESUS selection almost doubled AF detection rate compared to recent studies such as the ILR group of the Crystal-AF trial (17% compared to 10%).

## ESOC-0752

## 16. AF &amp; Cardioembolism

## Local hemostatic abnormalities in the fibrillating atrium

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Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia associated with a high risk of stroke. The latest American guideline on secondary stroke prevention considers the usefulness of closing the left atrial appendage with the Watchman device uncertain. We intended to identify coagulation and fibrinolytic abnormalities associated with AF by presenting local differences using venous and arterial blood samples of patients suffering from AF (n = 22) and controls having other types of supraventricular tachycardia (n = 10) undergoing transcatheter radiofrequency ablation. Blood samples were drawn from femoral vein, left atrium and left atrial appendage. All medications influencing coagulation were discontinued at least 5 days before the procedure. The following tests were

carried out from all blood samples: blood count, hemostasis screening tests, fibrinogen, factor VIII activity, von Willebrand factor antigen levels, factor XIII activity, thrombin-antithrombin complex, quantitative fibrin monomer test, activated factor VII-antithrombin complex, thrombin generation assay, D-dimer, plasminogen-activator inhibitor-1 activity and antigen concentration, plasmin-antiplasmin complex. C-reactive protein was measured from venous blood samples. Clinical data of patients and controls (BMI, smoking habit, previous cardiovascular events, medications) were registered. We have not found difference between the left atrium and left appendage concerning hemostatic parameters and no difference was found between intracardial and femoral vein samples was specific to AF itself.

## ESOC-0258

### 16. AF & Cardioembolism

#### Detection of right-to-left shunt in young ischemic stroke patients – pilot study

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**Objective:** Right-to-left shunt is associated with a number of clinically important syndromes including paradoxical thromboembolism causing stroke or other systemic infarct, mainly in young patients. Flow detection system CardioxTM (FDS) represents a new, comfortable method for right-to-left shunt detection independent on examiner experience with exact measurement of Valsalva maneuver. The aim was to assess the correlation between FDS, contrast transcranial Doppler ultrasound (cTCD) and transesophageal echocardiography (TEE) in right-to-left shunt detection in young ischemic stroke patients.

**Methods:** All consecutive patients presenting with acute ischemic stroke/transient ischemic attack aged 18–55 years and able to perform sufficient Valsalva maneuver were enrolled to the pilot study during 5 months. TEE, FDS, cTCD and brain MRI/CT were performed in all patients. Correlations in right-to-left shunt detection were statistically evaluated using Spearman's and interclass correlation coefficient.

**Results:** Totally 30 patients (21 males, mean age  $46.2 \pm 8.5$  years) were included. Right-to-left shunt was detected in the same 8 (26.7%) patients using TEE and cTCD, and in one more patient (totally 9, 30.0%) using FDS. Spearman's coefficients for FDS and cTCD were 0.92 and 1.00, resp. Interclass correlation coefficient was 0.975. Sensitivity, specificity, positive and negative predictive values were 100%, 95.5%, 88.9%, 100% for FDS and 100%, 100%, 100%, 100% for cTCD, resp.

**Conclusions:** Correlations between FDS and cTCD, and TEE as a gold standard in right-to-left shunt detection were almost perfect with 100% sensitivity. Both FDS and cTCD seem to be sufficient as a screening method.

Supported by the internal grant of University Hospital Ostrava RVO-FNOs/2014.

## ESOC-0539

### 16. AF & Cardioembolism

#### Detection of silent atrial fibrillation after ischemic stroke (SAFFO) guided by implantable loop recorder. A multicentre Italian trial based on neurocardiology unit network

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**Background:** Atrial fibrillation (AF) is associated with a high risk of stroke and its prevalence increases in subjects aged  $\geq 65$  years. After an ischemic stroke, the use of standard monitoring methods may underestimate the detection rate of AF. Hence, it is very likely that even patients having a first atherothrombotic or lacunar stroke with high burden of vascular risk factors are exposed to increased risk of developing AF in the subsequent years and AF may be the cause underlying possible recurrent strokes.

**Objectives:** The Silent Atrial Fibrillation after Ischemic Stroke (SAFFO) trial has the objective to evaluate the incidence of AF or atrial flutter (AFL) as first diagnosis detected by implantable loop recorder (ILR) in patients with first-ever atherothrombotic or lacunar stroke. We hypothesize that the incidence will be higher than that found by using standard cardiac monitoring.

**Methods:** SAFFO is a prospective, multicenter, randomized, controlled, open-label trial with blinded assessment of outcome measures. Patients who fulfill inclusion criteria will be randomized to either continuous monitoring using ILR plus standard monitoring (intervention arm) or standard heart rhythm monitoring alone (control arm) with a ratio of 1:1. The primary endpoint is the incidence of AF/AFL as first diagnosis in the first 12 months of the study period. The study has been approved by Ethic Committee.

**Discussion:** If positive, SAFFO trial could have important clinical implications in terms of changing standard diagnostic protocols in patients with atherothrombotic or lacunar stroke and of increasing the shift of secondary prevention treatment from antiplatelet to anticoagulant therapy.

## ESOC-0320

### 16. AF & Cardioembolism

#### Are new anticoagulants really as safe as it is said?

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**Introduction:** NOACs have drawn much attention in Medicine, particularly in secondary prevention of stroke (SPS). In addition to advantages in use, they have proven to be safer than warfarin in clinical trials. However, it remains unclear if this safety profile is reproducible in routine clinical practice.

**Material and methods:** We conducted a prospective descriptive study including patients on Rivaroxaban in SPS admitted at our Stroke Unit in the last 24 months with at least of 3 months of follow-up. Demographic characteristics, HASBLED score and clinically significant bleeding were recorded. Results were compared to those in the SPS subgroup of ROCKET-AF study: clinically significant bleeding (CSB) (13.31%/year), major bleeding (3.13%/year) and intracranial hemorrhage (ICH) (0.59%/year).

**Results:** Eighty-nine cases were enrolled -median follow-up: 15 months (IQR 9–21), median age: 77 yo (IQR 72–82), 52.8% females, median HASBLED 3 (IQR 2–3), median time to initiation NOAC after stroke: 4

days (IQR 1- 90). We observed 8 CSB (6.58%/year), 1 major bleeding (0.82%/year) and 1 ICH (0.82%/year).

**Conclusions:** Despite Rivaroxaban was used in higher bleeding risk patients (older than 80 years, lower delay of initiation after stroke and higher HASBLED score) than the ROCKET-AF post-stroke population, in our experience it appears to be as safe as it has been shown in the clinical trial. We found a lower rate of CSB or major bleedings and a similar rate of ICH. Current multicenter registries are conducted to confirm these data.

## ESOC-0471

### 16. AF & Cardioembolism

#### Correlation between prothrombin fragment 1 + 2 and routine coagulation tests in NVAF patients treated with dabigatran and rivaroxaban

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**Background:** In non-valvular atrial fibrillation (NVAF) patients treated with non-vitamin K antagonist oral anticoagulant (NOAC), no reliable method for coagulation monitoring is established. We have reported the usefulness of prothrombin fragment 1 + 2 (PF1 + 2) which is hemostatic molecular marker indicating thrombin generation in NVAF patients under warfarin anticoagulation. In this report, we evaluated the utility of PF1 + 2 among NVAF patients taking NOACs.

**Subjects and methods:** We recruited 35 NVAF patients treated with either dabigatran or rivaroxaban more than three months. Activated partial thrombin time (aPTT), prothrombin time (PT) and PF1 + 2 were measured simultaneously from serial blood specimens. We evaluated the correlation between PF1 + 2 value and aPTT ratio or PT ratio. Both ratios were calculated as "patient value / control value".

**Results:** Sixty-five specimens from 18 dabigatran patients (three females, average 70.3 y/o) and 37 specimens from 17 rivaroxaban patients (five females, average 65.5 y/o) were assessed. Whereas we found a statistically significant correlation between PF1 + 2 and aPTT ratio ( $r = -0.67$ ,  $p < 0.0001$ ) in patients treated with dabigatran, there was no correlation between PF1 + 2 and PT ratio nor PT-INR in those with rivaroxaban.

**Conclusion:** The correlation between PF1 + 2 and routine coagulation test differed between two NOACs. Difference of dosing time and coagulation factor which both drugs are inhibiting may affect our results.

## ESOC-0088

### 16. AF & Cardioembolism

#### The efficacy of novel oral anticoagulants for the secondary stroke prevention in the real world

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Novel oral anticoagulants (NOACs) have been recently released for the prevention of embolic stroke recurrence. However, the benefits and safety of NOACs in the real clinical world have not been fully understood. In this study, for exploring whether there are any difference of outcome in stroke patients between warfarin and NOACs, the embolic stroke patients with newly prescribed anticoagulants were prospectively investigated.

Between July 2012 and June 2013, acute ischemic stroke patients who started anticoagulant therapy were consecutively enrolled. All patients were classified into warfarin, dabigatran and rivaroxaban treated groups (W: n = 37, D: n = 33 and R: n = 42, respectively). The outcome in one

year was investigated at outpatient clinic or telephone interview. Recurrence of stroke and death were considered as the major outcome.

As the results, mRS at discharge was significantly lower in the D group compared with W and R groups ( $p < 0.01$ : 1.2, 3.1 and 3.0, respectively). Risk factors and renal function were not significantly different among 3 groups. The incidence of major outcome in one year was 29.9%, 12.6% and 12.8% in W, D and R groups, respectively. Recurrence rate of ischemic stroke in one year was 13.6%, 9.7% and 8.1% in W, D and R groups, respectively. Most of stroke recurrence was the embolic stroke. However, one lacunar infarction was observed in the D group and one intracerebral hemorrhage was observed in the W group.

According to our data reflecting the real clinical world, both dabigatran and rivaroxaban showed the better outcome and safety compared with warfarin.

## ESOC-0603

### 16. AF & Cardioembolism

#### Statin treatment is associated with improved prognosis in patients with af-related stroke

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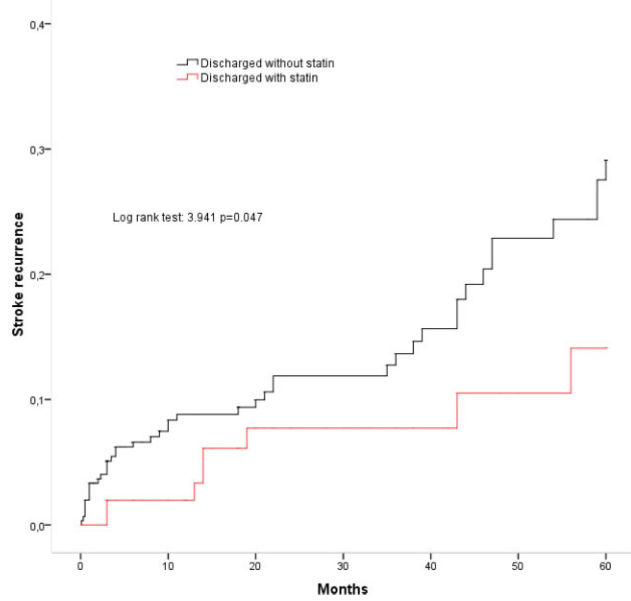
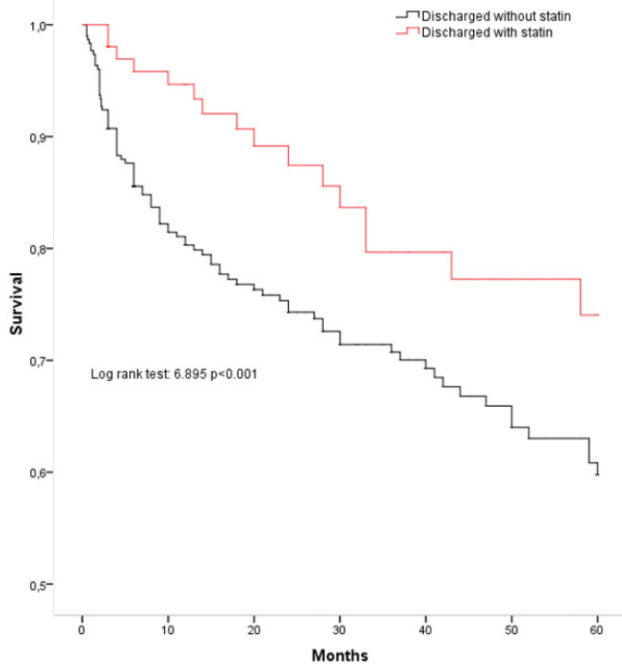
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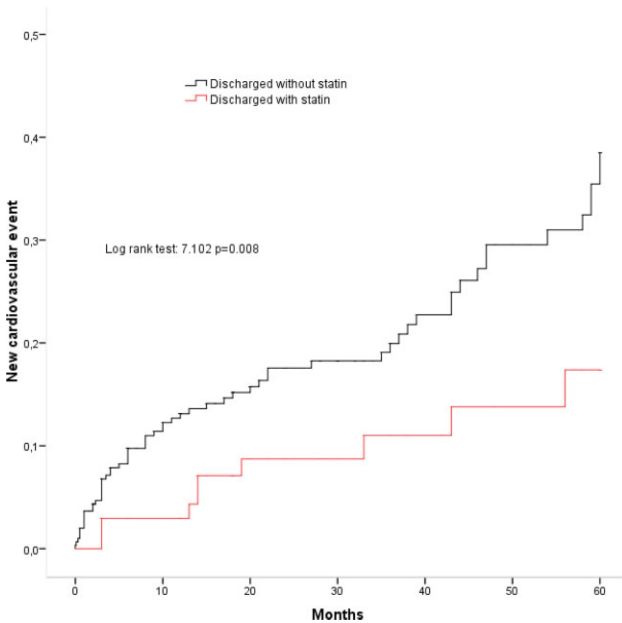
**Background/objectives:** The most recent ACC/AHA guidelines recommend high-intensity statin therapy in ischemic stroke patients of presumably atherosclerotic origin. On the contrary, there is no specific recommendation for the use of statin in patients with non-atherosclerotic stroke, e.g. strokes related to atrial fibrillation (AF). We investigated whether statin treatment in patients with AF-related stroke is associated with improved survival and reduced risk for stroke recurrence and future cardiovascular events.

**Methods:** All consecutive patients registered in the Athens Stroke Registry with AF-related stroke and no history of coronary artery disease nor clinically manifest peripheral artery disease were included in the analysis and categorized in two groups depending on whether statin was prescribed at discharge. The primary outcome was overall mortality; the secondary outcomes were stroke recurrence and a composite cardiovascular endpoint comprising of recurrent stroke, myocardial infarction, aortic aneurysm rupture or sudden cardiac death during the 5-year follow-up.

**Results:** Among 1602 stroke patients, 404 (25.2%) with AF-related stroke were included in the analysis, of whom 102 (25.2%) were discharged on statin. On multivariate Cox-proportional-hazards model, statin treatment was independently associated with a lower mortality (hazard-ratio (HR): 0.49, 95%CI:0.26-0.92) and lower risk for the composite cardiovascular endpoint during the median 22 months follow-up (HR: 0.44, 95%CI:0.22-0.88), but not with stroke recurrence (HR: 0.47, 95%CI:0.22-1.01,  $p = 0.053$ ).



**Conclusions:** In this long-term registry of patients with AF-related stroke, statin treatment was associated with improved survival and reduced risk for future cardiovascular events.



**ESOC-0458**

**16. AF & Cardioembolism**

**Atrial fibrillation is associated with disturbed glucose metabolism in patients with ischemic stroke and TIA**

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**Objectives:** The prevalence of atrial fibrillation (AF) is increased in type 2 diabetes. Whether prediabetes and newly-diagnosed diabetes are risk factors for AF is controversial. We aimed to assess the prevalence of AF in patients with ischemic stroke or TIA with prediabetes, newly-diagnosed diabetes and pre-existent diabetes compared with normal glucose metabolism.

**Methods:** We included 1380 patients with TIA or ischemic stroke. In all nondiabetic patients, 2-hour post-load glucose levels were determined on day 2–5. We defined prediabetes and newly-diagnosed diabetes according to current guidelines. Pre-existent diabetes was defined as the use of oral or parenteral anti-diabetic medication prior to admission. AF was defined as a combination of known AF prior to admission and registered AF during admission on an electrocardiogram or on 24-hour cardiac rhythm observation. We studied the occurrence of AF in groups with different glucose metabolism. Multiple logistic regression was applied to study the associations between the glucose groups and AF.

**Results:** One hundred sixteen patients (8%) were known to have AF, and 38 (3%) had de novo AF. 372 patients (27%) had prediabetes, 277 (20%) newly-diagnosed diabetes, and 301 (22%) pre-existent diabetes. AF was more often present in patients with prediabetes (10%, p = 0.010), newly-diagnosed diabetes (15%, p < 0.001), and pre-existent diabetes (12%, p = 0.001) than in those with normal glucose metabolism (5%). Prediabetes (aOR 1.7; 95% CI 0.8–3.6), newly-diagnosed diabetes (aOR 2.4; 95% CI 1.2–5.0), and pre-existent diabetes (aOR 1.9; 95%CI 0.9–4.0) were associated with AF.

**Conclusion:** Prediabetes and newly-diagnosed diabetes are risk factors for AF.



## ESOC-0580

## 16. AF &amp; Cardioembolism

**Early recurrence and cerebral bleeding in patients with acute ischemic stroke and atrial fibrillation: Effect of anticoagulation and its timing. The (RAF) study**M Paciaroni<sup>1</sup><sup>1</sup>Cardiovascular Medicine, Stroke Unit, Perugia, Italy for the RAF Investigators

**Background:** Anticoagulation timing in acute cardioembolic stroke remains controversial. In a prospective cohort of patients with acute stroke and atrial fibrillation (AF), we evaluated: 1) the risk of recurrent ischemic event and severe bleeding; 2) the risk factors for recurrence and bleeding; 3) the risk of recurrence and bleeding associated with anticoagulant therapy and its starting time after the acute stroke.

**Methods:** The primary outcome of this multicenter study was the composite of stroke, transient ischemic attack (TIA), symptomatic systemic embolism, symptomatic cerebral bleeding and major extra-cranial bleeding within 90 days from acute stroke.

**Results:** Of the 1,029 patients enrolled, 123 had 128 events (12.6%): 77 (7.6%) ischemic stroke or TIA or systemic embolism, 37 (3.6%) symptomatic cerebral bleeding and 14 (1.4%) major extra-cranial bleeding. High CHA2DS2-VASc score, high NIHSS, large ischemic lesion and type of anticoagulant were predictive factors for primary study outcome. Patients treated with oral anticoagulants alone had a better prognosis compared to those treated with low molecular weight heparins (LMWHs) alone or followed by oral anticoagulants. At adjusted Cox regression analysis, initiating anticoagulants 4 to 14 days from stroke onset was associated with a significant reduction in primary study outcome, compared to initiating treatment before 4 or after 14 days: Hazard Ratio 0.53 (95% CI 0.30–0.93).

**Conclusions:** Acute stroke in AF patients is associated with high rates of ischemic recurrence and major bleeding at 90 days. Anticoagulant treatment administered between 4 and 14 days from the acute event was associated with improved functional outcome.

## ESOC-0608

## 16. AF &amp; Cardioembolism

**Predicting the outcomes of acute ischemic stroke in atrial fibrillation: The role of baseline CHADS2, CHA2DS2-VASc and HAS-BLED score values**V Padjen<sup>1</sup>, D R Jovanovic<sup>2</sup>, I I Berisavac<sup>2</sup>, M D Ercegovac<sup>2</sup>, P Stanarcevic<sup>1</sup>, M Stefanovic Budimkic<sup>1</sup>, L Beslac Bumbasirevic<sup>1</sup><sup>1</sup>Emergency neurology Department, Neurology Clinic Clinical Centre of Serbia, Belgrade, Serbia<sup>2</sup>Emergency neurology Department, Neurology Clinic Clinical Centre of Serbia Medical Faculty University of Belgrade Belgrade, Belgrade, Serbia

**Objective:** Atrial fibrillation (AF) related risk of stroke is commonly assessed using the CHADS2 or CHA2DS2-VASc score, whilst the oral anticoagulation-related bleeding risk can be estimated by the HAS-BLED score. We investigated the association of these scores with outcomes of AF-associated strokes, defined as symptomatic intracranial haemorrhage (sICH), favourable outcome (modified Rankin Scale [mRS] 0–2) or death.

**Methods:** Analyses of prospective data on stroke patients with non-valvular AF treated in the Stroke Unit from January 2009 to June 2012 were performed.

**Results:** Of 787 patients with an acute ischemic stroke, 131 had AF (16.6%, median age 70, range 62–76 years). Of those, 6 patients (4.6%) had sICH, 49 (37.4%) died and 55 (42.0%) had a favourable 90-day outcome. HAS-BLED score of  $\geq 3$  was associated with sICH both in the univariate analysis (OR 15.13;95%CI, 2.11–108.25,  $p = 0.007$ ) and in the multivariable model (OR 19.96;95%CI, 2.23–178.81,  $p = 0.007$ ), which

also included the baseline neurological deficit score (NIHSS), intravenous thrombolysis or the use of antiplatelet/anticoagulant therapy. The CHADS2 and CHA2DS2-VASc scores were associated with 90-day mortality in the univariate analyses (OR 1.47;95%CI, 1.11–1.95 and OR 1.36;95%CI, 1.08–1.69, respectively, both  $p = 0.008$ ). The CHA2DS2-VASc score was inversely related to the favourable outcome in the univariate analysis (OR 0.80;95%CI, 0.65–0.99,  $p = 0.042$ ).

**Conclusion:** HAS-BLED was found to have an independent predictive value on the occurrence of sICH regardless of the treatment (thrombolysis or conservative therapy). A trend toward statistical relation to the influence of the CHA2DS2-VASc values on the favourable outcome was registered.

## ESOC-0599

## 16. AF &amp; Cardioembolism

**Adherence to oral anticoagulant therapy in secondary stroke prevention – impact of the novel oral anticoagulants**S Luger<sup>1</sup>, C Hohmann<sup>2</sup>, D Niemann<sup>1</sup>, P Kraft<sup>3</sup>, I Gunreben<sup>3</sup>, T Neumann-Haefelin<sup>2</sup>, C Kleinschnitz<sup>3</sup>, H Steinmetz<sup>4</sup>, C Foerch<sup>4</sup>, W Pfeilschifter<sup>1</sup><sup>1</sup>Neurology, University Hospital Frankfurt, Frankfurt am Main, Germany<sup>2</sup>Neurology, Fulda Hospital, Fulda, Germany<sup>3</sup>Neurology, University Hospital Würzburg, Würzburg, Germany<sup>4</sup>Neurology, Frankfurt University Hospital, Frankfurt am Main, Germany

**Background:** Oral anticoagulant therapy (OAT) potentially prevents stroke in patients with atrial fibrillation. After vitamin K antagonists (VKA) have been the only OAT for decades, novel non-VKA oral anticoagulants (NOAC) have entered the market during the last few years and stirred up many questions, among them their influence on medication adherence. We assessed the adherence to VKA and NOAC in secondary stroke prevention.

**Methods:** We entered all patients treated for ischemic stroke or transient ischemic attack from 10/2011–09/2012 at three academic centers with a subsequent indication for OAT into a prospective registry and recorded baseline data and antithrombotic treatment at discharge. At one-year follow-up, we assessed current OAT to determine the adherence to different OAT strategies. We noted OAT changes, reasons to change treatment and factors that influence medication adherence.

**Results:** In patients discharged on OAT, we achieved a fatality-corrected response rate of 73.3 % ( $n = 209$ ). 92 % of these patients received OAT at one-year follow-up. We observed good adherence to all three therapies (VKA: 80.9 %; dabigatran: 70.9%; rivaroxaban: 83.3 %) with a statistically non-significant tendency towards a weaker adherence to dabigatran. Disability at one-year follow-up was an independent predictor of lower adherence to any OAT after multivariate analysis whereas the choice of OAT did not have a relevant influence.

**Conclusions:** One-year adherence to OAT after stroke is strong (>90%) and patients who switch therapy most commonly switch towards another OAT. The one-year adherence rates to VKA and NOAC in secondary stroke prevention do not differ significantly.

## ESOC-0736

## 16. AF &amp; Cardioembolism

## Spontaneous hyperdense M1 sign is predictive of cardioembolic etiology in acute ischemic stroke

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**Introduction:** Spontaneous hyperdense M1 middle cerebral artery sign (HM1S) in non-contrast CT (NCCT) in patients with acute ischemic stroke (AIS) has a high specificity for middle cerebral artery occlusion. "Red" thrombi produce a higher attenuation in NCCT than "white" thrombi, but there is no consensus regarding their most likely source. Our aim was to study the association of HM1S with stroke etiology.

**Methods:** Retrospective study of all patients admitted in our hospital for anterior circulation AIS during 2013. Review of clinical records and admission NCCT images. Identification of HM1S, quantification of Hounsfield Units (HU) of HM1S and HM1S / contralateral MCA HU ratio. Patients with incomplete etiological investigation were excluded.

**Results:** Among 322 patients with anterior circulation AIS, 78 had HM1S on admission NCCT. Patients with HM1S were more frequently female ( $p = 0.003$ ), diabetic ( $p = 0.036$ ), had higher NIHSS scores ( $p < 0.001$ ) and higher in-hospital mortality ( $p = 0.006$ ). Cardioembolic etiology was found in 60 patients (76.9%) with HM1S and in 136 patients (55.7%) without HM1S (OR = 2.65, 95%CI = 1.47–4.78,  $p = 0.001$ ). Logistic regression adjusted for NIHSS and age showed that presence of HM1S was independently associated with cardioembolic etiology (OR = 2.30, 95%CI = 1.01–5.25,  $p = 0.047$ ).

**Conclusion:** Patients with HM1S present more severe deficits and have higher in-hospital mortality, similar to what is reported in the literature. This study suggests that HM1S in NCCT is a predictive sign of cardioembolic etiology of stroke, which is independent of stroke severity and age. Main limitations of this study are its retrospective design and absence of systematic confirmation of large vessel occlusion using other methods.

## ESOC-0316

## 16. AF &amp; Cardioembolism

## Diagnostic work-up to detect paroxysmal atrial fibrillation after acute ischemic stroke – results from a cross sectional survey on German Stroke Units

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**Background:** Multiple methods to detect paroxysmal atrial fibrillation (pAF) in acute stroke patients are available. However, it is unknown which approaches are performed in daily clinical routine to unveil pAF and recommendations by guidelines remain vague to the extent of recommended cardiac monitoring. We aimed to characterize the current diagnostic efforts for pAF detection on Stroke Units (SU) in Germany.

**Methods:** A standardized anonymous questionnaire was sent to all clinical leads of 250 certified SUs. The questionnaire focused on basic characteristics of SUs, procedures to detect AF and estimates on AF detection.

**Results:** 179 SU leads participated (response rate 72%). All patients underwent mandatory continuous bedside ECG monitoring (CEM), and 78% of SUs initiated additional 24 h Holter ECG in >50% of patients without known AF. Monitoring of TIA patients was significantly shorter compared to patients with ischemic stroke. Independent of stroke unit type or size, 68% of leads assumed to fail detecting pAF in 5–20% of patients. In cryptogenic stroke, additional ECG monitoring was recommended by 90% but only 14% of all SUs performed routine ECG follow-up visits for these patients. The use of implanted event recorders was low (1–10 patients/year by 61% of SUs), 28% did not use implanted event recorders, and 84% did not use external event recorders.

**Conclusions:** Our survey demonstrates substantial heterogeneity among German SUs with regard to diagnostic work-up for pAF detection. Future multicenter studies should focus on systematic evaluation of different methods to uncover pAF during inpatient management and thereafter.

## ESOC-0388

## 16. AF &amp; Cardioembolism

## Admission elevation of serum cardiac markers in young acute ischemic stroke patients can be associated with presence of relevant cardiac source of emboli

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**Background and purpose:** In young ischemic stroke (IS) patients, the cause of IS remains often unclear. An extensive and time-consuming diagnostic setting is needed for reliable exclusion of relevant cardiac abnormalities as the source of emboli. The aim was to evaluate whether the admission elevation of specific serum cardiac markers (CM) in young acute IS patients may be associated with the presence of relevant cardiac source of emboli.

**Methods:** The study set consisted of acute IS patients <50 years enrolled in the prospective HISTORY (Heart and Ischemic STroke Relationship study) study. In all patients, brain ischemia was confirmed on CT/MRI. Admission ECG, serum CM (N-terminal pro-brain natriuretic peptide and high sensitive Troponin T), transoesophageal echocardiography (TEE), 24-hour and 3 week ECG-Holter were performed in all patients. **Results:** Out of 695 patients enrolled in the HISTORY study, 112 (58 males, mean age  $40 \pm 7.9$  years) were <50 years. In total, 21 (19%) patients had elevated serum CM at admission. Relevant cardiac abnormalities were detected in 12 (57%) patients with elevation of serum CM and in 2 (2%) with normal level of serum CM ( $p < 0.0001$ ). Atrial fibrillation including paroxysmal was detected in 10 (71%) patients, other three patients had ischemic coronary disease and one patient had severe valve defect.

**Conclusion:** Young acute IS patients with elevated serum CM had more frequently relevant cardiac abnormalities with embolic potential. Study was supported by the IGA MH CR grants NT11046-6/2010 and NT14288-3/2013.

**Clinical Trial Registration:** <http://www.clinicaltrials.gov>. Unique identifier: NCT01541163.

## ESOC-0148

## 16. AF &amp; Cardioembolism

**Predictors of previously unknown atrial fibrillation in acute ischemic stroke – a substudy of the Troponin Elevation in Acute Ischemic Stroke (TRELAS) study**J Scheitz<sup>1</sup>, H Erdur<sup>1</sup>, K G Haeusler<sup>1</sup>, H J Audebert<sup>1</sup>, M Roser<sup>2</sup>, U Laufs<sup>3</sup>, M Endres<sup>1</sup>, C H Nolte<sup>1</sup><sup>1</sup>Neurology, Charité – Campus Benjamin Franklin, Berlin, Germany<sup>2</sup>Cardiology, Charité – Campus Benjamin Franklin, Berlin, Germany<sup>3</sup>Cardiology, University Homburg/Saar, Berlin, Germany

**Background:** Detection rates of paroxysmal atrial fibrillation (AF) after acute ischemic stroke increase with duration of ECG monitoring. Until now, it is unknown which patient group may benefit most from intensive monitoring strategies. Therefore, we aimed to identify predictors of previously unknown AF during in-hospital ECG monitoring.

**Methods:** All consecutive patients with imaging-confirmed ischemic stroke admitted to our tertiary care hospital from February 2011 to December 2013 were registered prospectively. Patients received continuous bedside ECG monitoring for at least 24 h. Detection of previously unknown AF during in-hospital ECG monitoring was obtained from medical records. Patients with AF on admission ECG or known history of AF were excluded from analysis.

**Results:** Among 1228 patients (median age 73, median NIHSS 4, 43.4% female), previously unknown AF was detected in 114 (9.3%) during a median time of continuous ECG monitoring of 3 days (IQR2–4). Duration of monitoring ( $p < 0.01$ ), older age ( $p < 0.01$ ), history of hypertension ( $p = 0.03$ ), insular cortex involvement ( $p < 0.01$ ) and higher high-sensitivity cardiac troponin T (hs-cTnT,  $p = 0.04$ ) on admission were independently associated with subsequent detection of AF in a multiple regression analysis. Addition of hs-cTnT, insular cortex stroke or both to the CHADS<sub>2</sub>-score significantly improved c-statistics from 0.63 to 0.68 ( $p = 0.01$ ), 0.70 ( $p < 0.01$ ) and 0.72 ( $p < 0.001$ ), respectively.

**Conclusions:** Insular cortex involvement, higher admission hs-cTnT, older age, hypertension, and longer monitoring are associated with new detection of AF during in-hospital ECG monitoring. Patients with higher hs-cTnT or insular cortex involvement may be candidates for prolonged ECG monitoring.

## ESOC-0360

## 16. AF &amp; Cardioembolism

**Use of anticoagulants for the prevention of cardioembolic stroke – retrospective study of the past 6 years in Chiba Cerebral and Cardiovascular Center in Japan**J Shimada<sup>1</sup>, S Matuda<sup>1</sup>, K Honma<sup>1</sup>, Y Akaogi<sup>1</sup>, K Hashimoto<sup>1</sup>, Y Nakano<sup>1</sup>, T Machida<sup>2</sup>, S Ishige<sup>2</sup>, O Nagano<sup>2</sup>, T Okuyama<sup>2</sup>, J Ono<sup>2</sup><sup>1</sup>Neurology, Chiba Cerebral and Cardiovascular center, Ichihara, Japan<sup>2</sup>Neurosurgery, Chiba Cerebral and Cardiovascular center, Ichihara, Japan

**Background:** It is important to prophylactically treat cardioembolic stroke, which can arise from non-valvular atrial fibrillation (NVAF), with oral anticoagulants. However, dozens of acute cardioembolic stroke patients are admitted to our hospital each year, without stroke prevention. In 2011, the novel oral anticoagulant (NOAC) was approved, which was expected to improve the prevention of cardioembolic stroke from NVAF.

**Methods:** We investigated acute cardioembolic stroke patients from April 2008 to September 2014, in two groups: 1) the before NOAC group: BN, from April 2008 to March 2011, before NOAC was approved and 2) the after NOAC group: AN, from October 2011 to September 2014, after

NOAC was approved. We investigated the number of patients, CHADS<sub>2</sub> score, anticoagulant usage, NIHSS score on admission, mRS on discharge and ischemic dimension on MRI between the two groups.

**Results:** There were 325 and 352 patients in the BN and AN groups, respectively. High-risk NVAF patients (CHADS<sub>2</sub> score  $\geq 2$ ) represented 67.6% and 87.5% of the BN and AN groups. The proportions of high-risk NVAF patients treated with appropriate anticoagulation were 6.8% and 12.6% in the BN and AN groups, respectively ( $p = 0.028$ ). The patients who took appropriate anticoagulants exhibited lower NIHSS on admission (3.5 vs. 14:  $p < 0.001$ ), lower mRS on discharge (2 vs. 4:  $p < 0.001$ ) and smaller ischemic dimension on MRI ( $28.4 \pm 39.3$  mm vs.  $54.8 \pm 42.4$  mm:  $p < 0.001$ ).

**Conclusions:** We concluded that anticoagulant therapies for stroke prevention had spread since NOAC was approved in our hospital. Furthermore, cardioembolic stroke patients who took appropriate anticoagulants tended to exhibit a less severe illness.

## ESOC-0731

## 16. AF &amp; Cardioembolism

**Are we getting the message across? – An audit of anticoagulation for atrial fibrillation in a district general hospital**A Williams<sup>1</sup>, A E El Nour<sup>2</sup>, MA Khan<sup>3</sup>, A Ijaz<sup>3</sup><sup>1</sup>Medicine, Scarborough General Hospital, Scarborough, United Kingdom<sup>2</sup>Stroke, York District General Hospital, York, United Kingdom<sup>3</sup>Medicine, Scarborough General Hospital, Scarborough, United Kingdom

**Introduction:** There has been increased publicity in the UK regarding the importance of anticoagulation of AF patients as a stroke prevention measure even if they are at risk of falls. Our audit assessed the anticoagulation practice for AF patients in Scarborough General Hospital- a district general hospital.

**Methods:** A “snapshot” audit conducted in September 2014 identified all the AF patients on admission in the general medical and rehabilitation wards over a 24 hour period. Data collected and analysed include age, stroke risk and bleeding risk scores, anticoagulants prescribed, contraindications to anticoagulants, falls and discharge instruction with respect to anticoagulation.

**Results:** Forty-nine patients recruited of which 35 (71.42%) were elderly. 21 patients were on anticoagulants- 14 on warfarin and 7 on Novel Oral Anticoagulants (NOAC). 10 of the 28 not anticoagulated had a valid contraindication to anticoagulation and 2 of these patients were later commenced on NOAC. 18 patients were not anticoagulated with no valid reason. 13 of these patients were not anticoagulated because of history of falls. Only 5 patients had their CHA<sub>2</sub>DS<sub>2</sub>-VASC score documented and none had HAS-BLED score documented.

**Conclusion:** Our audit results conform to previous studies and shows most of the patients in AF are elderly with a significant percentage being at risk of falls. The audit suggests falls is still taken as a contraindication to anticoagulation by many physicians in our hospital even though recent guidelines such as the NICE AF guidelines suggest otherwise. There was poor documentation of stroke and bleeding risk scores.

## ESOC-0461

## 16. AF &amp; Cardioembolism

## Population impact of trial evidence of benefit of anticoagulation in older patients with atrial fibrillation on the incidence of potentially preventable vascular events

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**Background:** Anticoagulation has been underused in primary prevention of stroke in older individuals with atrial fibrillation (AF). Publication of the Birmingham Atrial Fibrillation Treatment of the Aged (BAFTA) Trial in 2007 provided strong evidence of safety and effectiveness of warfarin at age  $\geq 80$  years, but the impact on incidence of AF-related ischaemic stroke and peripheral embolic vascular events is uncertain.

**Methods:** We studied age-specific incidence and outcome of all AF-related strokes and systemic emboli from 2002–2012 in a population-based study of all acute vascular events (Oxford Vascular Study).

**Results:** Of 3096 acute cerebral or peripheral vascular events, 748 (24.2%) were AF-related. Of the 597 disabling or fatal incident ischaemic strokes, 262 (43.9%) were AF-related. There was no reduction in number of AF-related incident events between 2002–2007 and 2007–2012 at all ages ( $n = 223$  vs  $231$ ; adjusted RR 1.11, 0.91–1.36,  $p = 0.29$ ) or at age  $\geq 80$  ( $137$  vs  $135$ , adjusted RR 1.15, 0.94–1.40,  $p = 0.17$ ). Scope for improved prevention at older ages was considerable. Among 208 patients with incident AF-related events at age  $\geq 80$  and known prior AF, only 19 (9.1%) were anticoagulated prior to their event. Of the 189 patients not anticoagulated, 166 (87.8%) had no major disability prior to the event and 167 (88.4%) had an embolism risk score favouring treatment, of whom 139 (83.2%) were also at low risk of complications. Yet, 125/167 (74.9%) were dead or institutionalised after the event.

**Conclusion:** There had been no reduction in the incidence of AF-related vascular events since publication of the BAFTA trial.

lower hemorrhagic events (HR 0.58, 95%CI [0.63–0.92]) but was neutral in the subgroup of patients without prior stroke (HR 0.67, 95% CI [0.40–1.12]).

**Conclusions:** Anticoagulation is an effective and safe stroke prevention strategy and decreases mortality in AF patients in a real-world practice. Further studies to evaluate AF screening in stroke prevention and to determine the optimal therapy in patients at high risk of intracerebral hemorrhage would be of interest.

## ESOC-0331

## 16. AF &amp; Cardioembolism

## Population risk of stroke and mortality in incident atrial fibrillation – the Alberta experience

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**Background:** Atrial fibrillation (AF) is common and associated with increased stroke risk. Anticoagulation is an effective therapy, but fear of hemorrhagic complications leads to under treatment of AF in the community. We investigated population rates of ischemic and hemorrhagic strokes as well as mortality in newly diagnosed AF patients in the province of Alberta, Canada.

**Methods:** We used administrative data to conduct a population-based cohort study of chronic non-valvular AF. We included new-onset AF patients in 2009–2010 with follow-up through December 31 2013. We assessed anticoagulation status as a predictor on stroke and death, using time-to-event analysis and adjusted for sex and CHADS2 score using Cox proportional hazards modeling.

**Results:** Ten thousand seven hundred forty-five patients were identified. 68.5% received anticoagulation. Amongst the 747 patients with prior ischemic stroke, 28.5% were diagnosed with AF at the time of stroke. Multivariable analysis confirmed that anticoagulation is associated with significantly decreased ischemic stroke (HR 0.38, 95%CI [0.32–0.46], all stroke (HR 0.42, 95%CI [0.35–0.50]), and all stroke and death (HR 0.14, 95%CI [0.13–0.16])). Anticoagulation was associated with significantly

## Brain-Heart Interactions

ESOC-1122

### 17. Brain-Heart Interactions

#### SICFAIL – stroke induced cardiac failure in mice and men

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Cardiac diseases are known risk factors of ischemic stroke (IS). Conversely, there is increasing evidence that brain ischemia can cause cardiac dysfunction, in particular during the acute phase. In contrast, little is known about the delayed consequences of IS on cardiovascular function. We hypothesized that IS can induce long term systolic dysfunction (SD) in mice and men that might be modifiable by therapeutic interventions. In the experimental part of the study, focal cerebral ischemia will be induced in mice by middle cerebral artery occlusion (MCAO). Cardiac function will be monitored by serial echocardiography until week 8 after stroke and correlated with neurological outcomes. In addition, hemodynamic measurements, determination of sympathetic activity and biomarker studies will be performed. In the clinical part, we will estimate the prevalence of SD after IS in acute stroke patients. Furthermore the natural course of SD up to 6 months after IS will be determined.

Our initial investigations revealed that cardiac ejection fraction was significantly reduced 8 weeks after MCAO while heart blood volume, BNP- and TNF $\alpha$ -gene expression levels were elevated, thereby reflecting features of chronic SD. In the first year of the clinical study, about 250 IS patients were recruited, 89% underwent echocardiography. SD was observed in 14% during the acute phase.

Our preliminary results suggest that IS can foster the development of SD. Additional experiments in aged and comorbid mice as well as interventional studies are currently ongoing. The clinical study continues to enroll patients and the first patients already underwent follow-up examinations.

ESOC-0455

### 17. Brain-Heart Interactions

#### Contribution of a systematic cardiovascular assessment in transient global amnesia

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Transient global amnesia (TGA) is a syndrome defined by the sudden onset of an isolated anterograde and retrograde amnesia, spontaneously resolved within less than 24 hours. Its aetiological mechanisms are still open to question. The aim of this study was to describe the MRI characteristics and the vascular assessment of a prospective cohort of patients presenting with TGA at the Besançon emergency services. This analysis involved 11 prospectively included patients, with a mean age of 63 (50–76) and a sex ratio of 1:10. The TGA diagnosis was given on the basis of the clinical criteria. The parameters studied were the demographic and clinical data, the brain MRI and the vascular assessment. Seven patients had a cardiovascular risk factor. The MRI was abnormal in 10 patients. There

were hippocampal hyperintense lesions on diffusion-weighted imaging in eight patients, including one bilateral and one with an extra-hippocampal hyperintensity. Atrial fibrillation was diagnosed in two patients, leukoaraiosis in six, and carotid atheroma in three. The MRIs at 48 hours and at one month respectively showed five and two new lesions. If age, ictal onset and MRI anomalies during the TGA's acute phase are arguments in favour of a vascular mechanism, then there is no such evidence today. Despite its small population size, this study challenges the relevance of the completion of a systematic cardiovascular assessment after a TGA. It is no longer acknowledged as purely functional. It should perhaps be considered as a sign whose vascular aetiology must be urgently explored.

ESOC-1506

### 17. Brain-Heart Interactions

#### Mini mental state examination can be helpful in evidence of patients with high thromboembolic risk?

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*Aims:* To determine whether atrial fibrillation (AF) is associated with impaired cognition and to determine the correlation between thromboembolic risk and the cognitive impairment.

*Methods:* One hundred ninety patients with atrial fibrillation and no history of stroke were consecutively examined. All cases underwent physical examination, blood chemistry, ECG, echocardiography. To investigate the cognitive status, subjects underwent the neuro-psychological rating scale Mini Mental State Examination (MMSE).

*Results:* The subjects (190) (mean age 70.1  $\pm$  0.65 years; 56% Women) were stratified according to ECG features into 3 groups: (1) those with de novo AF (2.8%), (2) those with paroxysmal AF (18.4%), and (3) with chronic AF (78.9%). Cognitive status was found to be different in the 3 groups: group 1- 28.1  $\pm$  1.9; group 2-25.9  $\pm$  2.9; and group 3-24.9  $\pm$  2.9 ( $P < 0.01$ ). Thromboembolic risk (according to CHA2DS2-VASc) was similar between groups (3.1  $\pm$  0.6 in chronic AF vs. 2.9  $\pm$  0.8 in paroxysmal AF and 1.9  $\pm$  0.2 in de novo AF,  $p = 0.05$ ). There was an association between thromboembolic risk and the presence of cognitive disturbances (MMSE < 26) (8.7% low risk, 21.4 % moderate risk, and 48% high risk,  $p < 0.05$ ). Brain CT has shown lacunar changes or multiple cerebral ischemic areas in 52% of patients with cognitive disturbances. Among 56 patients with CHA2DS2-VASc score = 1 twelve of them (21.4%) have had MMSE – 26/30, with lacunar in 3/12 (25%).

*Conclusions:* Cognitive dysfunction is common in elderly patients with atrial fibrillation. The MMSE additionally to CHA2DS2-VASc identifies patients with atrial fibrillation who need oral anticoagulation and also extra efforts to maintain it effective and improve outcomes.

ESOC-0041

### 17. Brain-Heart Interactions

#### Incidence and risk factors for recurrent stroke after coronary artery bypass grafting in elderly patients

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*Objective:* Preventing stroke after CABG remains a therapeutic goal. The aim of this study was to identify incidence and risk factors for recurrent stroke in elderly CABG patients with a previous history of stroke.

**Methods:** Between October 2001 and December 2011, 418 elderly patients (age  $\geq 65$  years) with history of stroke, underwent CABG at our center and divided into two groups according to the occurrence of recurrent postoperative stroke. Pre-operative and post-operative data were retrospectively collected and analyzed by univariate and multivariate logistic regression analysis.

**Results:** Fifty-two patients (12.44%) suffered post-operative recurrent stroke. Univariate analysis identified several statistically significant risk factors in the post-operative recurrent stroke group, including on-pump surgery, post-operative AF, and hypertension. Multivariate analysis identified several independent risk factors for recurrent stroke: unstable angina (odds ratio (OR) = 2.79, 95% CI: 1.13–7.28), use of cardiopulmonary bypass, (OR = 2.77, 95% CI: 1, 35–9.62), atrial fibrillation (OR = 4.69, 95% CI: 1.89–11.63), and systemic inflammatory response (OR = 2.55, 95% CI: 1.07–6.04)

**Conclusion:** Unstable angina, use of cardiopulmonary bypass, post-operative AF and systemic inflammatory response are independent risk factors of recurrent stroke in CABG patients (age  $\geq 65$  years) with a previous history of stroke.

## ESOC-0975

### 17. Brain-Heart Interactions

#### Focus on haematological and urinary parameters to improve neurological care

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Haematological and urinary parameters are useful in monitoring clinical conditions and predict prognosis in cerebrovascular diseases. However, they reflect more the chronicity than the acuity (Fiori P. et al, 2014).

The aim of our study is to assess the predictive values and the correlations between such parameters, clinical, echocardiographic and radiological findings.

So far we recruited 264 patients affected with Acute Stroke (AS), 177 with Chronic Cerebrovascular Disease (CCVD), 59 with Other Neurological Disease (OND). We classified them in subgroups according to the severity of neurological and heart dysfunctions, evaluated by Glasgow Coma (GCS), Glasgow Outcomes (GOS), Modified Rankin (MRS), CHAD2DS2VAsc, HAS BLED, Hachinski scales, New York Heart Association (NYHA) and American Cardiology Association (ACA) scales. Moreover, within the AS group, we identified patients without or with concomitant CCVD at Computerized Tomography and/or Magnetic Resonance Imaging.

Preliminary results show higher levels of Erythrocytation Rate, C Reactive Protein, Troponin ths, NT-Pro-Brain Natriuretic Peptide, urea, creatinaemia, proteinuria, urinary polyclonal light chains, ejection fraction, pulmonary arterial pressure and left atrial dilatation in AS and CCVD, especially in patients affected with both conditions and severe cardiac dysfunctions (class III/C, IV/D). The most significant correlations were found among cardiac markers and CHAD2DS2VAsc, Hachinski and Modified Rankin scales, urinary parameters, GCS and GOS.

In conclusions, the acuity in the chronicity of brain/heart dysfunctions is an extreme challenge neurology has to win.

## ESOC-1321

### 17. Brain-Heart Interactions

#### Feasibility and diagnostic accuracy of point-of-care handheld echocardiography in ischemic stroke patients treated at an acute stroke unit

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**Background:** Guidelines recommend echocardiography for patients with suspected cardiac embolic stroke as part of diagnostic work-up. However, access to adequate echocardiography is often limited. We investigated diagnostic performance of a bedside point-of-care ultrasound device (“hand-held-echo”) compared to a state-of-the-art transthoracic echocardiography.

**Methods:** Hand-held-echo was performed at an acute stroke unit within 72 hours after ischemic stroke onset by a technician who had received an intensive structured echocardiographical training. Basic cardiac parameters were assessed focussing on left heart dimensions, wall thickness, ejection fraction (EF), major valve abnormality, and pericardial effusion. Within 48 hours of hand-held-echo, patients received a standardized transthoracic echocardiography by an experienced echo-technician as reference standard. The test performance of the results of both examinations was compared.

**Results:** Seventy-eight consecutive ischemic stroke patients were included. Investigation was performed with sufficient imaging quality and without any other problems in 83% of hand-held and 86% of standard echocardiography. Intraclass-correlation coefficient of interrater reliability between hand-held and standardized echocardiography was for: EF 0.78 (95% 0.67–0.86); septal left-ventricular wall thickness (LVWT) 0.84 (0.76–0.89); posterior LVWT 0.88 (0.81–0.92); systolic LV diameter (LVD) 0.93 (0.89–0.96); diastolic LVD 0.85 (0.77–0.90). Sensitivity of hand-held-echo for detecting an EF < 55% was 100%, specificity 84.4%, area-under-the-ROC-curve 0.98 (95%CI 0.96–1.00). One pericardial effusion was not detected by hand-held-echo. No other major differences were found between hand-held and standard echo results.

**Conclusion:** Hand-held-echocardiography was demonstrated to be a reliable screening tool for the detection of clinically relevant cardiac dysfunction in stroke patients potentially benefitting from a more detailed cardiologic examination.

## ESOC-0440

### 17. Brain-Heart Interactions

#### Relationship between insular cortex infarction and newly diagnosed atrial fibrillation

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**Introduction and objective:** Newly diagnosed atrial fibrillation (NDAF) after a cerebral infarction (CI) could be a consequence of the insular injury and not previous to the CI. Our aim was to analyse whether the insula is affected more frequently when the atrial fibrillation (AF) is diagnosed after the CI than when it is previously known.

**Methods:** Observational study of stroke patients admitted to a Stroke Centre (2010–2014). Variables: basal and clinical data, prior or newly diagnosed AF, stroke severity (NIHSS), CI with insular involvement in neuroimaging and stroke subtypes. Multivariate models were performed to evaluate the association between AF and insular involvement.

**Results:** 1004 patients were included, 58.2% male, mean age 70.65 years. The involvement of the insula was similar in patients with prior AF vs. NDAF (34.8 vs. 33.5%) and greater than in those without AF (17.6%) ( $P < 0.0001$ ). Left atrial enlargement was more frequent in patients with known AF and NDAF than in those without AF (74.6%, 60.6% and 38.6%,  $P < 0.0001$ ). Multivariate analysis showed that AF (both, known and newly) was associated with insular infarction (OR 1.472; 95% CI 1.016–2.131) as well as diabetes mellitus (OR 1.863; 95% CI 1.243–2.792), and NIHSS on admission (OR 1.121; 95% CI 1.095–1.146).

**Conclusion:** The insular involvement in patients with CI is similar in those with known and newly diagnosed AF. This suggests that NDAF is probably previous and not a consequence of CI.

## ESOC-0840

### 17. Brain-Heart Interactions

#### Frequency of left ventricular dysfunction in stroke patients and its impact on outcome

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**Background:** Severe left ventricular systolic dysfunction (LVSD) is associated with increased morbidity and mortality in ischemic stroke (IS). However, it's unknown whether the left ventricular dysfunction (LVD) including mild to moderate LVSD and left ventricular diastolic dysfunction (LVDD) could influence IS outcome. Increasing left ventricular filling pressure (LVFP) is an echocardiographic finding which is present in both types of LVD of any severity. Our objective was to analyse the frequency of LVD in IS patients and its impact on outcome.

**Methods:** Retrospective observational study. Study period: 2010–2014. Demographics, vascular risk factors, results of diagnostic tests, reperfusion treatments and outcome at 3 months (unfavourable if mRS  $> 2$ ) were prospectively collected. The results of transthoracic echocardiography (TTE) including left atrial enlargement (LAE), increasing left ventricular filling pressure (LVFP) and left ventricular ejection fraction (LVEF) were recorded. A predictive model of factors associated with unfavourable outcome was generated.

**Results:** Four hundred fifty-nine IS patients with complete LVD parameters measured by TTE were included. Mean age 67.8 years, 60.3% male. TTE showed data of LVD in up to 211 patients (46%), LVSD in 38 (8.3%) and LVDD in 191 (41.6%). Overall, 70 patients (15.2%) had mRS  $> 2$  at 3 months being increased LVFP associated with unfavourable outcome (OR 2.209, 95% CI 1.135–4.299,  $p < 0.020$ ) after adjustment for diabetes mellitus, stroke severity and in-hospital complications.

**Conclusion:** LVD is present in almost half of the ischemic stroke and it is associated with poor outcome at 3 months. Increased LVFP could be a marker of poor outcome in IS patients.

## ESOC-1159

### 17. Brain-Heart Interactions

#### Percutaneous closure of patent foramen ovale in cryptogenic cerebral ischemia: The data of the Turin Molinette Registry

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**Objective:** To describe the results of the endovascular treatment in patients affected by cryptogenic cerebral ischemic events (CCIE), Patent Foramen Ovale (PFO) and associated high risk conditions such as interatrial septal aneurysm, hypercoagulable state, multiple ischemic events, large shunt or shunt at rest.

**Patients and methods:** Two hundred six patients were studied; protocol included clinical and lab examinations, neuroimaging, duplex scanner, transthoracic (TTE) and transesophageal echocardiography (TEE). Antiplatelet agents were employed before and after closure. An Amplatzer PFO-occluder was positioned in 95% of cases. The follow up included a cardiological and neurological reevaluation at 1 and 6 months and subsequently every 6 months, a TTE at 1 month, a TEE at 6 months.

**Results:** The success rate was 100%. In the periprocedural time a transient paroxysmic atrial arrhythmia was observed in 4 pts and 1 TIA occurred; no residual large shunts or hemorrhagic events were identified. During a mean follow up of 32,6 months 9 small and 3 severe residual shunts were identified, 1 stroke and 1 TIA, 5 transient arrhythmias and an interatrial sept erosion occurred, 3 pts underwent surgery.

**Conclusions:** According to recent metanalyses (Rengifo-Moreno, Pickett, Stortecky) in our group endovascular closure of PFO proved safe and effective in the short and mid term. It seems promising the TIA-Stroke annual Recurrence Rate (RR) resulted 0,36% and the stroke annual RR 0,18%, considerably lower than reported in previous literature. (Mas 4,8 and 3,8%, Nedeltchev 9,9% CCIE, Anzola 8,2% CCIE, Almekhlafi 4 and 1,6%, the FORI Study 4,2 and 3,4%, Furlan 3%).

## ESOC-0945

### 17. Brain-Heart Interactions

#### Vascular risk factors as predictors of pathological biomarkers in cerebrospinal fluid 1 year post-stroke

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**Background:** Post-stroke cognitive impairments may be related to vascular, degenerative or mixed disease. Pathological values of total-tau, phosphorylated-tau and  $\beta$ -amyloid in the cerebrospinal fluid (CSF) indicate neurodegenerative disease mechanisms. Vascular factors are thought to contribute to vascular dementia, and in the cascade of degenerative pathology. We aimed to evaluate if vascular risk factors present at onset of stroke symptoms predict pathological CSF biomarkers one year post-stroke, adjusted for possible effects of genetic risk and stroke severity.

**Method:** We included patients with first-ever stroke and TIA. Baseline examination included assessment of exposure to vascular risk factors (hypertension, hyperlipidemia, diabetes, body mass index, smoking and atrial fibrillation). After 12 months, biomarkers in CSF were assessed. The main outcome was pathological biomarkers, defined as pathological values in one or more of the CSF-biomarkers. The association between vascular risk, age, gender, education, stroke severity and Apolipoprotein E4 (ApoE4) and the outcome was studied using logistic regression.

**Results:** One hundred ninety-eight patients completed the follow-up. 56 had a lumbar puncture. In the univariate analyses, age ( $p = 0.018$ ) and ApoE4 ( $p = 0.044$ ) were significantly associated with pathological biomarkers, but in the multivariate analyses, there were no significant associations between the risk factors and the outcome ( $p = 0.061$ – $0.147$ ).

**Discussion:** One year post-stroke, there was no association between vascular risk factors and pathological biomarkers in CSF. We could not confirm the hypothesis that vascular risk factors are related to neurodegenerative processes with pathology in CSF after stroke.

## ESOC-1164

### 17. Brain-Heart Interactions

#### Left ventricular hypertrophy is associated with cerebral white matter hyperintensity in patients with acute ischemic stroke and transient cerebral ischemic attack

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**Objectives:** We aim to investigate whether WMHs on MRI are independently associated with LVH in patients with acute ischemic stroke or transient cerebral ischemic attack (TIA).

**Methods:** We included consecutive acute ischemic stroke or TIA patients who were admitted within 7 days after onset of symptoms and underwent MRI and transthoracic echocardiography (TTE). LVH was defined as a left ventricular mass index (LVMI) on TTE of  $>115$  g/m<sup>2</sup> for men and  $>95$  g/m<sup>2</sup> for women. WMHs were rated according to the modified Fazekas scale (grade 0, 1, 2, and 3) on the baseline MRI.

**Results:** A total of 841 patients was analyzed. LVH and 4th quartile of LVMI were associated with grade 2 (OR 2.3, 95% CI 1.1 to 5.0 and OR 3.2, 95% CI 1.4 to 7.2) and grade 3 (OR 2.5, 95% CI 1.1 to 5.9 and OR 2.7, 95% CI 1.1 to 6.6). Binary logistic regression analysis (WMH grade 0–1 versus grade 2–3) showed that age per year (OR 1.09, 95% CI 1.07 to 1.12,  $p < 0.001$ ), hypertension (OR 1.8, 95% CI 1.2 to 2.7,  $p = 0.004$ ), previous stroke or TIA history (OR 2.3, 95% CI 1.5 to 3.4,  $p < 0.001$ ) and increased LVMI per 10 g/m<sup>2</sup> (OR 1.15; 95% CI 1.06 to 1.24,  $p < 0.001$ ) were independently associated with grade 2–3 WMH.

**Conclusions:** These findings demonstrate that higher LVMI or LVH are independently associated with moderate to severe WMHs in acute ischemic stroke and TIA patients regardless of the presence of established cardiovascular risk factors.

## ESOC-0966

### 17. Brain-Heart Interactions

#### Comparison of risk factors for stroke subtypes versus acute coronary syndrome: A population-based study

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**Background:** Stroke and acute coronary syndromes (ACS) share risk factors, but population-based data on differential associations with stroke subtype and ACS are limited. We studied pre-morbid risk factors in stroke subtypes and acute coronary syndrome.

**Methods:** We studied all first-ever TIA/strokes and ACS from 2002–2012 in a population-based cohort (Oxford Vascular Study). Risk associations were compared by logistic regression, adjusted for age and sex, for hypertension, diabetes mellitus, hyperlipidaemia, atrial fibrillation, current smoking and over-weight (BMI  $> 25$ ).

**Results:** One thousand nine hundred thirteen TIA/ischaemic strokes (mean age 71.6 years, women 53.9%), 112 intracerebral haemorrhages

(ICH) (mean age 71.0 years, 51.8% women) and 1191 ACS (mean age 71.35 years, 35.4% women) were studied. Compared to ACS, hypertension (adjusted OR = 1.34, 95%CI = 1.15–1.56,  $p < 0.001$ ), hyperlipidaemia (1.27, 1.07–1.50,  $p = 0.006$ ) and atrial fibrillation (1.40, 1.12–1.76,  $p = 0.004$ ) were more strongly associated with TIA/ischemic stroke than with ACS. However diabetes mellitus (0.71, 0.57–0.88,  $p = 0.002$ ), current smoking (0.62, 0.51–0.75,  $p < 0.001$ ) and over-weight (0.78, 0.65–0.93,  $p = 0.007$ ) were negatively associated with TIA/ischemic stroke compared with ACS. For ICH, hypertension (1.85, 1.22–2.81,  $p = 0.004$ ) was more strongly associated than with ACS, whereas hyperlipidaemia (0.56, 0.32–0.97,  $p = 0.039$ ), current smoking (0.40, 0.21–0.74,  $p = 0.004$ ) and over-weight (0.64, 0.42–0.99,  $p = 0.045$ ) were negatively associated. When ICH was compared with TIA/ischemic stroke, the negative associations with hyperlipidaemia (0.43, 0.25–0.74,  $p = 0.002$ ) remained. Results were unchanged after exclusion of TIA.

**Conclusions:** Diabetes mellitus, current smoking and obesity are more strongly associated with ACS than with stroke, whereas hypertension is a stronger risk factor for ischaemic and haemorrhagic stroke. Hyperlipidaemia is negatively associated with ICH.

## ESOC-1531

### 17. Brain-Heart Interactions

#### Baroreflex predicts prognosis in aneurysmal subarachnoid hemorrhage

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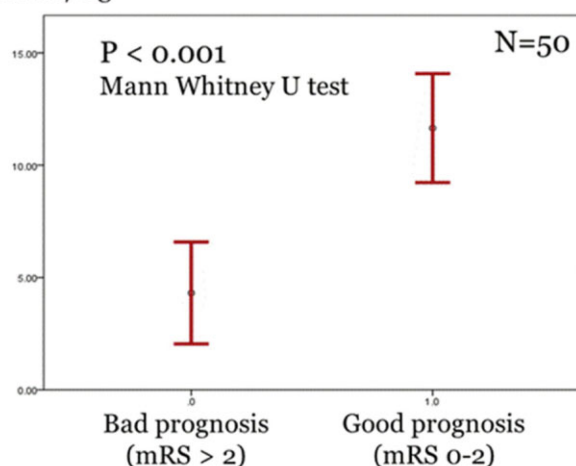
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**Background:** Aneurysmal subarachnoid hemorrhage (SAH) is characterized by a strong activation of the sympathetic system. The baroreflex is a key parameter of the cardiovascular autonomic nervous system. Its prognostic role in SAH is not known. In this study, we assessed the prognostic value at 3 months of the baroreflex measured at the acute phase of SAH. **Methods:** We assessed data prospectively collected in 50 patients hospitalized for acute SAH. Baroreflex sensitivity (BRS, in ms/mmHg) was measured in time-domain, using the cross-correlation method, during the 7 days that followed SAH. Bad prognosis was defined as a modified Rankin scale (mRS) above 2 at 3 months.

**Results:** Median age was 60.5 (36 to 81); F/M: 36/14. Median WFNS grade was 2 (1 to 5). Initial BRS, mean BRS and lowest BRS during the 7 days following SAH were correlated with bad prognosis ( $P = 0.001$ ;  $P < 0.001$ ;  $P < 0.001$ , Mann-Whitney U test). Lowest BRS during the first 7 days was associated with bad prognosis independently of age, WFNS and Fisher grades ( $P = 0.015$ ).



BRS mm/Hg



**Conclusion:** BRS impairment, more specifically the “nadir” of BRS (lowest BRS) at the acute phase of SAH, was associated with bad prognosis at 3 months.

The “nadir” of BRS may be jointly affected by: 1) poor prior cardiovascular health, 2) the severity of SAH and 3) the capacity of the patient to thrive against early complications.

These data point to baroreflex as a potential therapeutic target in SAH. They first need to be confirmed in a multicenter study.

## ESOC-0021

### 17. Brain-Heart Interactions

#### Study of hemomicrocirculatory bed among newborns with congenital heart anomalies

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The aim of the research was pathomorphological investigation of changes of the hemomicrocirculatory bed of the heart in newborns dying within the first 7 days of postnatal life from congenital heart disease.

Within the framework of research the dissection material (autopsy) of 48 infants was studied who had died in the neonatal period from congenital heart anomalies. The control group included the archive dissection material of 20 infants who died from other causes.

It was revealed that the newborns with congenital heart anomalies have deficiency of true capillaries in the hemomicrocirculatory system. This deficiency is observed in all newborns that died from congenital heart anomalies, but mostly was found in the premature newborns with the same anomalies. Pathology of development of microcirculatory system is determined not only by reducing the activity, and then blocking formation of new portion of terminal part of vascular system, but also by collapse, progressive reduction and sclerosis of already developed microvessels. There was also morphological (dystrophic, atrophic and sclerotic) alteration of myocardium.

## ESOC-0391

### 17. Brain-Heart Interactions

#### Coronary angiographic findings in ischemic stroke patients with elevated cardiac troponin

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**Background:** Frequency of coronary causes of elevated cardiac troponins (cTn) in patients presenting with acute ischemic stroke (AIS) is unknown. The aim of our study was to analyze coronary vessel status in AIS patients with elevated cTn compared to patients presenting with Non-ST-elevation acute coronary syndrome (NSTEMI-ACS).

**Methods:** Consecutive AIS patients at two tertiary hospitals were prospectively screened for cTn elevation (>50 ng/l, high-sensitivity cTnT). The primary outcome was presence of coronary culprit lesions indicating instable coronary artery disease (CAD). Age- and gender-matched patients presenting with NSTEMI-ACS served as a control. Diagnostic coronary angiograms were analyzed independently by two interventional cardiologists blinded for clinical data and diagnoses.

**Results:** A total of 29 AIS patients (median age 76 [interquartile range, IQR 70–82], 51.7% male) underwent coronary angiography within a median of 48 h after hospital admission (IQR 28–71 h). Median cTn on presentation was not significantly different in patients with AIS or NSTEMI-ACS (95 ng/l versus 94 ng/l,  $p = 0.70$ ). Compared to patients with NSTEMI-ACS, AIS patients were less likely to have instable coronary lesions (24.1% versus 79.3%,  $p < 0.001$ ) or to have evidence of any obstructive CAD (51.7% versus 86.2%,  $p = 0.01$ , median number of vessels diseased 1 [IQR 0–2] versus 2 [IQR 1–3],  $p < 0.01$ ). Presence of tako-tsubo cardiomyopathy on LV angiography was not different between the two groups (6.9% versus 6.9%,  $p = 1.0$ ).

**Conclusions:** Coronary causes of cTn elevation in AIS patients are present in approximately one out of four patients. In the majority of patients, alternative causes (i.e. demand ischemia or non-coronary causes) should be considered.

## ESOC-0518

### 17. Brain-Heart Interactions

#### Elevated troponin levels in acute stroke patients predict long-term mortality

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**Background:** Elevated plasma levels of troponin in acute stroke patients are common and have in several studies been shown to predict in-hospital and short-term mortality. Little is, however, known about the long-term prognosis of these patients. The aim of this study was to determine patient characteristics and five-year mortality in patients with acute stroke and troponin elevation on admission.

**Methods:** A retrospective cohort study of all consecutive patients with acute stroke and a plasma troponin I (TnI) analyzed on admission to Danderyd Hospital between January 1, 2005, and January 1, 2006 ( $n = 247$ ). Patient characteristics were obtained from the Swedish national stroke register, Riks-Stroke, as well as hospital records. Mortality data was obtained from the Swedish Cause of Death Register.

**Results:** There were 133 patients (54%) with TnI < 0.03 µg/L (normal), 74 patients (30%) with TnI 0.03–0.11 µg/L (low elevation) and 40 patients (16%) with TnI > 0.11 µg/L (high elevation). TnI elevations were associated with a higher age, prior ischemic stroke, chronic heart failure, renal insufficiency, stroke severity and ST segment elevation or depression on admission. The rate of hyperlipidemia decreased with increasing TnI. Adjusted for age and comorbidity, elevated TnI values on admission had a significantly and sustained increased mortality over the five-year follow-up, with a HR of 1.90 (95% CI 1.33–2.70).

**Conclusion:** Troponin elevation in patients with acute stroke, even when adjusted for several possible confounders, is associated with an almost twofold increased risk of five-year mortality.

## ESOC-1085

### 17. Brain-Heart Interactions Functional outcome of out-of-hospital cardiac arrest survivors. Data from the prospective FINNRESUSCI study

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**Purpose:** To study the one-year functional outcome of out-of-hospital cardiac arrest (OHCA) survivors treated in Finnish ICUs.

**Methods:** All OHCA patients treated in 21 Finnish ICUs between March 2010 and February 2011 were followed. Patients alive one year after the cardiac arrest were contacted by phone. A structured interview performed by trained neurologist included assessment of Barthel Index, questions about activities of daily living (ADL), accommodation, help received from family members or health care personnel, rehabilitation, occupation and return to work, car driving and self-experienced cognitive deficits. Additionally patients received EQ-5D and Extended ADL query forms by mail, to evaluate the self-assessed quality of life and ADL-functions.

**Results:** FINNRESUSCI cohort included 504 unconscious cardiac arrest patients. Of 213 one-year survivors, 206 (96.7%) could be contacted. Mean age of the survivors was 60 years, and 79% were male. Good outcome, defined as Cerebral Performance Categories 1 or 2, had been reached by 90.3% of survivors. Median Barthel Index score was 100 (IQR 100–100), and 91.3% of survivors were independent in ADL-functions. The great majority of survivors had been able to return to their home, and only 8.7% lived in a sheltered home or needed institutionalized care. 23.8% of survivors lived alone. Of those working before the CA, 72.6% had returned to work. 74.8% of survivors had not noticed any permanent cognitive deficits. Median EQ-5D VAS was 80 (IQR 70–90).

**Conclusions:** In this nationwide cohort study the functional outcome of OHCA one-year survivors was good in over 90% of patients.

## ESOC-1469

### 17. Brain-Heart Interactions Prognostic timing and testing after cardiac arrest (CA) and return of spontaneous circulation (ROSC) in patients with eventual withdrawal of life support (WOLS)

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**Introduction:** Guidelines regarding neurologic prognosis after CA suggest delaying testing to 72 hours or later and that multimodal testing (physical exam (PE) plus ancillary tests) should be performed.

**Methods/results:** Adults with out-of-hospital CA were randomized in 2007–2012 to standard care with or without prehospital cooling with IV 4°C normal saline following ROSC; the main trial results were neutral. There was no standardized protocol for establishing neurologic prognosis. Possible ancillary tests included EEG, SSEPs, MRI and CSF creatine kinase BB isoenzyme (CKBB) levels. In 908 patients, mean age was 65, 38% were female, 42% had initial ventricular fibrillation, and 34% mild or no neurologic impairment at hospital discharge. Overall, 331 patients (36%) had WOLS, a subgroup where prognostic patience, and testing, should be maximized. In this WOLS subgroup, at least 46% of patients had their last documented PE at < 72 hours from ROSC; EEG was done in 39%, SSEPs 16%, MRI 11% and CKBB 8%. At least 1 ancillary test was done in 44% of WOLS patients. Documentation described PE findings were a factor in the WOLS decision in 59%, and ancillary testing was a factor in 26%; overall, documentation of any factors in the WOLS decision was present in 73%.

**Conclusions:** In this cohort with ROSC after CA, almost half of patients with WOLS had prognostic decisions made prior to 72 hours and less than half had any ancillary prognostic testing. These findings may suggest the need for professional education on guideline based best practices for neurologic prognostication.

## ICH and IVH

ESOC-0686

### 18. ICH and IVH

#### Can baseline imaging identify patients likely to need subsequent external ventricular drainage after spontaneous intracerebral haemorrhage?

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**Introduction:** ICH may be complicated by hydrocephalus requiring external ventricular drain (EVD) placement. Reliable identification of acute patients at high risk of developing subsequent hydrocephalus may help divert limited neurosurgical resources towards such patients.

**Aim:** Identify baseline clinical and imaging factors predictive of subsequent need for EVD in acute ICH patients.

**Methods:** We identified all ICH patients referred to our regional neurosurgical centre between January 2008 and October 2010 who underwent EVD insertion and/or repeat brain imaging. Baseline GCS, ICH location, ICH volume, modified Graeb score, Evans index, Hemphill score and midline shift were derived. Primary outcome was a composite of EVD insertion and/or 'EVD indicated', based on blinded review of repeat imaging by an experienced Neurosurgeon. Logistic regression was used to calculate areas under receiver operating characteristic curves (AuROC).

**Results:** One hundred ninety-nine patients were included in the final analysis. 44 (22.1%) patients had the primary outcome of EVD inserted/indicated. GCS (AUROC 0.798, 95% CI 0.721–0.874), modified Graeb score (0.732, 0.637–0.826), Evans index (0.656, 0.562–0.750), Hemphill score (0.749, 0.673–0.825) and midline shift (0.714, 0.621–0.807) were predictive of the primary outcome. ICH location (0.565, 0.466–0.668) and volume (0.672, 0.585–0.759) were less predictive. A multifactorial model including GCS, modified Graeb score and midline shift was most predictive of the primary outcome (0.848, 0.779–0.917).

**Conclusion:** Patients likely to require an EVD after ICH may be objectively identified by combining GCS, midline shift and modified Graeb score but this requires validation in a large, unselected, prospective cohort of ICH patients.

ESOC-0784

### 18. ICH and IVH

#### Controversies in treatment of anticoagulation associated intracerebral haemorrhage

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**Introduction and background:** Use of anticoagulant therapy increases the risk of developing ICH by 7 to 10-fold, and anticoagulation-associated ICH(AAICH) accounts for up to 19% of all ICH patients. On the background of variable guidelines and no consensus treatment, we at our Hospital want to know the outcomes compared to others even if our management guidelines may slightly differ from others.

**Methodology:** Patients' data who were admitted with anticoagulant associated ICH (AAICH) were retrospectively collected from SSNAP database from 01/01/2014 to 19/09/2014. There were total 8 cases of AAICH out of 62 ICH cases.

**Conclusions and results:** All our patients with Anticoagulation associated Intracerebral haemorrhage were treated with Fresh Frozen Plasma and Vitamin K as per our trust guidelines.

1. Mortality was significantly higher in these patients compared to patients with spontaneous Intracerebral haemorrhage (30 day stroke mortality was 37.5%) against 43–62% nationally.

2. Although we have started using newer anticoagulants as first line treatment for secondary prevention of stroke since 2013, none of these patients were on newer anticoagulants. Should this be the standard now?

3. Measuring second INR following FFP was not done because of no clinical implication against few guidelines.

4. Although one patient had thrombocytopenia, we did not give platelet transfusions nor Desmopressin (DDAVP) as a part of treatment.

5. We did not use either Prothrombin complex concentrates (PCC) or rFVIIa as a part of treatment although some guidelines seem to suggest that these may be useful.

ESOC-1251

### 18. ICH and IVH

#### Anticoagulation associated intracerebral bleeding – what does influence the outcome?

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**Background:** Vitamin K antagonist (VKA)-associated intracranial haemorrhage (ICH) exhibits higher risk of hematoma expansion and larger hematoma volumes and is commonly related to worse outcome than spontaneous ICH1. Prothrombin complex concentrates (PCCs) and Fresh Frozen plasma (FFP) are indicated for urgent reversal of anticoagulation after VKA-associated ICH, however in the absence of randomized controlled trials strong evidence is lacking with regards to the timing, efficacy, and ways of normalizing coagulation in these patients2.

**Methods:** We conducted a retrospective study of patients treated with FFP for VKA-associated ICH at our hospital from 01/01/2014 to 19/09/2014. Primary outcomes included INR correction, modified Rankin scale scoring at discharge and in-hospital mortality.

**Results and conclusions:** INR was corrected with help of Vit K and FFP in 100% patients within 6 hours, mRs was greater than 3 in all but one patient and mortality was 37.5%. The reversal of anticoagulation after VKA-associated ICH along with time taken for effective INR correction and standard treatment have no influence on clinical outcome.

## ESOC-0031

## 18. ICH and IVH

## The phases score for prediction of intracranial aneurysm growth

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**Background and purpose:** Growth of an intracranial aneurysm occurs in around 10% of patients at 2-year follow-up imaging and may be associated with aneurysm rupture. We investigated whether PHASES, a score providing absolute risks of aneurysm rupture based on six easily retrievable risk factors also predicts aneurysm growth.

**Methods:** In a multicenter cohort of patients with unruptured intracranial aneurysms and follow-up imaging with computed tomography angiography or magnetic resonance angiography, we performed univariable and multivariable Cox regression analysis for the predictors of the PHASES score, with aneurysm growth as outcome. We calculated hazard ratios (HR) and corresponding 95% confidence intervals (CI), with the PHASES score as continuous variable and after division into quartiles.

**Results:** We included 557 patients with 734 unruptured aneurysms. Eighty-nine (12%) aneurysms in 87 patients showed growth during a median follow-up of 2.7 patient-years (range 0.5–10.8). Per point increase in PHASES score HR for aneurysm growth was 1.32 (95% CI: 1.22–1.43). With the lowest quartile of the PHASES score (0–1) as reference, HRs were for the second [PHASES 2–3] 1.07 (95% CI: 0.49–2.32), the third [PHASES 4] 2.29 (95% CI: 1.05–4.95), and the fourth quartile [PHASES 5–14] 2.85 (95% CI: 1.43–5.67).

**Conclusions:** Since higher PHASES scores were associated with an increased risk of aneurysm growth, our findings show that aneurysm growth can be used as surrogate outcome measure of aneurysm rupture in follow-up studies on risk prediction or interventions aimed to reduce the risk of rupture.

## ESOC-0462

## 18. ICH and IVH

## Association between diabetes mellitus and risk of spontaneous (non-traumatic) intracerebral haemorrhage (ICH): Systematic review and meta-analysis

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**Background:** Whether diabetes mellitus (DM) is a risk factor for the development of spontaneous intracerebral haemorrhage (ICH) remains unclear. We performed a systematic review to investigate this possible association.

**Methods:** We registered our protocol (PROSPERO CRD42014015039). One reviewer searched OVID Medline and Embase 1980–2014 inclusive for case-control or cohort studies investigating the association between DM and the incidence of first-ever, spontaneous, primary ICH at any age. Two reviewers independently confirmed each study's eligibility, characterised its methods to assess risk of bias, and extracted data to calculate the relative risk (RR) in cohort studies or odds ratio (OR) in case-control studies.

**Results:** We analysed summary data from 18 case-control studies (15 hospital-based, 3 population-based, 696 cases and 5,439 controls) and found that DM was associated with ICH in all studies (crude OR 1.35, 95% CI 1.02 to 1.79; I-squared 62%) and in studies that controlled for age and sex (crude OR 1.94, 95% CI 1.16 to 3.26; I-squared 65%). There was no difference in the association in hospital-based (OR 1.31, 95% CI 0.95 to 1.81) and population-based studies (OR 1.57, 95% CI 0.96 to 2.58). We did not find an association in 5 population-based cohort studies in which ICH occurred in 80 (1.65%) of 4,837 diabetic and 786 (0.87%) of 90,539 non-diabetic patients during un-quantified periods of follow-up (crude RR 1.35, 95% CI 0.74 to 2.47; I-squared 81%).

**Conclusion:** DM may be a risk factor for ICH, but further large, population-based studies that adequately control for major confounders are needed.

## ESOC-0560

## 18. ICH and IVH

## Clinicoradiological pattern of convexal subarachnoid hemorrhage: Differences between cerebral amyloid angiopathy and other causes

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**Background:** Cerebral amyloid angiopathy (CAA) is a common cause of convexal subarachnoid hemorrhage (cSAH) specially in the elderly. The aim of this study was to compare the pattern of cSAH related to CAA and other causes.

**Methods:** Retrospective review of clinical and radiological data of consecutive patients admitted in our institution with a cSAH revealed by neurological symptoms.

**Results:** Sixty-two patients (37 women; mean age 66.2 ± 14.1 years) were included. CAA accounted for 50%. The main other etiologies were reversible vasoconstriction syndrome (13%), endocarditis (11%), and severe intracranial or cervical arterial stenoses (8%). CAA patients were older (mean age: 74 vs 58 years; p = 0.02) and presented essentially with transient focal neurological episodes (TFNE) (80.6 vs 19.3%; p < 0.001) without headache (18% vs 58%; p = 0.002). CAA-related cSAH was strongly associated with superficial siderosis (SS) (77 vs 0%; p < 0.001) and cortical microbleeds (63 vs 9%; p < 0.001). Follow up data were available in 55 patients (88.7%). New subarachnoid bleedings in CAA vs other causes occurred in 68% vs 13% (p < 0.001). Among 39 patients with MRI follow-up, evolution from acute cSAH to SS was observed in 91.7% of CAA patients and 66.7% of patients with other origins (p = 0.08).

**Conclusions:** CAA-related cSAH has a specific pattern defined by TFNE, high risk of recurrence and superficial siderosis. However, evolution from cSAH to SS does not seem specific of CAA.

## ESOC-1508

## 18. ICH and IVH

**A prospective study of intracerebral haemorrhage over a 12 year period**M Cooney<sup>1</sup>, S O'Callaghan<sup>1</sup>, I Noone<sup>1</sup>, S O'Kelly<sup>1</sup>, M Crowe<sup>1</sup><sup>1</sup>Medicine for the Elderly, St. Vincent's University Hospital, Dublin, Ireland

**Background:** Intracerebral haemorrhage (ICH) typically accounts a minority of strokes. However, a high case fatality rate means that ICH accounts for a substantially higher proportion of stroke deaths. This underscores the need for continued monitoring of trends in ICH incidence rates and associated factors.

**Methods:** St Vincent's University hospital is a tertiary referral hospital serving a population of 300,000 in Dublin, Ireland. All stroke patients are reviewed by the stroke team prospectively. We analysed the percentages of all strokes accounted for by intracerebral haemorrhage across three time periods from 2003 to 2014, subdivided by age group. We excluded ICH associated with trauma or other secondary causes. Fisher's exact test was used to assess for significant differences between percentages.

**Results:** Three thousand five hundred forty-seven stroke patients presented between 2003 and 2014; 11.1% (394) were due to ICH. The percentage of strokes accounted for by ICH increased from 9% in 2002–2006 to 11% in 2007–2010 to 12% in 2010–2014,  $p = 0.019$ . We also noted a 2.5 fold increase in the number of all strokes accounted for by ICH in the group aged 80 and over,  $p = 0.016$ . In parallel with this, anticoagulant use increased, particularly in the older age group, with an increase from 10% in 2003–2006 to 24% in 2010–2014 in those 85 years and over.

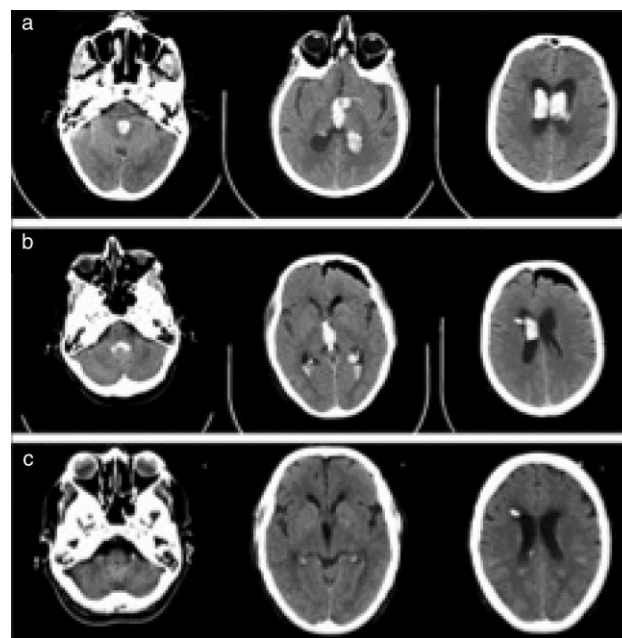
**Conclusion:** Intracerebral haemorrhage rates have increased over this 12 year period. Possible explanations include the aging population and increased use of antithrombotic and statin therapy. Examination of haemorrhage location and medication usage may advance our understanding of these relationships further.

## ESOC-0926

## 18. ICH and IVH

**Treatment of spontaneous intraventricular hemorrhage with endoscope-assisted aspiration and intraventricular tpa – early experience**J Fraser<sup>1</sup>, S Grupke<sup>1</sup><sup>1</sup>Neurological Surgery, University of Kentucky, Lexington, USA

Spontaneous intraventricular hemorrhage (IVH) as a result of hypertensive hemorrhagic stroke can cause neurologic deficits as a result of local mass effect and obstruction of normal cerebral spinal fluid (CSF) circulation. Patients frequently require permanent diversion of CSF with shunting. Current neurosurgical literature does not support treatment of deep-seated hemorrhage with open surgery. The Apollo™ System (Penumbra Inc, California USA) is a recently FDA-approved tool that allows for minimally invasive aspiration of intracerebral hematomas through a small craniotomy using an endoscope-assisted and neuronavigation-guided aspiration and irrigation probe. We describe our early experience with this device, noting technical considerations for evacuation of intraventricular hemorrhage. We also describe, our concomitant use of the procedure followed by a single dose of intraventricular t-PA to clear completely casted ventricular systems. Our early experience supports such intervention, as none of our patients required permanent CSF diversion with shunting compared to the high rate reported in the literature.



**Fig. 1** Representative CT images through the 4th, 3rd, and lateral ventricles of a patient treated with the Apollo System. Preoperative (a), 12-hours post-aspiration (b), and 12-hour post t-PA (c) images are shown.

## ESOC-0144

## 18. ICH and IVH

**Spontaneous isolated convexity subarachnoid hemorrhage: A report of 3 cases associated with cerebral amyloid angiopathy**D García-Estévez<sup>1</sup>, R García-Dorrego<sup>2</sup>, B Nieto-Baltar<sup>3</sup>,M Marey-Garrido<sup>2</sup>, T Hierro-Torner<sup>2</sup><sup>1</sup>Neurology Unit, Hospital Comarcal de Monforte de Lemos, Monforte de Lemos, Spain<sup>2</sup>Radiology Service, Hospital Comarcal de Monforte de Lemos, Monforte de Lemos, Spain<sup>3</sup>Radiology Service, Complejo Hospitalario Universitario de Vigo, Vigo, Spain

**Introduction:** Isolated, non-traumatic, convexity subarachnoid hemorrhage (cSAH) is a rare type of nonaneurysmal SAH characterized by blood collections in one or a few cortical sulci at the convexity of the brain. Etiology depends on age, so in patients under 60-years-old is associated with a reversible vasoconstriction syndrome, while in older patients the main cause of the bleeding is due to cerebral amyloid angiopathy (CAA). We report a clinical series of 3 patients with cSAH associated with probably CAA.

**Cases:** The age and sex of the patients were: 67 years-old man, 79 years-old man and 72 years-old woman. All patients had recurrent tingling paresthesias (cheiro-oral symptoms) and two had dysarthria and one had motor dysphasia. Nobody had headache or clinical dementia.

**Results:** Brain CT scan detected acute cSAH as an isolated hyperintensity intrasulcal of the frontal brain convexity and brain gradient echo T2-weighted sequences MRI showed meningeal hemosiderosis and microbleeds. However, no atrophy was identified in medial temporal lobes including the hippocampal formation. Sacular aneurysm were ruled out with a MR angiography. All patients had low levels of beta-amyloid peptide in their CSF (287 pg/mL, 466 pg/mL and 358 pg/mL, respectively) and high level of phosphorylated-Tau protein (104 pg/mL, 73 pg/mL and 95 pg/mL, respectively). The APO-E status was: E2/E3, E3/E4 and E3/E3, respectively. The outcome of the patients was good after treating them with prednisone and levetiracetam.

**Conclusions:** In our series, cSAH associated with CAA was characterized by focal sensory seizures, but both headache and dementia were not clinical features.

## ESOC-1565

### 18. ICH and IVH

#### Decompressive hemicraniectomy for supratentorial spontaneous intracerebral hemorrhage: A retrospective case-control study using propensity score matching

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**Background:** Spontaneous intracerebral hemorrhage (ICH) contributes disproportionately to stroke mortality. Retrospective studies suggest that decompressive hemicraniectomy (HC) in ICH patients is safe but evidence of efficacy is lacking without a control population. We hypothesized that HC would be associated with improved outcomes compared to no HC by performing a propensity score analysis.

**Methods:** HC patients were identified from the University of Texas-Houston's prospectively collected stroke registry from 2011–2014; concurrent control ICH patients were identified from the multi-center, prospective, Ethnic/Racial Variations of Intracerebral Hemorrhage study. Exclusion criteria included infratentorial ICH, secondary cause of ICH, and care directed toward comfort measures. A propensity score model consisting of ICH volume, age, antiplatelet use, and GCS was combined with race, sex, and ICH location to perform 3:1 matching. Primary outcomes were in-hospital mortality and poor outcome defined as modified Rankin scale  $\geq 5$  at 3 months.

**Results:** We identified 38 cases with ICH and HC and matched by propensity score variables to 114 control cases of ICH. In-hospital mortality was 31.6% vs 15.8% for controls and cases, respectively ( $p = 0.06$ ); 55.3% of controls compared to 34.2% of cases had poor outcome at 3 months ( $p = 0.02$ ). Additional analysis is on-going and final results will be reported.

**Conclusion:** HC showed a benefit on poor outcome at 3 months and a trend towards improved in-hospital mortality. Although retrospective in nature, this study represents the largest case-control study of HC in ICH patients to date and provides the foundation for a clinical trial of HC in ICH.

## ESOC-0531

### 18. ICH and IVH

#### Outcome after intracranial haemorrhage from dural arteriovenous fistulae: A systematic review and case-series

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**Background:** Dural arteriovenous fistulae (DAVFs) are a rare cause of intracranial haemorrhage. We aimed to investigate outcome of patients with intracranial haemorrhage from a DAVF.

**Methods:** We performed a systematic literature search in PubMed and Embase for studies reporting outcome after intracranial haemorrhage caused by a DAVF. We used predefined selection criteria and assessed the quality of the studies. In addition, we studied outcome in all patients with DAVF who had presented with intracranial haemorrhage at two university centers in the Netherlands, between January 2007 and April 2012. We calculated case-fatality and proportions of patients with poor outcome (defined as modified Rankin Scale  $\geq 3$  or Glasgow Outcome Scale  $\leq 3$ ) during follow-up with 95% confidence intervals (CIs). We investigated mean age, sex and mid-year of study as determinants of case-fatality and poor outcome.

**Results:** The literature search yielded 12 studies, all but one retrospective and all hospital-based. Combined with our cohort of 29 patients the total number of patients with DAVF related intracranial haemorrhage was 236 (55% intraparenchymal haemorrhage). At a median follow-up of 10 months case-fatality was 6.0% (95%CI:3.4–9.7; 13 cohorts) and the proportion of patients with poor outcome 7.4% (95% CI: 2.0–15.9; 8 cohorts). We found no effect of mean age, sex or mid-year of the cohorts on either outcome measure.

**Conclusions:** Hospital based case-series suggest a relatively low risk of death and poor outcome in patients with intracranial haemorrhage due to rupture of a DAVF. These risks may be underestimated because of bias.

## ESOC-0454

### 18. ICH and IVH

#### An analysis of cerebral amyloid angiopathy by the Boston Criteria in the Ethnic/Racial Variations of Intracerebral Hemorrhage (ERICH) cohort

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**Background:** Cerebral amyloid angiopathy (CAA) is known to cause lobar intracerebral hemorrhages (ICH) in older adults. We examined risk factors and imaging characteristics of ERICH cases with and without CAA defined by the Boston Criteria.

**Methods:** ERICH is a multi-center, prospective, case-control study of ICH. At least every 5th ICH case enrolled undergoes a baseline MRI per study design.

**Results:** Of 636 patients with MRI data, 407 (64.0%) were age  $\geq 55$ . Of these, 9.6% met criteria for probable CAA and 20.6% met criteria for possible CAA. The frequency of CAA varied by race/ethnicity (Table). Patients with possible/probable CAA were older, had less hypertension, larger hemorrhage volumes, and greater rates of superficial siderosis. Microbleeds were more common in probable CAA cases.

	No CAA n = 284	Possible CAA n = 84	Probable CAA n = 39	p value
Mean Age (SD)	66.4(9.6)	71.1(9.5)	70.2(10.3)	<0.0001
Race/Ethnicity				0.026
White	60.8%	27.5%	11.8%	
Black	77.8%	13.9%	8.3%	
Hispanic	71.8%	20.0%	8.2%	
Hypertension	84.9%	72.6%	79.5%	0.023
Mean ICH Volume (SD)	11.7 (14.5)	26.1 (22.8)	27.1 (27.9)	<0.0001
Presence of Microbleeds	62.7%	0%*	79.5%	<0.0001†
Superficial Siderosis	4.6%	8.3%	20.5%	<0.0001

\*Defined by Boston Criteria

†Probable vs. no CAA

**Conclusions:** Previously, CAA had been considered an infrequent cause of spontaneous ICH. Our study finds that 1/3 of spontaneous ICH cases age  $\geq 55$  meet Boston Criteria for possible/probable CAA. Superficial siderosis was 4x more common in probable vs. no CAA. The higher proportion of possible/probable CAA among whites with ICH may reflect a higher frequency of hypertensive hemorrhage in minority populations.

## ESOC-0046

### 18. ICH and IVH

#### Predictors of early mortality in young adults after intracerebral hemorrhage

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**Background and Purpose:** Patient and radiological characteristics of intracerebral hemorrhage (ICH), surgical treatment, and outcome after ICH are interrelated. Our purpose was to define whether these characteristics, or surgical treatment correlate with mortality among young adults.

**Methods:** We retrospectively reviewed clinical and imaging data of all first-ever non-traumatic ICH patients between 16 and 49 years of age treated in our hospital between January 2000 and March 2010, and linked these data with national causes-of-death registry. A logistic regression analysis of factors associated with 3-month mortality, and a propensity score comparison between patients treated conservatively and operatively was performed.

**Results:** Among the 325 eligible patients (59.4% males) factors associated with 3-month mortality included higher National Institutes of Health Stroke Scale score, infratentorial location, hydrocephalus, herniation, and multiple hemorrhages. Adjusted for these factors as well as demographics, ICH volume, and the underlying cause, surgical evacuation was associated with lower 3-month mortality (OR 0.06; 95% CI 0.02–0.21). In propensity-score matched analysis, 3-month case-fatality rates were three-fold in those treated conservatively (27.5% vs. 7.8%,  $p < 0.001$ ).

**Conclusions:** The predictors of short-term case-fatality are alike in young and elderly ICH patients. However, initial hematoma evacuation was associated with lower 3-month case-fatality in our young ICH patients.

## ESOC-0047

### 18. ICH and IVH

#### Medical acute complications of intracerebral hemorrhage in young adults

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**Background and Purpose:** Medical complications are frequent among patients with intracerebral hemorrhage (ICH) and are a significant cause of mortality. We investigated their frequency and impact on short-term mortality in young ICH patients.

**Methods:** We retrospectively reviewed clinical, imaging, and laboratory data of all first-ever non-traumatic ICH patients between 16 and 49 years of age treated in our hospital between January 2000 and March 2010 to identify medical complications suffered in the acute phase, and linked these data with national causes-of-death registry. Univariable comparisons and logistic regression analysis were performed to identify complications associated with increased 3-month mortality.

**Results:** Among the 325 eligible patients (59% males), infections were discovered in 90 (28%), venous thrombotic events in 13 (4%), cardiac complications in 4 (1%), renal failure in 59 (18%), hypoglycemia in 15 (5%), hyperglycemia in 165 (51%), hyponatremia in 146 (45%), hypernatremia in 91 (28%), hypotatremia in 104 (32%), and hyperpotatremia in 27 (8%). Adjusted for gender, hematoma volume, infratentorial hematoma location, presence of intraventricular extension, National Institutes of Health Stroke Scale score at arrival, and hematoma evacuation, the only independent complication associated with 3-month mortality was plasma glucose  $>8.0$  mmol/L (odds ratio 5.96, 95% confidential interval 2.34–15.19,  $p < 0.001$ ). Three or more separate complications suffered also associated with increased mortality (odds ratio 6.57, 95% confidential interval 1.28–33.59,  $p = 0.024$ ).

**Conclusions:** Hyperglycemia is a frequent complication of intracerebral hemorrhage in young adults and associates with increased short-term mortality. Multiple complications increase mortality even further.

## ESOC-0711

### 18. ICH and IVH

#### Clinical correlates and prognostic implications of cerebral microbleeds detected by susceptibility weighted imaging in Chinese with ischaemic stroke

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**Background:** Compared with gradient-recalled echo imaging, susceptibility-weighted imaging (SWI) has been shown to have superior sensitivity in detection of cerebral microbleeds (CMB). However, literature on the prognostic implications of CMBs detected using SWI amongst patients with ischaemic stroke (ISS) remains uncertain.

**Methods:** We retrospectively reviewed 1556 patients who received a MRI stroke protocol at The University of Hong Kong during 2008–2012. CMBs were detected using SWI and graded using the Microbleed Anatomical Rating Scale. Clinical characteristics, cardiovascular risk factors and subsequent clinical outcome of study subjects were retrieved.

**Results:** Amongst 726 Chinese ISS patients (mean age 68 years, 61% males), 44% had CMBs detected (34%, 6% and 4% with CMBs of grade 1, 2 and 3 respectively). Burden of CMBs were strongly associated with increasing age, underlying hypertension, history of TIA or stroke and glomerular filtration rate ( $p < 0.05$ ). Burden of CMBs were also significantly associated with periventricular and subcortical white matter hyperintensities ( $p < 0.01$ ). After a mean follow-up of  $35 \pm 15$  months, 75 patients (10%) developed a recurrent stroke and 71 patients (10%) died. Compared to patients without CMBs, those who had deep-seated CMBs of grade 3 severity had the greatest risk of developing a recurrent stroke (adjusted hazard ratio (HR) 5.75, 95% confidence interval (CI) 1.75–18.94,  $p < 0.01$ ) and in particular, haemorrhagic stroke (adjusted HR 70.45, 95% CI 2.70–187.2,  $p < 0.01$ ). CMBs were not predictive of recurrent ISS or mortality.

**Conclusions:** Amongst Chinese with ISS, those with deep-seated CMBs are at greatest risk of developing a recurrent stroke, in particular intracerebral haemorrhage.

### ESOC-0367

#### 18. ICH and IVH

##### Uric acid in subarachnoid hemorrhage patients: Temporal profile and its association to neurological complications

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**Objectives:** Uric acid (UA) is the most important endogenous antioxidant in humans. Its role in subarachnoid hemorrhage (SAH) has not been previously studied. We aimed to describe the temporal profile of UA concentration and its relationship to neurological complications in patients with spontaneous SAH.

**Methods:** Forty-seven patients and twenty-three healthy volunteers were included in a prospective observational study. Clinical, radiological and laboratory variables were collected. UA concentration was measured in serial blood samples at admission and on days 1, 4, 10 and 90. The development of angiographic vasospasm (VS) was monitored daily and new cerebral infarction was defined as the appearance of new lesions in successive neuroimages suggesting arterial cerebral ischemia.

**Results:** After SAH, 60% of patients presented angiographic VS and 50% developed new ischemic lesions. We observed a progressive decrease of UA concentration between admission and day 10. UA levels were significantly lower in cases compared to controls on day 1, 4 and 10 ( $p < 0.001$ ). Lower concentrations of UA on day 10 were significantly associated to the development of angiographic VS ( $3.81 \pm 1.54$  vs  $2.88 \pm 0.97$ ;  $p = 0.037$ ) and new cerebral infarction ( $3.63 \pm 1.15$  vs  $2.56 \pm 1.01$ ;  $p = 0.021$ ).

**Conclusions:** Decrease of UA concentration is related to ischemic cerebral damage after SAH. The pathophysiological role and outcome implications of this serum biomarker should be studied in more extensive samples of patients.

### ESOC-0721

#### 18. ICH and IVH

##### H-ATOMIC criteria for the etiologic classification of patients with intracerebral hemorrhage

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**Background:** There are no accepted criteria for the etiologic classification of Intracerebral Hemorrhage (ICH). We have developed a set of etiologic criteria and have applied them to a large number of patients.

**Methods:** A multicenter and prospective study of consecutive patients with spontaneous ICH. A prerequisite was to perform a basic study (neuroimaging -CT or MR-, blood tests -platelet count, liver function, coagulation-, and CT-angio or other angiographic modalities when a predefined score suggested an underlying structural abnormality). This basic study was extended at the discretion of the treating neurologist.

The H-ATOMIC classification includes 7 subtypes: Hypertension, Amyloid angiopathy, Tumor, Oral anticoagulants, arterio-venous Malformation/cavernoma), Infrequent diseases and Cryptogenic. For each category, the definition is graded as possible(= 3), probable(= 2) and definite(= 1). Combinations of >1 etiologic subtype for the same patient are accepted. In a random sample ( $n = 29$ ), percentage of agreement (PA) among 5 stroke neurologists was calculated.

**Results:** We included 387 patients (age  $70.7 \pm 14$ , 61% were men). A definite adjudication was achieved in 41.6% of the patients (H1 28.1%, A1 0.2%, T 0.2%, O 2.4%, M 4.3%, I 4.5%, C 1.9%); In the remaining patients ICH was attributable to a single (14%) or the combination of  $\geq 2$  (44.4%) possible/probable etiologies. H was the most frequent category (H1 + 2 + 3 79.5%) followed by A (A1 + 2 + 3 32%). PA ranged 75.8–96.8%.

**Conclusions:** According to the H-ATOMIC criteria for ICH, only 41.6% of patients receive a definite diagnosis, while up to 44.4% are attributable to more than one possible or probable etiology. Percentage of agreement is high.

### ESOC-0665

#### 18. ICH and IVH

##### Clinical and diagnostic findings in patients with elevated cerebrospinal bilirubin

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**Background:** Acute severe headache is a presenting feature of subarachnoid haemorrhage (SAH). When a computerized tomograph (CT) does not demonstrate blood in patients with a thunderclap headache, guidelines recommend investigation of cerebrospinal fluid (CSF) to look for



SAH. In a retrospective study we evaluated the clinical utility, diagnoses and CSF findings in patients with an elevated spectrophotometric CSF bilirubin level.

**Methods:** Over a ten year period consecutive patients with elevated CSF bilirubin admitted to two hospitals were studied. Clinical demographics, delays to investigation and final diagnoses were recorded. Patients with an identified intracranial vascular abnormality (avSAH) were compared with patients without such vascular abnormality (non-avSAH).

**Results:** Fifty-six patients had an elevated CSF bilirubin. Ten (17.9%) had an avSAH, of which eight (14.3%) had aneurysmal SAH. CSF spectrophotometry requests increased more than threefold during the study (test for linear trend,  $P < 0.001$ ), while detection of aneurysmal SAH remained stable (2.5 persons/million population/year). Delays from headache onset to admission, CT scan and lumbar puncture were not significantly different for avSAH and non-avSAH patients. CSF red cell counts were higher among av-SAH patients than non-avSAH patients ( $P = 0.005$ ). Recording of clinical history, neurological examination, lumbar puncture and accuracy of CT brain reporting had potential for improvement. Non-vascular causes of elevated CSF bilirubin included meningitis, spontaneous intracranial hypotension and carcinomatous meningitis.

**Conclusions:** CSF spectrophotometry has an important role in identifying avSAH in CT-negative patients presenting with a thunderclap headache. Careful clinical utility of CSF spectrophotometry could improve the positive predictive value of this investigation.

## ESOC-0084

### 18. ICH and IVH

#### Prognostic significance of delayed intraventricular haemorrhage in the interact studies

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**Background and purpose:** Intraventricular extension of intracerebral haemorrhage (ICH) predicts poor outcome but the significance of delayed intraventricular haemorrhage (dIVH) is less well defined. We determined the prognostic significance of dIVH in the Intensive Blood Pressure Reduction in Acute Cerebral Hemorrhage Trials (INTERACT 1 and 2).

**Methods:** Pooled analyses of the INTERACT CT substudies – international, multicenter, prospective, open, blinded endpoint, randomized controlled trials of patients with acute spontaneous ICH and elevated systolic blood pressure (SBP), randomly assigned to intensive (<140 mmHg) or guideline-based (<180 mmHg) SBP management. Participants had blinded central analyses of baseline and 24-hr CTs, with dIVH defined as new IVH on the latter scan. Outcomes of death and major disability were defined by modified Rankin scale scores at 90 days.

**Results:** There were 349 (27%) of 1,310 patients with baseline IVH, and 107 (11%) of 961 IVH-free patients who developed dIVH. Significant associations of dIVH were prior warfarin anticoagulation, high ( $\geq 15$ ) baseline National Institutes of Health stroke scale score, larger ( $\geq 15$  mL) haematoma volume, and greater haematoma growth and higher achieved SBP over 24 hrs. Compared to those IVH-free, dIVH had greater odds of 90-day death or major disability versus initial IVH (adjusted odds ratios 2.89 [95% CI 1.55–5.38] and 1.86 [95% CI 1.36–2.54], respectively [P trend < 0.0001]).

**Conclusion:** Although linked to factors determining greater haematoma growth including poor SBP control, dIVH is independently associated with poor outcome in acute ICH.

*Clinical Trial Registration Information* – URL: <http://www.clinicaltrials.gov>. Unique identifier: NCT00226096 and NCT00716079.

## ESOC-0350

### 18. ICH and IVH

#### Relation of prior cerebral microbleeds to clinical characteristics of patients presenting with acute intracerebral hemorrhage

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**Background:** Microbleeds (MBs) on MRI scanning is an important risk factor for subsequent hemorrhagic stroke. It remains unclear on the frequency and characteristics of acute ICH occurring at the same location as the previously identified MBs.

**Methods:** We enrolled 54 consecutive acute ICH patients (mean age 71; 63% male) who had undergone 1.5T gradient-echo T2\*-weighted MR imaging before the ICH onset for previous neurological disorders. We investigated clinical features, site and numbers of MBs and whether the site of acute ICH co-localised to the presence of MBs.

**Results:** The location of the acute ICH was at the thalamus in 16 patients (30%), basal ganglia in 14 (26%), other sites in 24 (44%). The median number of MBs was 5 (IQR 3–13). Hematoma corresponded to prior MBs in 24 patients ('co-localised group', 44%) and not in the other 30 ('non co-localised' group). Co-localisation rate was the highest in the thalamus (75%). MBs were more common in the co-localised group (median 10) than in the 'non co-localised' group (median 3,  $P = 0.002$ ). Age, sex, vascular risk factors, hematoma volume were similar between both groups. The rates of antiplatelet therapy (42% vs.43%, anticoagulation therapy (25% vs.20%, and dual antithrombotic therapy (4% vs.7%) before onset of the ICH were also similar.

**Conclusion:** ICH co-localisation with prior MBs tended to occur in thalamus and have high number of prior MBs, but was unrelated to other clinical features, including previous antithrombotic therapy.

## ESOC-0650

### 18. ICH and IVH

#### The first week constitutes the primary critical period in intracerebral hemorrhage – is neurological deterioration the real culprit?

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**Background:** Patients with intracerebral haemorrhage (ICH) are at high risk of neurological deterioration (ND). We aimed at establishing predictors of early as well as late neurological deterioration and to explore the impact of neurological stability during the first week on long-term prognosis.

**Method:** We included 283 acute ICH-patients ( $\leq 4.5$  hours from symptom-onset) admitted to our institution from March 2009 to July 2014. ND was evaluated based on consciousness and severity of neurological symptoms. ND during the first 24 hours after admission was defined as early ND (END) and from 24 hours to 7 days as late ND (LND). Patients were followed up until October 2014.

**Results:** We found that the spot sign on CT-angiography (OR 9.63 CI: 4.22–22.0) and extensive degree of intraventricular haemorrhage (IVH) (OR 9.63 CI: 2.91–31.9) were independent predictors of END. Whereas degree of comorbidity (Charlton Index), admission stroke severity, and degree of IVH predicted LND. On follow-up imaging, hematoma expansion was independently associated with END (OR 7.1 CI: 2.3–21.8), and expansion of IVH was independently associated with both END (OR 4.8 CI: 1.3–18.0) and LND (OR 12.1 CI: 1.3–111.5). ND during first week was associated with a one-year mortality of 61%, compared to 8% among the patients who remained stable (Log-Rank test  $p < 0.0001$ ).

**Conclusion:** The first week constitutes a very critical period and the results of this study suggest that stability during the first week entails an optimistic prognosis. Relatively easy and effective risk-stratification of END and LND is possible on admission.

## ESOC-0654

### 18. ICH and IVH

#### The CT-angiographic spot-sign predicts expansion of the intraventricular haematoma in patients with intracerebral haemorrhage

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**Background:** Expansion of the intraventricular haemorrhage (IVH) is a relatively undescribed but likely malicious consequence of on-going bleeding in intracerebral haemorrhage. We aimed at describing the relationship between haematoma expansion, the spot-sign and IVH-expansion along with its affect on mortality.

**Method:** We included 158 acute ICH-patients ( $\leq 4.5$  hours from symptom-onset) admitted from March 2009 to December 2014 with admission and follow-up CT. CT-angiography on admission was available in 128 (81%). Haematoma volume was calculated as ABC/2 and extent of the IVH using the GRAEB-score. IVH on follow-up, but not on admission imaging, was considered delayed IVH. An increase of above 2 GRAEB-points was considered a significant IVH-expansion and 12.5 mL a significant intraparenchymal haematoma expansion (SHE).

**Results:** Of the 158 patients, 53 (33.5%) had IVH on admission. Significant IVH-expansion was observed in 30 (19.0%) during the first 24 hours. Of the 30 patients, 12 (40.0%) had IVH on admission scan and 18 (60%) suffered delayed IVH – all above 2 GRAEB-point increase. In multivariate analysis, SHE (OR 3.95 CI: 1.21–12.9) and the spot-sign (OR 7.11 CI: 1.68–30.1) emerged as independent predictors adjusted for admission haematoma volume. Within the first 90 days, 32 (20.3%) died. Adjusted for age, admission neurological severity, admission haematoma volume, and admission GRAEB score – haematoma expansion (HR 1.01 CI: 1.00–1.02 per mL) and IVH-expansion (HR 1.2 CI: 1.01–1.40 per point) were independently associated with mortality.

**Conclusion:** The spot-sign predicts IVH-expansion beyond what can be attributed to intraparenchymal haematoma expansion. IVH-expansion is an independent predictor of mortality.

## ESOC-0314

### 18. ICH and IVH

#### Antithrombotic drugs use after spontaneous intracerebral haemorrhage and appearance of new microbleeds: Results from an observational cohort study

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**Background:** In patients with intracerebral haemorrhage (ICH), brain microbleeds (BMB) may interact with antithrombotic drugs and increase the risk of future ICH recurrence. We aimed to identify predictors of new BMB in ICH patients.

**Methods:** Observational prospective cohort of 168 ICH survivors who underwent 1.5T MRI after admission and during follow-up [median delay between first and last MRIs 3.4 (IQR 1.4–4.7) years]. We used multivariable logistic regression in overall population, and then stratified by the index ICH location (58 lobar ICH vs 103 non lobar ICH, excluding patients with multiple ICH or unclassifiable ICH location).

**Results:** Eighty-nine (53%) patients had BMB at baseline, and 80 (48%) exhibited new BMB during follow-up. The use of antiplatelet agents during follow-up was associated with the appearance of new BMB (OR 2.16; 95%CI 1.07–4.28). When stratifying by index ICH location, this association was only found in non-lobar ICH (OR 2.84; 95%CI 1.06–7.61). Radiological independent predictors of new BMB were: presence of old macro-haemorrhagic lesions (outside the index ICH) on the first MRI (OR 6.87; 95%CI 2.10–22.48), and progression of cortical atrophy (OR 2.36; 95%CI 1.04–5.35). In the subgroup of lobar ICH, new BMB were associated with the appearance of new macro-haemorrhagic lesions (OR 13.46; 95%CI 1.37–132.48).

**Conclusions:** New BMB frequently appeared during follow-up and anti-thrombotic drugs were especially relevant in non lobar ICH. Interestingly, new BMB were markers of an underlying evolving process (new macro-haemorrhagic lesions and progression of cortical atrophy) suggesting their impact on functional outcome including cognition.

## ESOC-1343

### 18. ICH and IVH

#### Antithrombotic treatment following intracerebral hemorrhage in patients with and without atrial fibrillation. A nationwide study based on Riksstroke

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**Background:** Patients who survive an intracerebral hemorrhage (ICH) often have compelling indications for anticoagulant and antiplatelet medication. We studied predictors, extent and timing of antithrombotic treatment following ICH in patients with and without atrial fibrillation (AF).

**Methods:** We included 14045 patients with a first ICH who were discharged alive and registered in the Swedish Stroke Register (Riksstroke) in 2005 through 2012. Personal identification numbers were used to link Riksstroke data with other national registers to find comorbid conditions and date of first dispensed prescriptions of antiplatelet (AP) and anticoagulant (AC) agents after discharge.

**Results:** Among the 2777 (19.8%) patients with AF, the proportion with dispensed prescription of antithrombotic agents was 8.5% (AC) and 36.6% (AP) within 6 months, and 11.1% (AC) and 43.6% (AP) within 1 year. Among the 11268 (80.2%) non-AF patients, the corresponding figures were 1.6% (AC) and 13.8% (AP) within 6 months, and 2.0% (AC) and 17.5% (AP) within 1 year. In AF-patients, less severe ICH, younger age, previous AC-treatment, valvular disease, and previous ischemic stroke were predictors of AC-treatment. High CHA2DS2-VASc scores did not correlate with prescription of AC; rather the inverted relationship was seen. There was a positive correlation between high CHA2DS2-VASc and HAS-BLED scores ( $rs = .0.590, p < 0.001$ ).

**Conclusions:** In a majority of patients who subsequently receive anti-thrombotic agents, treatment is initiated within 6 months from ICH. Other factors than high risk of embolic stroke by CHA2DS2-VASc are used to guide the anticoagulant treatment decision in clinical practice.

## ESOC-0974

### 18. ICH and IVH

#### Reliability of spontaneous intracerebral haemorrhage classification systems: A systematic review

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**Objective:** Distinguishing spontaneous ICH (sICH) subtypes accurately is important since they have different risk factors, causal pathways, management and prognosis. We systematically assessed the reliability of sICH classification systems.

**Methods:** We sought all available assessments of reliability of an anatomical or mechanistic sICH classification system from electronic databases (Medline, Embase) and through personal contact with researchers until October 2014. We assessed included studies' characteristics, including quality and bias; performed meta-analyses of the proportion of cases classified into each subtype; and summarised reliability with kappa value forest plots, assessing visually the factors that may affect it.

**Results:** We included 20 of 2152 studies initially identified. In pooled analyses: of anatomical systems, 35% of sICHs were lobar, 91% supratentorial, and 47% had intraventricular haemorrhage present; of mechanistic systems, hypertension-related ICH accounted for 51%, CAA 16%, and undetermined causes 13%. Reliability (range of kappa values) was substantial to almost perfect for both anatomical and mechanistic classification systems (inter-rater reliability 0.78–0.97 anatomical [6 studies], 0.89–0.93 mechanistic [3 studies]; intra-rater reliability 0.80–1 anatomical [3 studies], 0.92–0.93 mechanistic [2 studies]). Smaller numbers of raters and categories improved reliability, but there were insufficient data to assess all potential factors influencing reliability. Included studies were performed mainly in highly specialised settings with experienced raters, and had moderate reporting quality.

**Conclusions:** Existing classification systems perform very well in the settings in which they have been tested, but their reliability is unknown in other than highly specialised centres with experienced readers. Future studies of reliability should follow published reporting guidelines.

## ESOC-0844

### 18. ICH and IVH

#### Intracerebral hemorrhage evacuation by MIN techniques

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**Introduction:** STICH I and II trials examined a situation that actually is not representing today's reality regarding MIN strategies and techniques. EndoSTICH trial and MISTIE trial are studying two minimally invasive techniques (endoscopic evacuation and catheter-lysis) which however do not compete the needs of the majority of hemorrhages. We elaborated a MIN technique with high effectiveness.

**Material and method:** This MIN concept combined several techniques to assist microsurgery: High-end neurosonography with small probes (burr-hole-probe/ALOKA) and mouth tracking of the microscope, both mandatory. Additionally we added endoscopy (Wolf, Aesculap, Storz) and LASER (Th-YAG Revolix).

165 patients underwent this application, the approaches varied from burr-hole to 1€ or 2€ in size depending from the imaging findings and expected difficulties.

**Results:** In nearly all cases it was possible to evacuate the hematoma within 1 hour and the hematoma evacuation decreased the ICP to normal levels. Clinical results were excellent in lobar bleedings with isochoric before surgery. Large and deep-seated hemorrhages needed longer recovery time but in all cases postop CT showed fast reduction of perifocal edema.

**Conclusion:** Combination of ultrasound, mouth tracking, endoscopy and LASER enabled evacuation of all type of hematoma minimal invasively and very effectively in less than one hour. Ultrasound real-time control detected all types and locations of bleeding causes.

## ESOC-0853

### 18. ICH and IVH

#### Necrosectomy by MIN techniques versus craniectomy in stroke

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**Objective:** In the series of 165 hematoma evacuations some cases were hemorrhagic infarctions. In these cases additional to the hematoma the center of the necrosis was evacuated also. As these patients made a much better recovery than craniectomy cases we developed a novel concept.

**Methods:** Hemorrhagic infarctions were operated through key-holes under ultrasound control (burr-hole probe, Alpha 7, ALOKA) and by mouth-switch tracked microscope. Before surgery CTA or Duplex Sonography was made to see if the Infarction showed reperfusion, because in the latter condition the operation may be more difficult. Perfusion CT determined the center of the necrosis.

**Result:** In all cases we saw a much better course of recovery than in craniectomy cases. The patient were not disabled additionally by stigmata like craniectomy defect, big scar, loss of hair and psychological trauma. The beginning of rehabilitation therapy could start within one week only, the wound of 3 cm was not visible and during rehabilitation there was no fear by the rehabilitation clinics to soon start the full training program. We did not see any complication due to the MIN strategy.

**Conclusion:** The first promising results of MIN concept application in stroke decompression seem logical regarding pathophysiology. It is worthwhile to study this novel concept by trials. The operative technique, however is much more sophisticated than a simple craniectomy but also much faster and economic.

ESOC-0306

18. ICH and IVH

**Brief consent sheets are effective: Data from the on-going Tranexamic acid for hyperacute primary IntraCerebral Haemorrhage (TICH-2) trial**

N Sprigg<sup>1</sup>, KS Robson<sup>1</sup>, K Krishnan<sup>1</sup>, PM Bath<sup>1</sup>

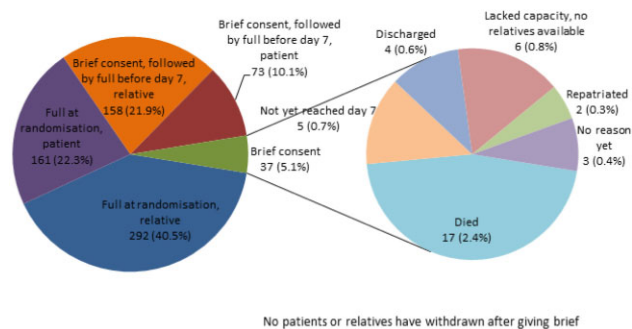
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**Background:** Obtaining consent in the ongoing TICH-2 trial is challenging since a large proportion of patients lack capacity and relatives are often unavailable.

**Methods:** Ethical approval was obtained to allow either verbal consent (using a brief information sheet) followed by full written consent, when full written consent was not possible or where patients lack capacity, permission can be sort from a relative acting as legal representative. If no relative was available, permission could be obtained if two clinicians (one unconnected with the trial) agreed. Permission from legal representatives could be given using a full or brief information sheet, followed by full written consent.

**Results:** Of 721 patients enrolled, 161 (22.3%) gave full informed consent, 89 (12.3%) gave brief verbal consent. The majority of patients (65.3%) were enrolled after proxy consent from a legal representative; full informed relative consent 292 (40.5%), brief relative consent 134 (18.6%), independent physician consent 45 (6.2 %). The majority of patients enrolled after brief consent went on to give full consent, but some died or were discharged without full written consent (Fig. 1). No patients or relatives who initially gave brief consent went on to withdraw consent, and no patients were lost to follow up.

**Obtaining consent**



**Conclusion:** Abbreviated information sheets and proxy consent can ensure patients are enrolled rapidly into emergency clinical trials, avoiding delays or exclusion.

ESOC-0310

18. ICH and IVH

**Blood pressure (BP) treatment after an intracerebral haemorrhage (ICH): Data from the on-going Tranexamic acid for hyperacute primary IntraCerebral Haemorrhage (TICH-2) trial**

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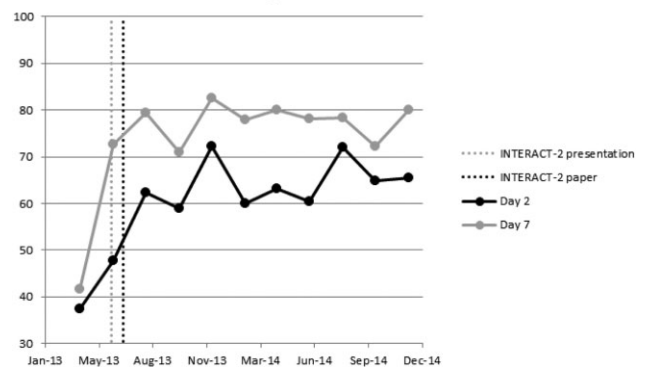
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**Background:** Few treatment options exist for ICH patients. INTERACT-2 found that lowering BP non-significantly improved functional outcome. The ongoing TICH-2 trial is testing whether tranexamic acid is effective at improving outcome in ICH. We assessed whether use of BP lowering treatment in TICH-2 increased after publication of INTERACT-2 results.

**Methods:** TICH-2 prospectively records BP and use of BP lowering drugs 2 and 7 days after randomisation. The percentage of participants on BP lowering treatment was examined over time to see if a relationship could be seen between the use of BP lowering and publication of INTERACT-2. **Results:** By December 2014, 700 patients had been enrolled into TICH-2 and had day 7 follow-up. Figure 1 shows use of BP lowering drugs plotted against time; the number of patients on BP treatment at day 2 increased from 26 (47.3%) before INTERACT-2 to 420 (65.1%) afterwards (chi-square,  $p = 0.008$ ). No significant difference was seen at day 7; 37 (67.3%) before and 503 (78.0%) after ( $p = 0.069$ ). The number of patients using IV BP treatment saw a significant increase after INTERACT-2 publication at day 2 ( $p = 0.001$ ) and day 7 ( $p = 0.0003$ ). No difference was seen in BP levels at day 2, before or after the INTERACT-2 results: 153.3/81.4 mmHg versus 151.6/80.5 (ANCOVA,  $p = 0.2835$ ).

**Conclusion:** Use of BP lowering medication has increased since publication of INTERACT-2.

**Percentage of patients on BP lowering treatment, averages over 2 months**



ESOC-0806

18. ICH and IVH

**Minimum detectable difference for hematoma volume measurement in acute intracerebral hemorrhage**

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**Background:** Limiting intracerebral (ICH) and intraventricular (IVH) hemorrhage expansion is a common target for acute ICH studies. We investigate the amount of hematoma volume difference between CT scans that can be considered as measurement error.

**Methods:** Five raters performed baseline (<6 h) and 24-hour total hematoma (ICH + IVH) volumetric analysis from 40 randomly selected ICH patients from the PREDICT study cohort. Estimates of intrarater and interrater reliability are expressed as intraclass correlation coefficients (ICC [95% CI]) and minimum detectable difference (MDD).

**Results:** Total hematoma volumetric analyses had excellent agreements (Table). MDD was higher the larger total hematoma volume was and in patients with subarachnoid hemorrhage (SAH) or IVH (Table).

**Conclusions:** Larger hematomas and those with SAH or IVH are susceptible to higher measurement error. >33% hematoma expansion definition appears well above MDD (~10% of hematoma volume) but >6 mL defi-

inition may be within the measurement error when assessing large hematomas. Larger absolute expansion thresholds are more suitable to defining hematoma expansion in large hematomas.

	n	Intrater ICC	Intrater MDD (mL)	Interrater ICC	Interrater MDD (mL)
<b>All</b>	40	0.994 (0.991–0.996)	6.68	0.992 (0.990–0.993)	7.72
<b>Volume (mL)</b>					
≤10	10	0.992 (0.978–0.996)	0.79	0.996 (0.993–0.998)	0.56
>10–30	10	0.979 (0.929–0.992)	2.52	0.986 (0.978–0.991)	2.06
>30–50	10	0.939 (0.872–0.969)	4.30	0.919 (0.878–0.945)	4.96
>50	10	0.976 (0.950–0.988)	8.22	0.962 (0.943–0.974)	10.35
<b>SAH</b>					
No	20	0.995 (0.990–0.998)	3.12	0.998 (0.996–0.999)	1.97
Yes	20	0.988 (0.979–0.993)	8.21	0.981 (0.974–0.985)	10.34
<b>IVH</b>					
No	29	0.997 (0.994–0.998)	3.82	0.993 (0.991–0.994)	5.83
Yes	11	0.985 (0.971–0.992)	8.79	0.979 (0.969–0.985)	10.40

## ESOC-0080

### 18. ICH and IVH

#### Intracranial hemorrhage caused by non-vitamin K antagonist oral anticoagulants (NOACs): A multicenter retrospective cohort study in Japan

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**Background:** We conducted a multicenter retrospective cohort study to elucidate the characteristics of intracranial hemorrhage in patients with atrial fibrillation treated with non-vitamin K antagonist oral anticoagulants (NOACs).

**Methods:** We sent a questionnaire to the directors of the 241 stroke centers in Japan to establish the clinical characteristics of NOAC-associated cerebral hemorrhage, including hematoma size, hematoma enlargement (HE) and in-hospital mortality of patients treated in their institutions. We undertook a literature review to establish the clinical characteristics of warfarin-associated cerebral hemorrhage and compared these with our data. The Institutional Review Board at the Kawasaki Medical School Hospital approved this study and waived the need for informed consent. This study was registered with the UMIN Clinical Trials Registry (UMIN000014230).

**Results:** We received 174 responses (72.2%), of which 67 (38.5%) gave anonymous details of 130 eligible patients (male, 67.7%; mean age, 77.3 ± 8.3 years, in-hospital mortality rate, 11.5%). We judged that 87 of the 130 patients had presented with cerebral hemorrhage: one-fifth had taken antiplatelet drugs. We found that the incidences of HE and mortality in the 87 patients presenting with NOAC-associated cerebral hemorrhage were lower than would have been expected in those with warfarin-associated cerebral hemorrhage (17% vs. 26%, and 16% vs. 35%, respectively).

**Conclusions:** More than half the stroke center directors who responded had not experienced cases of NOAC-associated intracranial hemorrhage. Compared with warfarin, NOACs appear to present a lower risk of HE and mortality in patients with atrial fibrillation who develop cerebral hemorrhage.

## ESOC-0191

### 18. ICH and IVH

#### Local delivery of neural progenitor cells and nanomaterial improves functional outcome in a rat model of intracerebral hemorrhage

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Hematoma aspiration reduces hematoma volume and decreases perihematoma edema. The hemorrhagic cavity provides space for local delivery of potential therapeutic agents. A nanomaterial RADA 16-I has been shown to replace the hematoma and reduce ICH-related injury. In this study, the effect of local delivery of neural progenitor cells (NPC) plus the nanomaterial in a rat model of ICH was studied.

NPCs were derived from day 13.5 embryos of green fluorescent protein (GFP) transgenic SD rats. ICH was induced by intrastriatal injection of bacterial collagenase IV. Hematoma aspiration was performed at 3.5 h after ICH. The RADA 16-I solution was injected into the cavity immediately following hematoma aspiration. The NPCs were transplanted embedded in the nanomaterial at 3.5 h after ICH or at 2 weeks after ICH. The functional outcome was assessed. The survival and differentiation of the survived NPCs and the underlying mechanism were evaluated.

The cells group exhibited better functional performance than the control group. NPCs survived in the brain cavity. More than half of the survived cells remained undifferentiated, while a quarter of the cells differentiated into GFAP positive astrocytes. Only a very small proportion of GFP cells were NeuN positive neurons. The cells group showed a trend toward increased secretion of neurotrophic factors.

Local delivery of neural progenitor cells and nanomaterial improves functional outcome. This study may provide evidence for a new therapeutic strategy for ICH.

## ESOC-0081

## 18. ICH and IVH

## Higher mortality in patients with right hemispheric intracerebral haemorrhage: INTERACT1 AND 2

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**Background and purpose:** Controversy exists over the prognostic significance of affected hemisphere in stroke. We aimed to determine the relationship between laterality of acute intracerebral haemorrhage (ICH) and poor clinical outcomes.

**Methods:** A subsidiary analysis of the INTERACT Pilot and INTERACT2 studies – randomised controlled trials of patients with spontaneous acute ICH with elevated systolic blood pressure (BP), randomly assigned to intensive (target systolic BP < 140 mmHg) or guideline-based (<180 mmHg) BP management. Outcomes were the combined and separate endpoints of death and major disability (modified Rankin scale [mRS] scores of 3–6, 6, and 3–5, respectively) at 90 days.

**Results:** A total of 2708 patients had supratentorial/hemispheric ICH and information on mRS at 90 days. Patients with right hemispheric ICH (1327, 49%) had a higher risk of death at 90 days compared to those with left hemispheric ICH after adjustment for potential confounding variables (odds ratio, 1.77 [95% confidence interval, 1.33–2.37]). There were no differences between patients with right and left hemispheric ICH regarding the combined endpoint of death or major disability or major disability in the multivariable-adjusted models (1.07 [0.89–1.29] and 0.85 [0.72–1.01], respectively).

**Conclusions:** Right hemispheric lesion was associated with increased risk of death in patients with acute ICH. The laterality of the ICH does not appear to affect the level of disability in survivors.

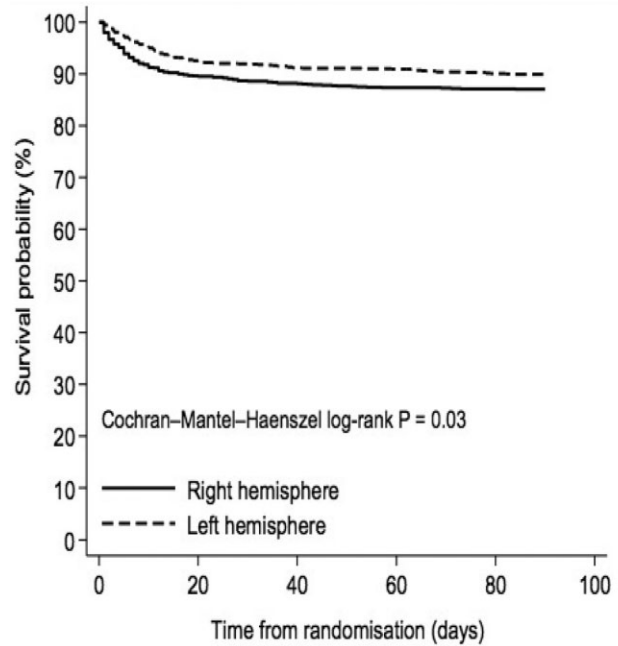


Fig. Kaplan-Meier curves for death in patients with right and left ICH.

## ESOC-0082

## 18. ICH and IVH

## Off-hour admission and outcomes in patients with acute intracerebral hemorrhage in the INTERACT2 trial

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**Background:** Conflicting data exist of an association between off-hour (weekend, holiday, or night-time) hospital admission and adverse outcome in intracerebral hemorrhage (ICH).

**Aims:** We determined the association between off-hour admissions and poor clinical outcome, and of any differential effect of early intensive blood pressure (BP) lowering treatment between off- and on-hour admissions, among participants of the Intensive Blood Pressure Reduction in Acute Cerebral Hemorrhage Trial (INTERACT2).

**Methods:** Subsidiary analysis of INTERACT2, a multinational, multi-center, clinical trial of patients with spontaneous ICH with elevated systolic BP, randomly assigned to intensive (target systolic BP < 140 mmHg) or guideline-based (<180 mmHg) BP management. Primary outcome was death or major disability (modified Rankin scale of 3–6) at 90 days. Off-hour admission was defined as night-time (4:30 pm to 8:30 am) on weekdays, weekends (Saturday and Sunday), and public holidays in each participating country.

**Results:** Of 2794 patients with information on the primary outcome, 1770 (63%) were admitted to study centers during off-hours. Off-hour admission was not associated with risk of poor outcome at 90 days (53% off-hour vs. 55% on-hour;  $P = 0.49$ ), even after adjustment for co-morbid

risk factors (odds ratio 0.92; 95% CI 0.76–1.12). Consistency exists in the effects of intensive BP lowering between off- and on-hour admission ( $P = 0.85$  for homogeneity).

**Conclusions:** Off-hour admission was not associated with increased risks of death or major disability among trial protocol participants with acute ICH. Intensive BP lowering is broadly beneficial irrespective of admission hours.

## ESOC-0465

### 18. ICH and IVH

#### Diagnostic yield and accuracy of CT angiography, MR angiography and digital subtraction angiography for detection of macrovascular causes of intracerebral haemorrhage – a prospective, multicentre cohort study

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**Background:** In patients with intracerebral haemorrhage (ICH), we assessed the diagnostic value for finding a macrovascular cause of early CT angiography (CTA), and additional MR angiography (MRA) and digital subtraction angiography (DSA) after 4–8 weeks.

**Methods:** We prospectively enrolled 301 patients with non-traumatic ICH, aged 18–70, excluding those >45 years with hypertension and ICH in basal ganglia, thalamus or posterior fossa. For yield and positive predictive value (PPV) of CTA, and of additional MRA and DSA, we calculated proportions with corresponding 95% confidence intervals (CI). We investigated determinants of finding a macrovascular cause with logistic regression, and constructed prediction charts for the probability of finding a macrovascular cause.

**Results:** In 70 of 301 patients a macrovascular cause was found; in 51/298 by CTA (yield 17%, 95%CI:13–22), in 55/283 by CTA + MRA (yield 19%,

95%CI:15–24), and 70/174 by CTA + MRA + DSA (yield 40%, 95%CI:33–48). PPV of CTA was 72% (95%CI:60–82), of additional MRI/A 35% (95%CI:14–62), and of additional DSA 94% (95%CI:70–99). Predictors for a macrovascular cause were age  $\leq 50$ , <4 units alcohol intake/day, lobar or posterior fossa ICH location, and absence of signs of small vessel disease on CT. The prediction score showed good discriminative ability ( $c$ -statistic 0.84, 95%CI:0.79–0.90).

**Conclusions:** CTA is an appropriate initial investigation to detect macrovascular causes in patients with ICH but accuracy is modest. Additional MRI/A may find cavernomas or alternative diagnoses but DSA is needed to diagnose macrovascular causes undetected by CTA or MRA. The prediction score identifies patients with low, intermediate and high risk of a macrovascular cause.

## ESOC-0798

### 18. ICH and IVH

#### Recurrent hemorrhage risk and long-term mortality after a first intracerebral hemorrhage in hereditary and sporadic cerebral amyloid angiopathy

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**Background:** Hereditary Cerebral Hemorrhage With Amyloidosis–Dutch type (HCHWA-D) is considered a model for sporadic Cerebral Amyloid Angiopathy (sCAA), but it is unclear whether the disease courses are comparable. We compared recurrent ICH risk and long-term mortality in HCHWA-D and sCAA-patients.

**Methods:** We included HCHWA-D-patients from Leiden University Medical Center and sCAA-patients from Massachusetts General Hospital with a first symptomatic ICH. Baseline characteristics, hemorrhage recurrence, and mortality during follow-up were compared in patients who survived 90 days after the presenting ICH. Hazard ratio's (HR), adjusted for age and sex, were calculated with a Cox regression analysis.

**Results:** We included 54 HCHWA-D and 316 sCAA-patients. HCHWA-D-patients less often had one or more cardiovascular risk factors (24% versus 70% in sCAA) and were younger (mean age  $54 \pm 8$  versus  $72 \pm 9$  in sCAA) at time of presenting ICH. Forty-six (85%) HCHWA-D-patients survived 90 days after their first ICH compared with 240 (76%) sCAA-patients. During mean follow-up of  $5 \pm 4$  years (total 1585 person-years), HCHWA-D-patients had higher risk of recurrent ICH (20.5 per 100 versus 8.9 per 100 person-years in sCAA; HR:2.6;95%CI:1.5–4.8) and a higher mortality rate (9 per 100 versus 8 per 100 person-years in sCAA; HR:3.3;95%CI:1.7–6.1).

**Conclusion:** HCHWA-D-patients have a higher risk of recurrent ICH and a higher long-term mortality than sCAA-patients. Absence of cardiovascular risk factors in the majority of HCHWA-D-patients suggests that vascular amyloid is mostly responsible for the recurrent events. HCHWA-D is a pure CAA form with an accelerated clinical course and provides a good cohort for trials targeting vascular amyloid.

## ESOC-0538

## 18. ICH and IVH

**Thrombelastometry (ROTEM®) as instrument for study of coagulative mechanism in patients with spontaneous intracerebral hemorrhage: a pilot study**

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**Background:** Spontaneous intracerebral hemorrhage (ICH) is linked with high morbidity and mortality and at present there are not evidences for use of any hemostatic drugs. Thrombelastometry (ROTEM®) gives a qualitative and dynamic evaluation of coagulative mechanism and it might be useful to give rapid information in ICH patients for assessing risk of hematoma expansion.

**Methods:** We performed a prospective pilot study including 11 patients with spontaneous ICH admitted in Stroke Unit. ROTEM® was performed within 8 hours of symptom onset. CT brain imaging was obtained at baseline and 24 hours. We evaluate if patients with major hematoma (defined as a total volume >25 ml) show different ROTEM® parameters than patients with minor hematoma (< 25 ml).

**Results:** In our sample three ICH experienced major hematoma. This group shows a trend toward longer CFT main values and minor MCF amplitude,  $\alpha$ -angle and G values, than patients with minor hematoma. These data could suggest that ICH patients with major volume present reduced speed and strenght of clot formation. On the contrary, patient with minor hematoma have stronger and faster clot formation, that could hypothetically reflect a more effective adaptive response to bleeding, resulting in a minor expansion of hemorrhage.

**Conclusions:** ROTEM® may rapidly show coagulation changes in patients with acute ICH. Clotting process may be different in immediate response to ICH, according to our preliminary data that suggest a weaker and slower pro-coagulative response linked to the formation of larger hematomas. Further wider studies are needed to confirm this hypothesis.

## ESOC-1117

## 18. ICH and IVH

**Impact of perihemorrhagic edema on outcome after intracerebral hemorrhage**

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**Objectives:** Intracerebral hemorrhage (ICH) is a devastating disease with a bad outcome. Initial hematoma volume and presence of intraventricular hemorrhage (IVH) could be established as main prognostic outcome factors. However, beside its possible effect on mortality the role of perihemorrhagic edema (PHE) and its natural course remains unclear. Aim of the present study was to elucidate the impact of the natural course of ICH and PHE on functional outcome.

**Methods:** Patients were identified from our institutional ICH database. Subjects with spontaneous supratentorial ICH who received >1 computed tomography (CT) scans were included. PHE volume was calculated using a semiautomatic threshold based volumetric algorithm. CT scans performed on days 1, 2-3, 4-6, 7-9 and 10-12 were analyzed. Dichotomized Modified Rankin Scale at discharge (0-3 = favorable vs. 4-6 = poor outcome) was used as outcome parameter.

**Results:** The selection algorithm resulted in 250 patients for final analysis. Mean ICH volume on admission was  $20.7 \pm 23.8$  cm<sup>3</sup>. Mean absolute PHE volume on admission was  $20.4 \pm 20.4$  cm<sup>3</sup> and increased to a mean peak

volume of  $34.6 \pm 31$  cm<sup>3</sup> during  $6.5 \pm 4.1$  days on average. Besides GCS at admission, baseline modified Rankin scale before ICH, mechanical ventilation and frequency of elevated intracranial pressure, high peak PHE volume significantly predicted poor outcome (Exp(B) 0.980 (95% CI 0.96 to 0.99)).

**Conclusions:** In summary we found that absolute PHE may have a negative impact on functional outcome after ICH. Therefore, PHE may represent a possible treatment target.

## ESOC-0070

## 18. ICH and IVH

**Spontaneous intracerebral hemorrhage in Tibetan plateau: How different from Han Chinese in Chengdu Plain**

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**Background and purpose:** The patterns of spontaneous intracerebral hemorrhage (ICH) in the Tibetans, who lived in the Tibet plateau with their unique natural geographical environment and dietary habit, are little known. We investigated the patterns of those patients, compared with Han Chinese patients in Chengdu Plain.

**Methods:** We enrolled consecutive patients with ICH who were admitted to West China Hospital and People' hospital of Garzê within 1 month of stroke onset from January 2013 to December 2013, respectively. Basic characteristics and functional outcomes for ICH were compared between Tibetan and Han Chinese.

**Results:** Of the 863 cases included, 105 (12.2%) patients were from Tibetan plateau and 758 (87.8%) patients were from Chengdu Plain. Patients from Tibetan plateau, compared with those from Chengdu Plain, were older, and more often had experienced hypertension, and less often had experienced diabetes and current smoking (all  $P \leq 0.014$ ). On admission due to ICH, they also had higher Glasgow coma scale (GCS) score, higher Systolic blood pressure and diastolic blood pressure, higher level of blood Hemoglobin and platelets, and lower lever of serum albumin (all  $P \leq 0.009$ ). In patients from Tibetan plateau, the 3-month death rate was 25.8%, which were similar to that in patients from Chengdu Plain ( $P = 0.917$ ).

**Conclusions:** The mortality of ICH patients from Tibetan plateau is similar to that from Chengdu plain and high blood pressure may be the main etiology for Tibetan ICH patients, which need to be verified by larger epidemiologic studies.



## ESOC-0564

## 18. ICH and IVH

**Accuracy of the ABC/2 score for intracerebral hemorrhage: systematic review and analysis of the MISTIE, CLEAR-IVH and CLEAR III trials**

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. MISTIE Trial Investigators<sup>5</sup>, . CLEAR Trial Investigators<sup>6</sup>

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<sup>6</sup>CLEAR Trial, CLEAR Trial, International, USA

**Background:** The ABC/2 score estimates intracerebral hemorrhage (ICH) volume, yet validations have been limited by small samples and inappropriate outcome measures. We determined accuracy of the ABC/2 score calculated at a specialized Reading Center (RC-ABC) or local site (site-ABC) versus the reference-standard, CT-based planimetry (CTP).

**Methods:** In the MISTIE-II, CLEAR-IVH and CLEAR-III trials, ICH volume was prospectively calculated by CTP, RC-ABC and site-ABC. Agreement between CTP and ABC/2 was defined as an absolute difference of at most 5 ml and as a relative difference within 20%. Determinants of ABC/2 score accuracy were assessed by logistic regression.

**Results:** In 4369 scans from 507 patients, CTP was more strongly correlated with RC-ABC ( $r^2 = 0.93$ ) than site-ABC ( $r^2 = 0.87$ ). Although RC-ABC overestimated CTP-based volume on average (RC-ABC = 15.2 cm<sup>3</sup>, CTP = 12.7 cm<sup>3</sup>), agreement was reasonable when categorized into mild, moderate and severe ICH volume ( $\kappa = 0.75$ ,  $p < 0.001$ ). This was consistent with overestimation of ICH volume by ABC/2 in 6/8 previous studies. Agreement with CTP was greater for RC-ABC (84% within 5 ml; 48% of scans within 20%) than for site-ABC (81% within 5 ml; 41% within 20%). RC-ABC had moderate accuracy for detecting  $\geq 5$  ml change in CTP volume between consecutive scans (sensitivity 0.76, specificity 0.86) and was more accurate with smaller ICH, thalamic haemorrhage and homogeneous clots.

**Conclusions:** ABC/2 scores are sufficiently accurate to assess ICH volume and also to determine eligibility for the CLEAR III and MISTIE III studies, and moderately accurate for change in ICH volume. However, accuracy decreases with large, irregular or lobar clots.

## ESOC-0543

## 18. ICH and IVH

**Dimethylarginines in patients with intracerebral hemorrhage: Association with outcome**

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**Background:** Asymmetric dimethylarginine (ADMA) – an endogenous NO-synthase inhibitor has been regarded as mediator of endothelial dysfunction and oxidative stress. Experimental data suggest an involvement in intracerebral hemorrhage (ICH). We hypothesized that levels of ADMA and its analogon symmetric dimethylarginine (SDMA) are elevated after ICH and are associated with adverse clinical outcome.

**Methods:** Blood samples from 20 patients with acute ICH treated at Hannover Medical School were taken at  $\leq 24$  h, 3 d and 7 d after the event. Dimethylarginines were determined in serum using high-performance liquid chromatography–tandem mass spectrometry. Levels were compared with those in 30 control subjects without ICH not differing in regard to baseline characteristics and cardiovascular risk factors. According to the modified Rankin Scale (mRS) score at 90 d, 9 patients had favorable (mRS 0–2) and 11 patients unfavorable outcome (mRS 3–6).

**Results:** Levels of ADMA – but not SDMA – were significantly elevated in ICH patients at any time point compared to controls (ADMA  $\leq 24$  h:  $p < 0.001$ ; 3 d:  $p = 0.001$ ; 7 d:  $p < 0.001$ ). While ADMA levels increased from  $\leq 24$  h to day 7 ( $p = 0.030$ ), SDMA levels decreased from  $\leq 24$  h to day 3 ( $p = 0.029$ ). Dimethylarginine levels were significantly increased in patients with unfavorable outcome compared to those with favorable outcome (ADMA  $\leq 24$  h:  $p = 0.031$ ; SDMA  $\leq 24$  h:  $p = 0.016$ ; SDMA 3 d:  $p = 0.004$ ; SDMA 7 d:  $p = 0.031$ ). Outcome groups did not differ in regard to baseline characteristics and cardiovascular risk factors.

**Conclusion:** Our data show that dimethylarginine levels are increased after the acute event of ICH in relation to outcome. Further studies are needed to investigate the mechanisms behind.

## ESOC-1165

## 18. ICH and IVH

**Intracranial hemorrhage: 4 years experience**

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**Objective:** Patients with spontaneous intracerebral haemorrhage (ICH) were evaluated in terms of risk factors, hematoma size, localization and their effects over mortality and morbidity and post-stroke depression.

**Materials-methods:** Between 1/January/2010–1/March/2014, 216 ICH patients (142M:74F) were evaluated, demographic findings, risk factors and neurological examinations were recorded. Diagnosis, volume and localization of hematoma, its ventricular extension were evaluated by CT. First 30-days mortality rate was evaluated by ICH score and ICH grading scale. Modified Rankin Scale (mRS) was used to evaluate the dependency status and functional recovery. Hamilton Depression Rating Scale was applied for psychosocial determination.

**Results:** The mean age was  $65.3 \pm 14.5$  years. In 80.6% of patients HT, in 18.5% DM, in 15,3% hyperlipidemia and in 8.3% of patients CRF were

determined. The locations of ICH were lobar(28.3%), thalamus(26.4%), basal ganglia(24.0%), cerebellum(13.9%) and brainstem(7.4%) respectively. Hematoma volume average was  $15.8 \pm 23.8$  cm<sup>3</sup>. Ventricular extension of hemorrhage developed in 34.4%, midline shift in 28.7%, perihematomal edema in 27.8% were the most frequent complications. Six months follow-up showed (mRS: <3 good- $\geq$ 3 poor) poor prognosis in 57.9% and good in 42.1%. The mean age of poor prognosis group was significantly higher ( $p = 0.003$ ). The first 30-day mortality rate was significantly more frequent in patients with low GCS on admission, large volumes of hematoma, ventricular extension of hemorrhage ( $p = 0.0001$ ). In poor prognosis group, the presence of moderate depression (39.13%) was significantly higher ( $p = 0.0001$ ).

*Conclusion:* Evaluation and distinguishing the factors that may affect prognosis and mortality is crucial in achieving more effective management in patients with ICH.

## Imaging

### ESOC-0950

#### 19. Imaging

##### Diagnostic accuracy of CT-angiography for internal carotid artery stenosis – comparison with a revisited multiparametric ultrasound approach

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**Background:** We aimed to determine the accuracy of CT-angiography (CTA) compared with the novel multiparametric duplex ultrasound (DUS) approach from the Neurosonology Research Group (NSRG) for extracranial ICA stenosis diagnosis.

**Methods:** We studied consecutive acute ischemic stroke patients who were admitted from 01/2012 to 12/2012 and underwent CTA and DUS. On DUS, ICA stenosis and complete occlusion were graded according to the published NSRG criteria. Axial CTA source images were independently assessed and NASCET-type measurements were manually performed for each extracranial ICA. We calculated accuracy parameters of CTA for identification of 50–99% and 70–99% ICA stenosis, and complete ICA occlusion using DUS as reference.

**Results:** A total of 339 patients (age  $72 \pm 12$  yrs, 58% men, median NIHSS 4, interquartile range 8) provided 651 DUS and CTA measurement pairs. On DUS, 50–99% stenosis was found in 28, 70–99% stenosis in 16, and complete occlusion in 29 ICAs. The sensitivity of CTA against DUS was low for both 50–99% and 70–99% ICA stenosis (64% and 31%, respectively). Further accuracy parameters of CTA were as follows: specificity 97%, PPV 49%, NPV 98% and overall accuracy 96%, and 99%, 56%, 98% and 98%, respectively. The highest accuracy of CTA was obtained for discriminating between complete ICA occlusion and non-occlusion: 100%, 96%, 91%, 100% and 99%.

**Conclusions:** In comparison with the widely used NSRG criteria, CTA seem to underestimate the degree of extracranial ICA stenosis. The validity of the NSRG criteria is currently evaluated in a prospective multicenter validation study utilizing invasive angiography as gold standard.

### ESOC-1178

#### 19. Imaging

##### Brain atrophy as assessed by baseline clinical computed tomography scans predicts post-stroke delirium

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**Background:** Delirium affects ~25% of stroke patients in hospital, and is associated with adverse outcomes. It is unclear whether acute (stroke lesion) and chronic (cerebral atrophy and white matter lesions (WMLs)) brain changes on routine computed tomography (CT) brain imaging predict delirium. We aimed to identify whether CT features predicted delirium at up to four months post-stroke.

**Methods:** Ninety-five participants (aged > 60, median 77) with acute stroke were assessed for delirium, using the Confusion Assessment Method-ICU and the Delirium Rating Scale-Revised-98 on alternate days for one week after stroke, then at 14 days, 28 days and 4 months. Baseline CT scans were rated for acute stroke lesions and presence and severity

of cerebral atrophy and WMLs (0 = none, 1 = mild, 2 = moderate, 3 = severe). Relationships between CT features and delirium diagnosis (binary outcome, based on at least one positive screening test) were examined with Chi-square.

**Results:** 26 (27%) participants developed delirium. Greater severity of brain atrophy predicted delirium after stroke. Neither WMLs nor a visible acute stroke lesion predicted delirium (see table).

CT feature	Delirium (n = 26) n(%)	No delirium (n = 69) n(%)	p
Atrophy present	24 (92)	54 (78)	.026*
WMLs present	21 (81)	42 (61)	.296*
Visible acute stroke lesion	13 (50)	26 (38)	.281

\*Chi-squared test of severity of atrophy/WMLs (0,1,2,3) and delirium (yes/no)

**Discussion:** Greater severity of brain atrophy as assessed by CT predicted development of delirium in the four months after stroke. CT parameters derived from routine clinical scans may aid prediction of those most at risk of delirium.

### ESOC-1334

#### 19. Imaging

##### Continuing versus stopping pre-stroke antihypertensive therapy and neuroimaging findings and outcomes following acute ischaemic stroke:

##### Results from the Efficacy of Nitric Oxide in Stroke trial

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**Introduction:** Around 50% of patients with acute stroke are on antihypertensive therapy at presentation. It remains unclear whether this medication should be continued or stopped temporarily.

**Methods:** ENOS randomised 2097 participants to continue or stop pre-stroke antihypertensive therapy for 7 days. We assessed the relationship between baseline imaging and outcome at day 90 (modified Rankin scale, Barthel Index), and the effect of continuing antihypertensives on follow-up neuroimaging at day 7. Data are adjusted odds ratio (95% confidence intervals).

**Results:** Baseline imaging variables associated with worse mRS scores at day 90 were; previous stroke lesion (OR 1.38, 95% CI 1.14–1.67,  $p = 0.001$ ), acute stroke change (OR 1.31, 1.10–1.57,  $p = 0.003$ ), lobar infarction (OR 1.45, 1.06–1.97,  $p = 0.019$ ), ASPECTS score  $\leq 7$  (OR 0.95, 95% CI 0.91–0.98,  $p = 0.001$ ), and mass effect (OR 1.40, 1.16–1.69,  $p < 0.001$ ). In subgroup analyses, patients with cerebral atrophy at baseline were more likely to benefit from stopping therapy (interaction  $p = 0.044$ ). There were no significant differences between treatment

groups in the 26.8% of patients with neuroimaging at day 7: lesion site, size, ASPECTS score, mass effect, ischaemic characteristics, and haemorrhagic transformation.

**Discussion:** Baseline imaging variables can contribute to early prognostication of patients with acute ischaemic stroke. Patients with cerebral atrophy on imaging may particularly benefit from stopping therapy short term, perhaps because it reflects dehydration. Continuation or stopping pre-existing antihypertensive treatment does not affect early neuroimaging findings.

## ESOC-1018

### 19. Imaging

#### Hemodynamic determinants of effective reperfusion in patients with acute ischemic stroke as assessed by CT perfusion

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**Background:** We sought to identify CTP parameters at stroke onset and at follow-up associated with reperfusion at 24 hours and good clinical outcome at 90 days.

**Methods:** We retrospectively investigated 80 patients with anterior circulation acute ischemic stroke (11 untreated and 69 treated with either intravenous thrombolysis or endovascular therapy) who were imaged <6 hours from stroke symptom onset with non-enhanced CT, CT Angiography (CTA) and CT perfusion (CTP) at admission and at 24 hours. Cerebral blood flow (CBF), cerebral blood volume (CBV) and Tmax were measured in total hypoperfused area as outlined on baseline Tmax maps. Recanalization was assessed on 24 hour CTA according to TIC1 criteria modified for CTA. Successful reperfusion was defined as  $\geq 59\%$  reduction in size of baseline Tmax lesion at follow-up CTP. Good outcome was defined as 90 day-modified Rankin scale (mRS)  $\leq 2$ .

**Results:** Recanalization and reperfusion occurred in 82.5% and 51.2% of cases, respectively. A good outcome was present in 68.3% of reperfusers. Admission CBF, CBV and Tmax were similar between reperfused and non reperfused patients and between good and poor outcome reperfusers. 24-hour CBF was higher ( $p < 0.01$ ) and Tmax was lower ( $p < 0.00001$ ) in reperfused than nonreperfused patients but 24-hour CBF and CBV were higher ( $p < 0.05$  and  $p < 0.01$ , respectively) in poor than good outcome reperfusers. Successful recanalization was equally distributed between good and poor outcome reperfusers.

**Conclusions:** Our findings suggest that CBF and CBV values detected in ischemic brain at 24 hours after stroke may be determinants of the efficacy of reperfusion (i.e. good outcome in reperfusers).

## ESOC-1289

### 19. Imaging

#### Extension of ischemic lesions differs between grey and white matter

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**Purpose:** In acute ischemic stroke (AIS), white matter (WM) is considered to be more resistant to infarction than grey matter (GM). We compared the evolution of ischemic lesions within WM and GM using magnetic resonance imaging (MRI).

**Methods:** From a multicenter prospective database (*I-KNOW*), 50 patients presenting an anterior AIS with (1) a perfusion (PWI) / diffusion-weighted imaging (DWI) mismatch ratio of 1.2 or more; and (2) available T1-weighted images were identified.

Five tissue compartments were outlined: (1) initial DWI lesion; (2) initial PWI-DWI mismatch ( $T_{max} > 4$  s and DWI-negative); (3) final infarct mapped on 1-month FLAIR; (4) lesion growth (between acute DWI and 1-month FLAIR); (5) DWI lesion reversal at 1-month.

WM and GM were segmented on T1-weighted images and corresponding volumes were calculated for each compartment. All images were coregistered within subjects to the baseline MRI.

**Results:** Median delay between symptom onset and baseline MRI was 140 minutes.

Volume of WM was significantly greater in the following compartments: initial mismatch (16.08 versus 12.40 mL,  $p = 0.003$ ), final infarct (8.28 versus 5.74 mL,  $p < 0.001$ ) and lesion growth (5.18 versus 2.72 mL,  $p < 0.001$ ). There was no significant difference between GM and WM volumes within the initial DWI lesion or tissue showing DWI lesion reversal.

**Conclusion:** These results suggest that ischemic lesions may extend preferentially within the WM. Therapeutic strategies that are effective within the WM should be developed.

## ESOC-1389

### 19. Imaging

#### Comparison between the "DWI B0-DWI B1000" mismatch and the DWI-FLAIR mismatch to identify patients with acute ischemic stroke within 4.5 hours: A preliminary study

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**Purpose:** The diffusion-weighted imaging–fluid-attenuated inversion recovery (DWI-FLAIR) mismatch can be used to identify patients within 4.5 hours after stroke onset.

DWI includes  $b = 0$  sec/mm<sup>2</sup> images that are T2-weighted but not diffusion-weighted, unlike  $b = 1000$  sec/mm<sup>2</sup>.

We compared the accuracy of the b0–b1000 mismatch (lesion absent on b0, hyperintense on b1000) and the DWI-FLAIR mismatch (FLAIR negative, b1000 positive) to identify patients presenting within 4.5 hours.

**Methods:** Patients were included in an European multicenter database (*I-KNOW*) and presented an anterior acute ischemic stroke (AIS) lesion hyperintense on DWI b1000, with known time of onset.

Two readers independently evaluated lesion conspicuity on FLAIR images (absent, subtle or frank). Absent and subtle signal changes were classified in the “FLAIR negative” group.

Lesion visibility on b0 images was independently evaluated by two other readers, who considered the lesion either absent (b0 negative) or present (b0 positive).

**Results:** Among 122 patients analysed, 85 (75.89%) were within 4.5 hours after stroke onset.

“b0-b1000” mismatch identified patients within 4.5 hours with 72.94% [95%CI 63.50–82.39] sensitivity, 70.37% [53.15–87.59] specificity, 88.57% [81.12–96.02] PPV and 45.24% [30.19–60.29] NPV.

DWI-FLAIR mismatch identified patients within 4.5 hours with 80.00% [95%CI 71.50–88.50] sensitivity, 62.96% [44.75–81.18] specificity, 87.18% [79.76–94.60] PPV and 50.00% [33.19–66.81] NPV.

Interrater agreement for lesion visibility on b0 was excellent ( $\kappa = 0.826$ ; 95%CI 0.718–0.934,  $p < 0.001$ ), better for deep MCA territory lesions ( $\kappa = 0.910$ ). Interrater agreement on FLAIR was good ( $\kappa = 0.719$ ; 95%CI 0.577–0.861,  $p < 0.001$ ).

**Conclusion:** The “b0-b1000 mismatch” could be considered as an alternative for the diffusion-FLAIR mismatch in situations that have to be determined more precisely.

**Background:** The location and volume of cerebral infarction after acute ischemic stroke is strongly related with patient outcome. A probabilistic atlas of cerebral infarctions represents the likelihood of finding infarcted tissue at a specific position for each subject. Knowledge of this topographic distribution of ischemic infarctions has the potential to provide insight in the patient’s outcome, progression of the disease, and may guide treatment decisions.

**Methods:** We describe the creation of a digital probability atlas of infarction location and volume, associated with patient specific characteristics and vessel branch occlusion territory using NCCT images. Infarctions were automatically segmented on follow-up NCCTs and registered into a coordinate space of a healthy subject’s brain.

**Results:** We included 361 follow-up NCCTs of acute ischemic stroke patients who were enrolled in the MRCLEAN study. This resulted in a 3D-representation of the probability of infarction after an acute ischemic stroke due to thromboembolic occlusion of the anterior circulation. The atlas can dynamically be changed to determine the relation with patient’s characteristics and probability of ischemic core.

**Conclusion:** We have created a novel digital probability atlas of ischemic infarctions using CT imaging techniques. This approach is a paradigm shift in studying the relation between baseline characteristics and radiological outcome and has the potential to establish the distribution of arterial territories and their role in patient outcome.

## ESOC-1445

### 19. Imaging

#### Digital probability atlas of cerebral ischemic infarctions after acute ischemic stroke

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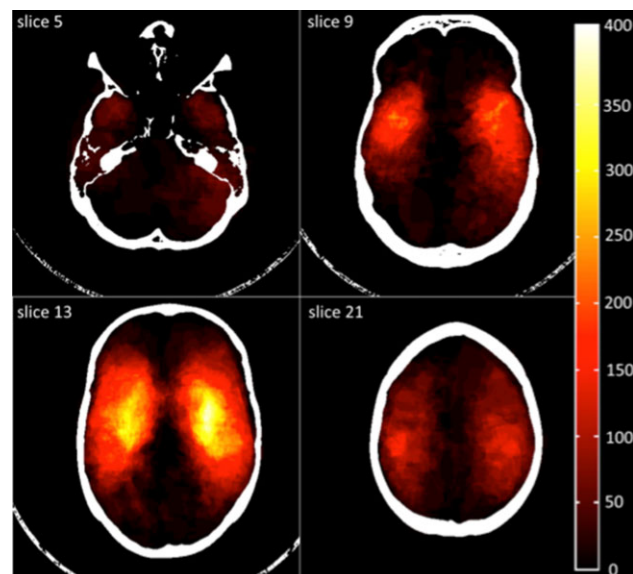
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## ESOC-0961

## 19. Imaging

**Severe hypoperfusion in the absence of a large ischemic core should not exclude patients from reperfusion therapies**

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**Background:** Optimal imaging selection for endovascular therapy for ischemic stroke remains controversial with a range of criteria used in the recent positive trials. Large volume severe hypoperfusion ( $T_{max} > 10$  s) is one such criterion, with optimal threshold  $> 82$  mL ('malignant profile'), in a previous study. We examined whether this was associated with poor response to reperfusion in the EXTEND-IA randomized trial, which did not exclude patients on this basis.

**Methods:** Patients receiving tPA  $< 4.5$  h with major vessel occlusion and favourable CT-perfusion (CTP) were randomised (after written informed consent, IRB-approved) to thrombectomy after tPA versus tPA-alone. CTP eligibility required mismatch ratio  $> 1.2$  between hypoperfused tissue ( $T_{max} > 6$  s) and irreversibly injured ischemic core (relative cerebral blood flow  $< 30\%$ ), absolute mismatch  $> 10$  mL, ischemic core  $< 70$  mL (RAPID software, Stanford University).  $T_{max} > 10$  s volume was calculated and effect on clinical outcomes examined.

**Results:** There were 70 patients, 35 in each arm, mean age = 69, median NIHSS = 15. In these patients with ischemic core  $< 70$  mL, median  $T_{max} > 10$  s volume was 41 mL with 12/70 (17%)  $> 82$  mL,

6/70 (8.6%)  $> 100$  mL. Of the 'malignant' patients ( $T_{max} > 82$  mL), 6/12 (50%) had  $> 90\%$  reperfusion at 24 h (4 endovascular and 2 tPA-only), all of whom had 'early neurological recovery' ( $\geq 8$  point NIHSS reduction or 0–1 by day 3) and 5/6 (83%) had 90 day mRS0–1. No patient with  $< 90\%$  reperfusion had day 90 mRS  $< 3$ .

**Conclusions:** In ischemic stroke patients  $< 4.5$  h after onset, large  $T_{max} > 10$  s volume in the absence of a large ischemic core was uncommon. Although the numbers in this study were small, the 83% rate of excellent functional outcome after reperfusion suggests that excluding such patients from therapy may not be justified.

## ESOC-0829

## 19. Imaging

**Does penumbral volume decrease over time?**

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**Introduction:** Human imaging studies show significant penumbral volumes for many hours after stroke onset, yet loss of benefit from reperfusion within 6 h implies diminishing volumes of penumbra. We investigated core and penumbra volumes and collateral status in relation to time after stroke.

**Methods:** Using data from three CTP and CTA studies in acute ischaemic stroke  $< 6$  h after onset we measured core (rDT  $> 2$  s and rCBF  $< 40\%$ ) and penumbra (rDT  $> 2$  s) volumes and graded collaterals using Miteff's classification (good – vessels reconstitute distal to the occlusion; moderate – vessels seen at the Sylvian fissure; poor – opacification restricted to distal superficial branches). We defined target mismatch as core volume  $< 70$  ml, perfusion volume  $> 15$  ml, mismatch ratio  $> 1.8$ . Patients were grouped by onset-to-imaging time ( $< 3$ , 3–4.5, 4.5–6 h).

**Results:** Analysis included 144 patients. Across time epochs, proportions of penumbra (59%, 64%, 75% at  $< 3$ , 3–4.5,  $> 4.5$  h respectively,  $p = 0.4$ ), poor collaterals (15/56 [27%], 14/47 [30%], 4/15 [27%],  $p = 0.9$ ) and target mismatch (56%, 74%, 67%,  $p = 0.09$ ) were not different. Penumbra proportion was 45% with poor collaterals versus 72% with good-moderate collaterals ( $P < 0.001$ ); penumbra proportion was not related to time to imaging ( $R^2 = 0.003$ ;  $P = 0.5$ ) but a trend for divergent effects by collateral status was seen (slight increase in penumbra over time with good collaterals versus reduced with poor,  $p = 0.08$  for interaction).

**Conclusion:** Penumbra proportion did not vary over the first 6 hours after stroke. There was a trend for divergent effects of collateral status on penumbra proportion over time. Reduced penumbra proportion does not seem to account for loss of reperfusion efficacy.

## ESOC-1544

## 19. Imaging

**Relationship of cerebral haemorrhage and oedema with recanalisation after iv thrombolysis**

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**Introduction:** We investigated the associations of brain oedema, haemorrhage, and recanalisation after IV thrombolysis.

**Methods:** Data on patients treated with IV rtPA  $< 4.5$  h were extracted from three multimodal CT studies, obtaining volumes of core (rDT  $> 2$  s, rCBF  $< 40\%$ ) and penumbra (rDT  $> 2$  s). We defined large core as  $> 50$  ml. On 24 h CT, we classified intracerebral haemorrhage (ICH) by ECASS-2 and brain oedema as, no swelling (0), effacement of lateral ventricle (1), effacement of lateral & 3rd ventricle (2), midline shift (3). Significant Brain Swelling (SBS) was defined as edema types 2 or 3. Recanalisation was defined as TIMI 2–3 on 24 h CTA. Raters blinded to outcome read CTA and CTP independently.

**Results:** Of 123 subjects (median age 74 yrs, median NIHSS 15, median time to treatment 179 min, ICA or M1 occlusion 30/123 (25%), recanalisation 80/123 (66%)); ICH was more frequent with recanalisation (28/80, 35% vs. 8/43, 19%;  $p = 0.057$ ), but not PH1 or PH2 (6/80, 7% vs. 2/43, 4%;  $p = 0.5$ ), oedema (32/78, 41% vs. 23/43, 53.5%;  $p = 0.18$ ) or SBS (12/78, 15% vs. 6/43, 14%;  $p = 0.8$ ). ICA or M1 occlusion (19/23(82%) vs. 68/105(65%);  $p = 0.09$ ), poor collaterals (9/18 (50%) vs. 17/86 (20%);  $p = 0.007$ ) were more frequent in SBS. SBS was associated with large core (OR 15.8, 95% CI 4.4–56;  $p < 0.01$ ). SBS (OR 0.8, 95% CI 0.3–3;  $p = 0.8$ ) and PH1 or PH2 (OR 1.7, 95% CI 0.33–8;  $p = 0.5$ ) were not associated with recanalisation.

**Conclusion:** SBS, but not PH1 or PH2 is associated with large core; both are not associated with recanalisation.

## ESOC-1241

### 19. Imaging

#### Predictors of focal perfusion abnormalities in CT perfusion for supratentorial transient ischemic attacks

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**Background:** Acute non-contrast CT (NCCT) for patients with TIA has poor sensitivity when compared with diffusion-weighted MRI (DWI). We investigated the frequency and predictors of focal perfusion deficits (FPD), i.e. hypo- or hyperperfusion, on acute CT perfusion (CTP) in patients with supratentorial TIA.

**Methods:** We prospectively collected data of consecutive patients with TIA clinically attributable to supratentorial territories who underwent CTP within 24 h of symptom onset from 06/2002 to 08/2014: demographics, risk factors, clinical symptoms and NIHSS, duration of TIA, symptom onset to CTP delay, and symptom persistence at CTP. We also recorded different ABCD scores, vascular territories and significant arterial pathology ( $\geq 50\%$  stenosis or occlusion in arteries leading to the ischemic territory). Variables were compared in uni- and multivariate analyses between patients with and without FPD.

**Results:** Of 223 supratentorial TIA patients, 98 (44%) had an early ischemic lesion on NCCT, and 98 (44%) had FPD, 97% of which had hypoperfusion. FPD was positively associated with significant intracranial arterial pathology (OR = 40.24,  $p < 0.001$ ), early ischemic changes on NCCT (OR = 8.34,  $p = 0.008$ ), CTP during symptoms (OR = 4.16,  $p = 0.003$ ), right hemispheric TIAs (OR = 3.42,  $p = 0.002$ ), preceding recent TIAs (OR = 2.53,  $p = 0.059$ ), NIHSS (OR = 1.24,  $p = 0.014$ ), and negatively with duration of the TIA (OR = 0.92,  $p = 0.022$ ). There was no significant association with different ABCD scores.

**Conclusions:** Our data suggest that the frequency of lesions detected on CTP for supratentorial TIAs may be similar to that known of DWI. Predictors of FPD include intracranial arterial pathology (most likely a source of emboli), and clinical symptom severity.

## ESOC-1497

### 19. Imaging

#### Cerebral infarct core estimation using aspects on plain CT and perfusion CT: Interregional variability

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**Background:** We aimed to compare the sensitivity and specificity of ASPECTS-score on plain-CT to predict the infarct core in each regions of ASPECTS-score and to identify those ASPECTS cerebral regions in which the estimation of infarct core using plain-CT is less reliable.

**Methods:** We prospectively studied consecutive acute middle cerebral-artery (MCA) stroke patients who underwent plain-CT and perfusion-CT (CTP). CTP source-images were postprocessed and quantitative maps were obtained by means Olea-Perfscape software. Two readers blinded to CTP-data. Infarct core was defined according to CTP by a relative Cerebral Blood Flow (CBF) map  $< 0.4$ . ASPECTS-score were analyzed on both plain-CT and CTP. Sensitivity and specificity and positive and negative predictive values (PPV/NPV) on plain-CT as compared to CTP.

**Results:** One hundred and twenty patients with MCA ischemic stroke were included (43.3% women, mean-age 73.06, median-NIHSS 15). Median-ASPECTS was 8 (7–10) on plain-CT vs 9 (7–10) on CTP. PPV-ranged from 41.9%–77.3% for each region of ASPECTS-score; whereas NPV-ranged from 80%–94.9%. PPV/NPV were M1 77.3%/87.2%, M2 57.1%/92%, M3 57.1%/92.2%, Lenticular 50%/94.9%, Caudate 61.1%/91.8%, internal capsule 54.5%/86.7%, Insula 41.9%/88.9%, M4 66.7%/80%, M5 58.3%/80.6%, M6 45.5%/94.6% respectively. Sensitivity/Specificity were M1 51.5%/94.2%, M2 59.2%/87%, M3 40%/94%, Lenticular 72%/78.9%, Caudate 50%/91.8%, internal capsule 25%/94.79%, Insula 74.28%/56.47%, M4 25.64%/93.82%, M5 20%/92.94%, M6 25%/94% respectively.

**Conclusions:** The reliability of cerebral infarct core estimation using ASPECTS-score on plain-CT varies between different regions analyzed. The sensibility is lower than 0.5 in M4, M5 and M6 regions whereas the only regions with a specificity  $< 0.9$  are insula and lenticular nucleus.

## ESOC-1439

### 19. Imaging

#### Multi-phase CTA: A new tool for the imaging triage of patients with acute ischemic stroke

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**Purpose:** To describe an imaging selection tool, multi-phase CTA (mCTA) for use in acute ischemic stroke (AIS), and to demonstrate its inter-rater reliability, and ability to determine clinical outcome.

**Methods:** The local ethics board has approved the study. Data is from the pilot phase of PROVEIT, a prospective observational study analyzing utility of multi-modal imaging in the triage of AIS patients. Patients had baseline non-contrast CT (NCCT), single-phase CTA head/neck, mCTA, and perfusion CT (PCT). mCTA generates time-resolved images of pial arteries. Pial arterial filling was scored on a 6-point ordinal scale and inter-rater

reliability tested. Clinical outcomes included  $\geq 50\%$  drop in NIHSS over 24 hours and 90 day mRS 0–2. Ability to predict clinical outcomes were compared between sCTA, mCTA and PCT using receiver operating curve (ROC) analysis, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

**Results:** One hundred forty-seven patients were included. Inter-rater reliability for mCTA is excellent ( $n = 30$ ,  $\kappa = 0.81$ ,  $p < 0.001$ ). On ROC analysis, ability to predict clinical outcome is modest (c-statistic 0.56, 95% CI: 0.52–0.63 for  $\geq 50\%$  drop in NIHSS over 24 hours and 0.6, 95% CI: 0.53–0.68 for 90 day mRS 0–2), but better than models using sCTA and PCT. ( $p < 0.05$  overall) Using AIC and BIC, models using mCTA are better than models using sCTA and PCT for  $\geq 50\%$  drop in NIHSS over 24 hours (AIC = 166 and BIC = 171.7; values least for mCTA) and 90 day mRS 0–2 (AIC = 132.1 and BIC = 137.4; values least for mCTA).

**Conclusion:** mCTA is a reliable tool for imaging selection in patients with acute ischemic stroke.

**ESOC-0835**

**19. Imaging**

**Stability of SWI acute ischaemic signs during transient hyperoxia**

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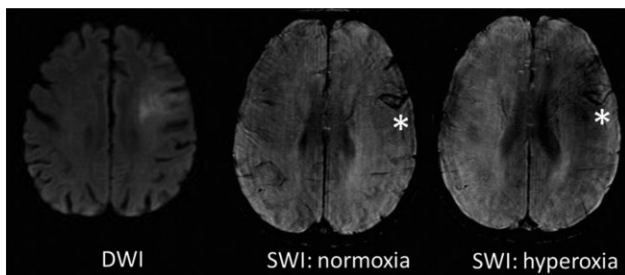
<sup>2</sup>*Department of Neuroradiology, Southern General Hospital, Glasgow, United Kingdom*

**Background:** Hyperoxia precipitates increases in T2\*-weighted signal, thereby reducing conspicuity of vessels on MRI. Using data from an ongoing study, we determined if early ischemic signs on Susceptibility Weighted Imaging (SWI) persist during hyperoxia.

**Methods:** Subjects within 48 h of onset of ischemic stroke underwent MRI including SWI before and during hyperoxia. We performed a side-by-side analysis of SWI acquired before and during hyperoxia and evaluated the following: susceptibility-vessel sign (SVS), cortical vessel sign (CVS), and the brush sign (BS).

**Results:** Nine consecutive subjects were analysed, of whom 8 had a final diagnosis of stroke. One subject did not complete baseline imaging. MRI was repeated after 5 days in 5 subjects. Of the 8 stroke subjects, clinical and demographic data (median, range) are: age = 67 y (59–84 y), NIHSS = 11(3–26), median time to MRI = 11 h (4–26 h). The SVS was seen in 4 subjects, BS in one (also seen on DWI) and CVS in 5 subjects. All signs remained visible during hyperoxia. Figure 1 shows persistence of a CVS (\*) after hyperoxia, and a suggestion of relative parenchymal hypointensity after hyperoxia in the DWI lesion region.

**Conclusions:** Important signs on SWI are not abolished by hyperoxia. The brush sign can also be seen on DWI in addition to SWI. Hyperoxia may highlight the relative hypointensity in regions of infarct core.



**ESOC-0809**

**19. Imaging**

**Cerebellar cortical cavities: Prevalence and association with risk factors and markers of cerebrovascular disease**

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**Purpose:** Cerebellar ischaemic cavities preferentially involve the cerebellar cortex and may present as an incidental finding on MRI. We aimed to investigate the occurrence, risk factor profiles, and MRI correlates of cerebellar cortical cavities (CCC's) on brain MRI in a cohort of patients with underlying vascular disease.

**Methods:** Within 636 patients ( $62 \pm 9$  years) from the SMART-Medea study, CCC's were visually determined on 1.5T 3D-T1-weighted images and were correlated with vascular risk factors and MRI markers of cerebrovascular disease, intracranial atrophy, and cerebral blood flow using logistic regression analyses.

**Results:** CCC's were observed in 9.6% of patients and were significantly associated with increasing age, history of cerebrovascular disease, atherosclerosis (IMT) and hyperhomocysteinemia. CCC's were significantly associated with supratentorial infarcts, brainstem infarcts, gray matter lacunes and atrophy, while no significant associations were found with white matter hyperintensities, white matter lacunes, or cerebral blood flow, after correction for age and sex.

**Conclusion:** CCC's are common in patients with arterial disease and are associated with other manifestations of cerebrovascular disease.

	<b>Odds Ratio</b>	<b>95% CI</b>
<b>Vascular Risk Factors</b>		
Smoking	1.0	1.0–1.0
Alcohol consumption	1.0	0.7–1.5
Arterial hypertension	1.6	0.9–2.8
Diabetes Mellitus	1.4	0.7–2.8
Cholesterol	0.8	0.6–1.1
Hyperhomocysteinaemia	1.8	1.01–3.3
IMT	2	1.1–3.7
<b>Cerebrovascular Markers on MRI</b>		
Supratentorial infarct	2.9	1.6–5.3
Brainstem infarct	5.1	1.9–13.6
Gray and White Matter Lacunes	2.4	1.3–4.2
Gray Matter Lacunes	3.0	1.6–5.8
White Matter Lacunes	1.1	0.5–2.5
White Matter Hyperintensities	1.2	0.8–1.8
Brain Parenchymal Fraction	0.8	0.7–0.9
Peak Blood Flow Total	1.0	1.0–1.0
Peak Blood Flow Basilar Artery	1.0	0.9–1.1



## ESOC-0810

## 19. Imaging

## Cerebellar cortical cavities and posterior circulation stroke

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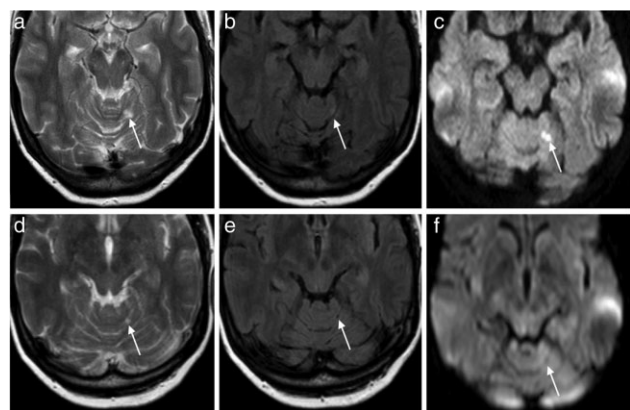
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**Purpose:** Cerebellar ischaemic cavities preferentially involve the cerebellar cortex and may present as an incidental finding on MRI. We aimed to investigate the relationship between cerebellar cortical cavities (CCC's) and vertebrobasilar TIA or stroke.

**Methods:** We retrospectively evaluated 46 patients with a recent vertebrobasilar TIA or stroke and symptomatic vertebral artery stenosis >50% from the Vertebral Artery Stenting Trial (VAST). We evaluated the presence of CCC's and acute posterior circulation infarcts on MRI. CCC's found at presentation were correlated with previous history of TIA or stroke, and were statistically correlated with cerebrovascular risk factors using Poisson regression analyses, before and after correction for age and sex. Available follow-up MRI scans were evaluated to document the evolution of acute cerebellar infarcts over time.

**Results:** Sixteen out of 46 (35%) patients showed CCC's on the initial MRI of patients presenting with vertebrobasilar TIA/stroke, while 73% of patients showed acute posterior circulation infarction(s). Of the 16 patients with CCC's, only one showed a positive history of prior stroke while only two showed a positive history of prior TIA. No significant associations independent from vertebrobasilar stenosis were found between CCC's and cerebrovascular risk factors. Three patients with evidence of acute – DWI positive – cerebellar infarction at presentation received follow-up MRI after an interval exceeding six months, and all three developed CCC's replacing the initial infarctions (Fig. 1).

**Conclusion:** CCC's are common in patients with recently symptomatic vertebral artery stenosis and may result from prior infarction of athero-thrombo-embolic origin, usually without prior history of TIA or stroke.



## ESOC-1216

## 19. Imaging

## 7-Tesla MRI relaxometry shows heterogeneity of white matter hyperintensities and correlates with clinical severity at the early stage of CADASIL

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White matter hyperintensities (WMH) are the first MRI marker to appear in cerebral small vessel disease (SVD), but their relationships to the clinical status early in the disease are unclear.

The aim of the present work was to compare CADASIL (Cerebral Autosomal Dominant Arteriopathy with Subcortical Infarcts and Leukoencephalopathy) patients without severe cognitive impairment and without disability (MMSE > 24 and modified Rankin's scale ≤1) and age and sex matched controls to: 1) demonstrate WMH heterogeneity using T2\* and T1 relaxometry obtained at ultra-high field; 2) evaluate whether relaxation times are related to early clinical symptoms.

Whole brain high-resolution T1 and T2\* maps were performed on a 7-Tesla scanner in 20 CADASIL patients (age 56.7 ± 11.1 years) and 17 controls (age 57.2 ± 12.3). All underwent a comprehensive neuropsychological and behavioral evaluation, including computerized tests of processing speed and executive functions, depression and apathy.

T2\* and T1 maps revealed strong heterogeneities in white matter compared to controls (for T2\*, SD/mean = 154% in patients vs. 26% in controls), left undetected by conventional MRI. This heterogeneity was represented by local variations of myelin content estimated from T1 and T2\* using a model recently demonstrated neuropathologically. In patients, myelin content was related to flexibility (p = 0.04), planning task (p = 0.04), scales of depression (p = 0.001) and apathy (p = 0.04). By contrast, other major conventional markers of SVD (volume of WMH, volume of lacunar lesions, brain atrophy) were not related to any cognitive/behavioral measure.

Our results support the hypothesis that WMH originate from various mechanisms that impact differently the clinical status at the early stage of SVD.

## ESOC-1141

## 19. Imaging

## Real-time transcranial optical monitoring of cerebral blood flow in acute ischemic stroke during and after thrombolysis

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**Background:** Recent clinical evidence suggests that tissue reperfusion is a better predictor of outcome than recanalization in acute ischemic stroke (AIS) after thrombolysis. Diffuse correlation spectroscopy (DCS) is a promising non-invasive tool for optical bedside monitoring of microcirculatory cerebral blood flow (CBF). We tested whether the effect of thrombolysis on cerebral perfusion can be assessed by real-time diffuse optical monitoring of CBF in patients with AIS.

**Methods:** In a sample of five patients with an acute MCA occlusion, we performed bilateral DCS monitoring to measure relative CBF in the frontal lobes continuously during the first 2,5 hours after rtPA bolus. We evaluated the CBF temporal profile by analyzing a 6-minutes-averaged

CBF value every 15 minutes in both hemispheres. We evaluated the results in relation to presence of recanalization on follow-up transcranial Doppler and early clinical outcome.

**Results:** Three men and 2 women (mean age  $80 \pm 14$ , median NIHSS 19) were monitored by DCS. Globally, a significant CBF increase was observed from 90 minutes after rtPA bolus in the ipsilateral stroke side (median 33%, range 23–71%), but not in the contralateral (median 8%, range –3–49%). At 24 hours, all patients improved by 8 or more points in the NIHSS (median NIHSS 3). Complete arterial recanalization was documented in all but one patient (due to insufficient acoustic window).

**Conclusions:** Bedside optical monitoring showed capability for real-time detection of the effect of reperfusion therapy on CBF after AIS. Continuous CBF monitoring may offer new therapeutic and prognostic insights in the management of acute stroke patients.

**ESOC-1004**

**19. Imaging**

**Intracranial atherosclerotic lesion characteristics correlate with cerebrovascular lesion load after TIA or ischemic stroke: A 7.0 Tesla MRI study**

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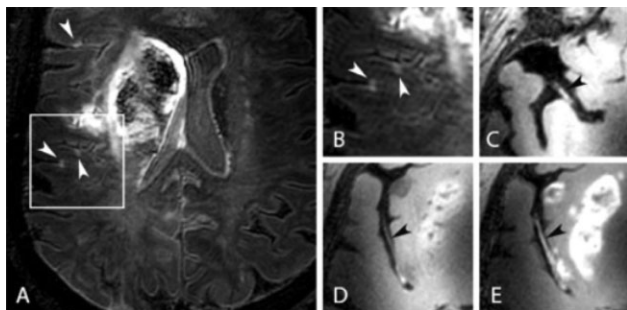
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**Purpose:** To explore the presence of cortical microinfarcts (CMIs) at 7T MRI in patients with TIA or ischemic stroke of the anterior circulation, and their relationship with intracranial atherosclerosis (ICAS) and macroinfarcts.

**Methods:** Eighteen patients presenting with ischemic stroke (n = 12) or TIA (n = 6) underwent FLAIR- and MPR-TSE<sup>1</sup> intracranial vessel wall imaging at 7T MRI. ICAS lesions and their characteristics,<sup>2</sup> as well as infarcts (CMIs and macroinfarcts) (Fig. 1), were scored by two raters. The relationship between ICAS lesions, calculated ratios of characteristics and infarcts were examined using linear regression analyses.

**Results:** 101 CMIs, 31 macroinfarcts and 75 ICAS lesions were found. 76% and 65% of CMIs and macroinfarcts, respectively, were found in the same vascular territory of ICAS lesions. A positive correlation existed between macroinfarcts and CMIs (p < 0.05) and concentric configuration and macroinfarcts (p < 0.01); for CMIs no correlation was found. A diffuse thickening pattern was positively correlated to macroinfarcts (p < 0.05); a weak trend was found for CMIs (p = 0.09).



**Fig. 1** A 75-year-old female patient presented with ischemic stroke of the right MCA territory. (A) Transverse 7T T2-weighted FLAIR image shows and infarct of the right MCA territory with three CMIs (white arrowheads); (B) shows a zoomed view of the box drawn in A. (C–E) Transverse 7T T2-weighted intracranial vessel wall images before (C and D) and after

contrast administration (E) show thickening of the right M1 (C) and M2 (D) segments of the MCA, and enhancement of the M2 vessel wall segment after contrast administration (E) (black arrowheads).

**Conclusion:** This study shows that in patients with TIA or ischemic stroke CMIs represent a relevant portion of the total cerebrovascular lesion load and coexist with macroinfarcts. These results demonstrate that the spectrum of parenchymal damage caused by ICAS is not restricted to macroinfarcts, but also include CMIs.

**Referens**

- 1 Van der Kolk et al., Stroke 2011
- 2 Dieleman et al., Neurology 2014

**ESOC-1014**

**19. Imaging**

**Plaque characteristics, burden and distribution assessment in an Asian population with high-resolution intracranial vessel wall imaging at 3 Tesla MRI**

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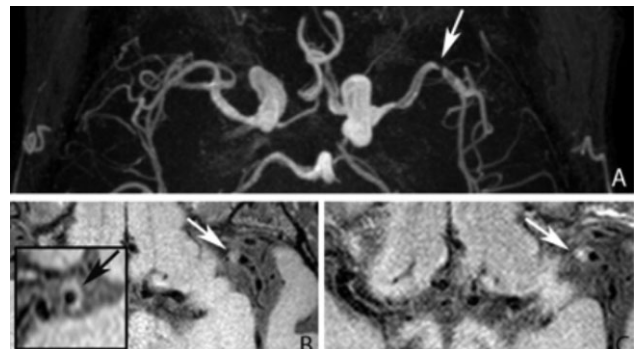
<sup>2</sup>Medicine, Chinese University of Hong Kong, Hong Kong, China

<sup>3</sup>Imaging and Interventional Radiology, Chinese University of Hong Kong, Hong Kong, China

**Purpose:** To qualitatively evaluate intracranial plaque characteristics (contrast enhancement, thickening and configuration (1), total plaque burden and distribution in patients with an middle cerebral artery (MCA) stenosis, using a 3D T1-weighted volumetric isotropic turbo spin-echo acquisition (VISTA) vessel wall sequence at 3T.

**Methods:** Nineteen Chinese ischemic stroke and TIA patients presenting with a symptomatic MCA stenosis underwent 3T MR imaging; the protocol included a Time-of-Flight Magnetic Resonance Angiography (TOF-MRA) and the T1w VISTA sequence before and after (83%) contrast administration. One observer reviewed the plaque characteristics.

**Results:** Vessel wall lesions were identified in 18 patients (95%), totaling 57 lesions in 494 segments (12% of segments). Most of the lesions were present in the anterior circulation. 75% of the lesions were eccentric (Fig. 1), 44% enhanced after contrast administration and 74% of the lesions were focal. Plaque burden and distribution are presented in Table 1.



**Fig. 1** A 57-year-old male patient with a left MCA stenosis. (A) Transverse TOF-MRA shows a stenosis of the right MCA (arrow). Transverse T1w VISTA images show a left MCA plaque (arrows in B) before contrast admiration. The plaque enhances after contrast admiration (arrow in C). Zoom box shows sagittal view of the eccentric plaque (black arrow).

Location	Right*	Left*	Total (n=57)*
Distal carotid segment	6	3	9
Bifurcation A1-M1-ICA	4	5	9
M1 segment	9	15	24
M2 segment	1	2	3
A1 segment	0	1	1
A2 segment	0	1	1
Basilar artery	-	-	3
Bifurcation BA-P1	2	2	4
P2 segment	0	3	3

\*Number of lesions at location.

**Table 1** Plaque burden in 18 patients with MCA stenosis

**Conclusion:** Intracranial vessel wall imaging using a 3D T1w VISTA vessel wall sequence at 3T was able to identify basic intracranial plaque characteristics and assess total plaque burden and distribution. Most of the lesions were found in the anterior circulation, corresponding to similar distributions found for ischemic strokes (2).

#### Referens

- 1 Dieleman et al., Neurology 2014
- 2 Bogousslavsky et al., Stroke 1988

## ESOC-1360

### 19. Imaging

#### Sodium fluoride-positron emission tomography provides a non-invasive method for identifying vulnerable plaques in carotid artery stenosis

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**Introduction:** Microcalcification is a histopathological feature of atherosclerotic plaques at risk of rupture, so-called “vulnerable plaques.” Positron emission tomography (PET) using 18F-sodium fluoride (NaF) to detect microcalcification has been shown to be an effective non-invasive method to identify vulnerable and ruptured coronary artery plaques. However, use of NaF-PET to assess carotid disease has been limited and mainly focused on asymptomatic disease.

**Methods:** An 89 year-old male with a left hemisphere ischemic stroke was found to have a symptomatic left internal carotid artery (ICA) stenosis of greater than 90% on Doppler ultrasound. The asymptomatic ICA showed near-occlusion. NaF-PET was performed four days after stroke. NaF dose was 125 MBq with 60 minute uptake on a GE Discovery 690 with 64 slice computed tomography. Uptake was measured using standardized uptake values for mean (SUVmean) and maximum (SUVmax) uptake. Written consent was gained in accordance with research ethics committee and local approvals.

**Results:** The symptomatic ICA mean SUVmean was 2.37 (SD 0.22) MBq/kg and mean SUVmax was 3.35 (SD 0.48) MBq/kg. The asymptomatic ICA mean SUVmean was 2.05 (SD 0.08) MBq/kg and mean SUVmax was 2.54 (SD 0.05) MBq/kg. SUVmean and SUVmax were significantly higher for the symptomatic than asymptomatic ICA (both  $p < 0.05$ ).

**Discussion:** Our results act as proof of principle that NaF uptake varies between symptomatic and asymptomatic carotid atheroma in the setting of an acute infarct secondary to carotid plaque rupture. Further trials of NaF-PET are needed to evaluate its clinical application in the assessment of carotid plaque vulnerability and rupture.

## ESOC-0941

### 19. Imaging

#### Patterns of collateral flow in stroke patients with unilateral and bilateral internal carotid artery (ICA) stenosis

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**Background and purpose:** Current over-emphasis on anatomical identification of luminal stenosis may be insufficient and misleading because collateral circulation are not considered. By using color velocity imaging quantification ultrasound (CVIQ) to measure extracranial arterial blood flow volume (BFV), the objective of this study was to evaluate the hemodynamic patterns in acute stroke patients.

**Patients and methods:** It was a hospital based cohort study including consecutive stroke patients admitted to the Prince of Wales Hospital from January 5 to December 28, 2000. Within the first week after stroke onset, carotid duplex was performed to determine the presence of ICA stenosis ( $\geq 50\%$ ) and CVIQ technique was performed to measure BFV in bilateral common carotid arteries (CCAs) and bilateral vertebral arteries (VAs).

**Results:** Of the 335 acute ischemic stroke patients (age  $67.9 \pm 12.5$  y), unilateral ICA stenosis was detected in 43 (12.8%) patients and bilateral ICA stenosis in 16 (4.8%) patients. In patients with unilateral carotid stenosis, the BFV of contralateral CCA was significantly higher than that in ipsilateral CCA ( $325.4 \pm 100.1$  mL/min vs.  $244.8 \pm 121.3$  mL/min,  $P = 0.001$ ). The sum of BFV in bilateral VAs increased significantly ( $P < 0.001$ ) to  $159.0 \pm 88.5$  mL/min in patients with bilateral ICA stenosis, compared to that in patients with unilateral ICA stenosis ( $108.1 \pm 64.8$  mL/min) and that in patients without ICA stenosis ( $101.8 \pm 45.3$  mL/min).

**Conclusions:** The present study demonstrates the different patterns of collateral flow from contralateral ICA and posterior circulation in stroke patients with carotid stenosis.

## ESOC-1288

### 19. Imaging

#### The impact of lesion location on post-stroke sleep apnea frequency

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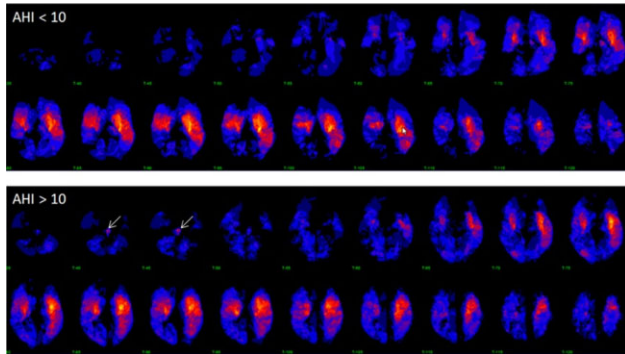
**Background:** Sleep apnea (SA) is common in patients with stroke and significantly affects outcome. Relevant risk factors for SA are age, gender and obesity. SA after stroke was assumed to be a direct consequence of the injury of specific central nervous system structures. However, conclusive results regarding post-stroke SA and lesion location are lacking. We therefore investigated whether specific infarct locations are associated with SA.

**Methods:** Overall, 142 patients with acute ischemic stroke from our stroke unit were included in a prospective observational study. All patients underwent magnetic resonance imaging (MRI) and polysomnography in the acute phase after stroke. The endpoint SA was defined by an apnea-hypopnea index (AHI)  $> 10$ . For each group (AHI  $>$  or  $< 10$ ), standardized maps were generated to depict voxel-wise probability distribution of infarction.

**Results:** Of 142 patients, 86 (59%) developed a SA. Age and NIHSS were significantly different between both groups. The voxel-based probability map of ischemic lesions demonstrates a higher probability of infarcts in patients with SA in the left-sided brainstem compared to patients without

SA (Fig.). Further analyses are ongoing to identify other factors associated with the occurrence of SA after stroke.

**Conclusion:** In this study, infarcts within the left-sided brainstem were associated with SA in the early phase after stroke. This finding might be considered in further studies targeting post-stroke SA.



**ESOC-0741**

**19. Imaging**

**Sparing of the hippocampus indicates better collateral blood flow in acute posterior cerebral artery occlusion**

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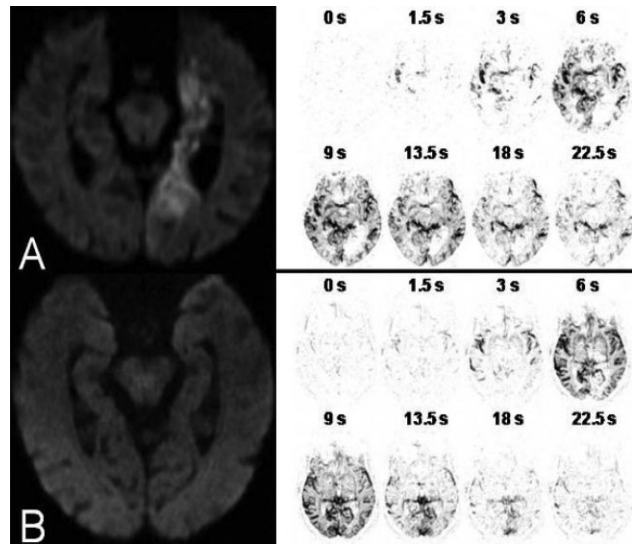
<sup>1</sup>Neuroradiology, University Hospital Mannheim, Mannheim, Germany

**Background:** In acute posterior cerebral artery (PCA) occlusion involvement of the hippocampus is a common finding. Nevertheless, infarction and ischemic lesion evolution in the hippocampus has not been studied systematically.

**Methods:** In 29 patients (mean age 70.5 ± 14.1 years, 19 (65.5%) males, 10 (34.5%) females) with proximal PCA occlusion, MRI findings were analyzed, with emphasis on hippocampal infarction patterns on diffusion-weighted images (DWI) and collateralization on dynamic 4D angiograms generated and analyzed by use of Signal Processing In NMR-Software.

**Results:** On initial DWI, we identified all known hippocampal infarction patterns: type 1 (complete) in 6/20 (30.0%), type 2 (lateral) in 12/20 (60.0%) patients, type 3 (dorsal) and type 4 (circumscribed) in 1/20 (5.0%) patient respectively. On dynamic 4D angiograms, the grade of collateralization was classified 1 in 10 (33.3%, see Fig. 1A), 2 in 2 (6.7%), 3 in 10 (33.3%), and 4 in 8 (26.7%, see Fig.1B) patients. On follow-up DWI, we found new ischemic lesions in 3 and infarction growth in the hippocampus in 6 patients. Patients with better collateralization (grade 3/4) less often had hippocampal infarctions on initial (p = 0.002)/follow-up DWI (p = 0.027) as well as type 1 on initial (p = 0.017)/follow-up DWI (p = 0.006).

**Conclusions:** Involvement of the hippocampus in proximal PCA occlusion is dependent on the extent of collateralization. The same holds true for hippocampal infarction patterns.



**Fig. 1**

**ESOC-0748**

**19. Imaging**

**Dynamic 4D angiograms for the estimation of blood flow in lacunar infarction**

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<sup>1</sup>Neuroradiology, University Hospital Mannheim, Mannheim, Germany

**Background:** Blood flow through anastomoses in lacunar infarction (LI) is not well evaluated.

**Methods:** In 101 LI patients who underwent MRI within 24 hours after symptom onset MRI findings were analyzed with special emphasis on DWI and PWI findings as well as blood flow on dynamic 4D angiograms derived from PWI raw images generated by use of Signal Processing In NMR-Software (SPIN). Classification of blood flow in LI is shown in Fig. 1.

**Results:** On DWI, LI was found in the basal ganglia (12.5%), internal capsule (25.8%), corona radiata (34.2%), and thalamus (27.5%). In 44 (43.6%) PWI was unremarkable, in 2 (2.0%) an area of hyperperfusion, and in 55 (54.5%) an area of hypoperfusion was found. In 45 (44.6%) a larger perfusion deficit (>7 mm) was observed. In these, blood flow was classified type 1 in 4 (8.9%), 2 in 8 (17.8%, see Fig. 2A), 3 in 17 (37.8%, see Fig. 2B), and 4 in 5 (11.1%) patients on dynamic 4D angiograms. The remainder (24.4%) was not classifiable.

**Conclusions:** Dynamic 4D angiograms are a novel, useful method for a detailed examination and graduation of blood flow in LI.

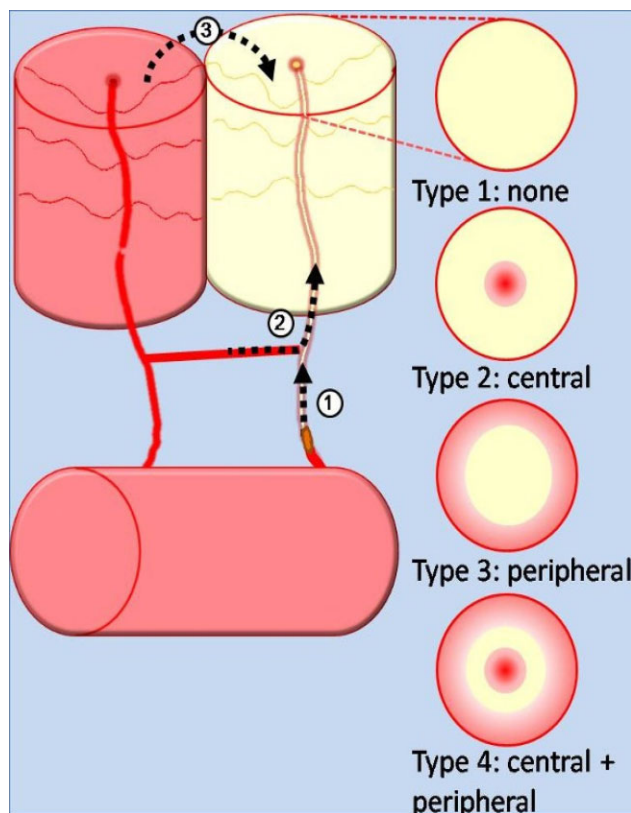


Fig. 1

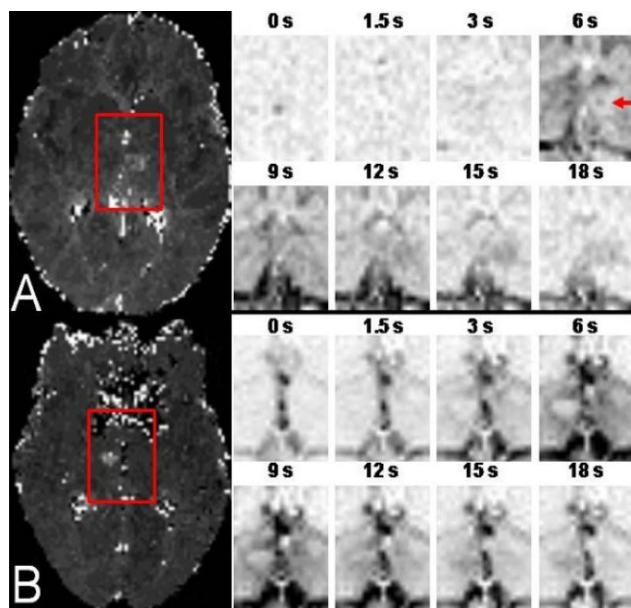


Fig. 2

ESOC-1103

19. Imaging

Quantitative measurements of relative flair signal intensities in brainstem stroke for estimation of lesion age

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**Background:** A mismatch between DWI and FLAIR lesion may be useful to identify acute ischemic stroke patients within a 4.5 hour time window. Recently, relative FLAIR signal intensity (rSI) has been proposed for quantitative measurement. However, this may be difficult in small ischemic lesion such as brainstem stroke.

**Methods:** In 34 patients with brainstem infarction, MRI findings were analyzed with emphasis on the rSI by use of Signal Processing In NMR-Software.

**Results:** Regarding baseline characteristics patients (17 (50%) males/females) had a median age of 70 (IQR 58.5–74.5) years, a median time from symptom onset to MRI of 212 (IQR 137–409.5) minutes, and a median DWI lesion volume of 0.28 (IQR 0.17–0.3725) ml. The rSI of FLAIR lesions showed a moderate correlation with time from symptom onset ( $r = 0.356, P = 0.039$ , see Fig. 1). The ROC analysis identified a rSI of 1.11 as the best cutoff value for predicting the symptom onset  $\leq 4.5$  hours with a sensitivity of 47% and a specificity of 47%. The rSI of FLAIR lesions showed no significant correlation to age ( $r = 0.110, p = 0.54$ ) nor lesion volume ( $r = -0.116, p = 0.51$ ).

**Conclusions:** Quantitative rSI measurements do not reliably identify patients within 4.5 h of symptom onset in acute ischemic brainstem stroke. Consequently, therapeutical decisions should not be based on quantitative rSI measurements in patients with brainstem stroke.

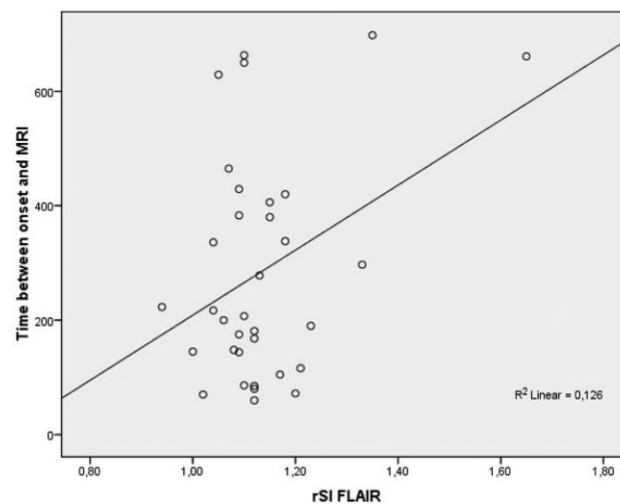


Fig. 1

## ESOC-0822

## 19. Imaging

**Distance to thrombus on magnetic resonance angiography predicts outcome of middle cerebral artery occlusion treated by IV thrombolysis**

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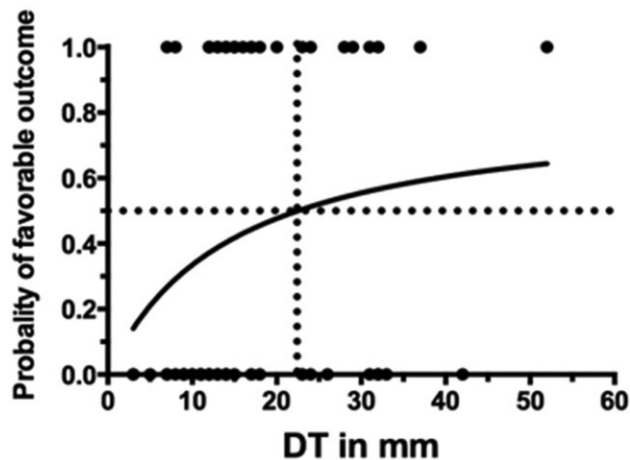
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**Background and purpose:** Our group recently proposed that the distance to thrombus (DT) on CT angiography might be a predictor of outcome in patients treated by intravenous thrombolysis (IVT) for stroke due to acute occlusion of the middle cerebral artery (MCA). The purpose of the present study was to validate its use and prognostic value on contrast-enhanced magnetic resonance angiography (CE-MRA).

**Methods:** Patients with acute MCA occlusions treated by IVT with recombinant tissue plasminogen activator and diagnosed with magnetic resonance imaging (MRI) were included. DT was defined as the distance from the carotid T to the thrombus in the MCA. Infarct volumes were calculated semiautomatically. Clinical status was determined using the initial NIH stroke scale (NIHSS) and 90-day modified Rankin Scale (90d mRS).

**Results:** Of 605 patients with acute stroke, 61 showed a lesion on a diffusion-weighted magnetic resonance image and an occlusion of the MCA on CE-MRA. We found a significant inverse correlation between DT and NIHSS scores at admission ( $r = -0.29$ ;  $P = 0.02$ ) and between DT and mRS at 90 days ( $r = -0.29$ ;  $P = 0.04$ ). For a DT 50% (see Fig.). The initial lesion volumes showed no significant correlation with the outcome.

**Conclusions:** DT on CE-MRA may predict clinical outcome in patients with acute MCA occlusion treated by IVT. It might therefore serve as a marker to triage patients into different treatment strategies.



## ESOC-1383

## 19. Imaging

**CT perfusion – Follow-up CT false positive infarct core mismatch in acute ischemic stroke**

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**Introduction:** CT perfusion software analyses the hemodynamic characteristics to estimate ischemic core and penumbra on baseline CTP. The aim of this study is to identify mismatch between CTP derived ischemic core and final NCCT infarct core, and investigate possible causes of mismatch.

**Materials and methods:** This study included 17 full brain coverage, standard (53 sec.) and extended (205 sec.) acquisition time CTP. Final infarct core volume was calculated on 5–7 day follow-up NCCT (FUCT) datasets. CTP processing was performed using Philips software (IntelliSpace 7.0). FUCT infarct core was automatically segmented. CTP and FUCT ischemic core were registered yielding false-positive ROIs. False-positive rate was defined as false-positive ROI divided by total CTP ischemic core. Absolute and relative CBV, CBF, and MTT were calculated for true and false positive CTP ischemic core and compared with rank-sum tests. CTP ischemic core is defined as  $rMTT > 145\%$  and  $aCBV < 2.0 \text{ ml}/100\text{g}$ .

**Results:** Average false-positive rate was 75%. Median  $rMTT$  (in %) false-positive core was 253 (IQR:157–398) ( $P < 0.001$ ), 357 for true-positive core (IQR:202–552) ( $P < 0.001$ ). Median  $aCBV$  (in  $\text{ml}/100\text{g}$ ) false-positive core was 1.7 (IQR:0.82–3.16) ( $P < 0.001$ ), 1.24 for true-positive core (IQR:0.56–2.56) ( $P < 0.001$ ). Median  $rCBV$  (in %) false-positive core was 52.8 (IQR:21.7–108) ( $P < 0.001$ ), 32.2 for true-positive core (IQR:11.8–71.6) ( $P < 0.001$ ).

**Discussion:** Average false-positive rate is high. Although absolute thresholds can differ significantly between patients, a significant difference in all parameter values between true-positive and false-positive core exists for all patients. To increase CTP sensitivity, thresholds for CTP ischemic core definition therefore need revision.

## ESOC-1520

## 19. Imaging

**Cerebral blood flow within the ischemic penumbra is unrelated to prehospital blood pressure**

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**Introduction:** Resistance to treating elevated prehospital blood pressure (BP) in acute stroke is based on fear of exacerbating cerebral blood flow (CBF) decreases within the penumbra, despite an absence of available data. We tested the hypotheses that prehospital SBP is correlated with severity and volume of hypoperfusion.

**Methods:** Acute stroke patients who underwent CT perfusion (CTP) at admission and prior to antihypertensive or thrombolytic therapy were included. Ischemic penumbra was defined as tissue with a relative delay time ( $rDT$ )  $> 2$  sec, and core was defined as  $rDT > 2$  sec and  $rCBF < 30\%$ . Pre-hospital SBP was obtained from EMS electronic records.

**Results:** Ninety-four patients ( $64.2 \pm 17.0$  years) with a median(IQR) NIHSS of 12(11) were included. The mean prehospital SBP was  $149.7 \pm 27$  mmHg. Median time from symptom onset to CTP was 4.8(7.4) hours. Median penumbral volume was 32.9 (46) mL with a mean rCBF of  $0.83 \pm 0.18$ . Median ischemic core volume was 21.3 (31.9) mL, with a mean rCBF of  $0.34 \pm 0.18$ . Prehospital SBP was not correlated with penumbral rCBF ( $r = -0.65$ ,  $p = 0.63$ ) or core rCBF ( $r = -0.03$ ,  $p = 0.8$ ). Prehospital SBP was inversely correlated with penumbral tissue volume ( $r = -0.29$ ,  $p = 0.008$ ). However, the correlation no longer existed after adjusting for the presence of large vessel occlusion ( $r^2 = 0.19$ ,  $p = 0.48$ ). Prehospital SBP was not correlated with core volumes ( $r = -0.19$ ,  $p = 0.1$ ).

**Conclusion:** We found no relationship between admission CBF and prehospital SBP in untreated acute ischemic stroke patients. Although acute penumbral perfusion values and volumes are variable, this is likely related to other factors, including large vessel occlusion, and cannot be explained by prehospital BP.

## ESOC-1488

### 19. Imaging

#### Analysis of collateral circulation in proximal cerebral vessel occlusions based on digital subtraction angiography (DSA)

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**Introduction:** In stroke due to proximal vessel occlusion (PVO), collaterals are essential for outcome. Different classification schemes for the assessment of collaterals exist, but most are not quantitative. We developed a semi-automated post-processing algorithm (sPPS) based on DSA, to obtain a more reliable and inter-observer independent method.

**Methods:** Data of patients with stroke due to acute PVO admitted to our institution for endovascular intervention between 2011–14, were analyzed. Cerebral anteroposterior time series from pre-/post-interventional DSA were compared. Using MatLab (MatLab R2013b (8.2.701), Math-Works), regions of interest (ROI) in the following territories (VTs) were analyzed: middle cerebral artery (MCA), anterior cerebral artery (ACA), lenticulostriate arteries (LSA). Time-intensity-curves (TIC) from these ROIs were plotted. Statistical analysis was done using Excel (Windows, version 14.3.9, Excel for Mac 2011).

**Results:** Application of this new sPPS resulted in different TICs according to the territory and interventional result. Recanalization led to a steeper slope and higher amplitude of the TIC within the MCA-ROI; whereas a post-intervention flattening of the TIC was observed in the VT of the ACA.

**Conclusion:** Our preliminary results show that it is feasible to assess the quality of the collaterals by DSA with this new sPPS. This method will be further elaborated and correlated to other imaging techniques, aiming to a reliable quantification of the collaterals.

## ESOC-1417

### 19. Imaging

#### Spontaneous and traumatic vertebral artery dissection: Imaging and clinical findings of a single tertiary stroke center

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**Background:** Vertebral artery dissection (VAD) is a potentially severe illness with significant morbidity. We present clinical presentation, imaging findings and course of patients diagnosed with VAD from a single tertiary stroke center.

**Methods:** 47 patients (33 male, 14 female, age 25–76 years) were included in this study. Initially, all patients underwent clinical evaluation and Duplex ultrasound imaging. Head and neck MR imaging, including TOF- and CE-MRA, was performed within 12 hours after admission.

**Results:** Diagnoses consisted of 34 spontaneous (72%) and 13 traumatic VAD (28%). Patients presented with focal neurological deficits (64%), headache (54%) and vertigo (50%). MRI revealed ischemic lesions in 36 patients (77%). Lesions occurred in cerebellar and medullar branches of PICA (51% of patients), PCA (19%), AICA (11%), SCA (8,5%) and basilar artery territories (15%).

Most frequent MRI/MRA findings indicative for VAD were vessel irregularity (87% of patients), vessel wall hyperintensity (81%), and loss of flow void (70%). The “classical” crescent-shaped wall hematoma was found more commonly in patients without ischemia (64%) than in those with ischemia (33%). Duplex sonography revealed VA occlusion in 56% and a dissection membrane in 26% of patients.

Patients underwent treatment with anti-platelet drugs and/or anticoagulation. 7 patients (15%) suffered recurrent dissection and/or stroke.

**Conclusion:** The data presented demonstrate the clinical diversity and the variability of MR and ultrasound imaging findings in patients with VAD. The algorithm of management of these patients should be based on a multi-modality approach.

## ESOC-0866

### 19. Imaging

#### Our experience including a routine 3D TOF imaging in patients with stroke or TIA

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**Introduction:** There is no consensus on the best vessel-imaging for routine work up in stroke. The 3D TOF-MRA showed a sensitivity of 93% and a specificity of 88% for detection of high-grade stenosis against cerebral angiography. We wanted to test the benefits of including a 3D TOF-MRA routinely in the work up of stroke/TIA patients.

**Patients and methods:** An eight minute-long 3T MRI (including T1, T2, gradient echo, FLAIR, DWI and ADC sequences) + 3D TOF-MRA protocol was designed and applied indiscriminately upon clinical decision. We retrospectively reviewed the MRA of patients with cerebral infarction (excluding those classified as cardioembolic by the TOAST) or TIA in the period October 1 2013–September 31 2014. The histories of those patients with any abnormal findings were reviewed to analyze coherence and relevance of the findings.

**Results:** The MRI/MRA protocol was performed in 79/162 patients (48%). In 34/79 (43%) abnormal findings were informed. In 22 of these

(64%) a second/confirmatory technique was considered, and coherence between both techniques was met in 17/22 patients (77%). In 26/34 patients (76%) the finding was relevant to the clinical picture and explained or contribute to do it, the possible underlying process of the stroke. In this group, 18 patients (69%) had a second/confirmatory technique, and in 16 patients (89%) coherence was met.

**Conclusions:** We consider that including a TOF-MRA in the routine work up of noncardiomebolic stroke/TIA patients at a minimum time expense definitively contribute to a better study of the disease underlying the clinical event.

## ESOC-0875

### 19. Imaging

#### Aspects on CT-angiography source images is a strong predictor of futile recanalization in acute ischemic stroke

**M Kawiorski**<sup>1</sup>, P Martinez-Sanchez<sup>2</sup>, A García-Pastor<sup>3</sup>, P Calleja<sup>4</sup>, B Fuentes<sup>2</sup>, B E Sanz-Cuesta<sup>2</sup>, E Fandiño<sup>5</sup>, F Díaz-Otero<sup>3</sup>, F Sierra<sup>6</sup>, G Ruiz-Ares<sup>7</sup>, A Cruz-Culebras<sup>1</sup>, A Gil-Núñez<sup>2</sup>, M Alonso de Leciñana<sup>1</sup>

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<sup>7</sup>Radiology, Hospital La Paz, Madrid, Spain

**Aim:** CT angiography source images (CTA-SI) Alberta Stroke Programme Early CT Score (ASPECTS) predicts final infarct volume and neurological outcome after an ischemic stroke. We aimed to determine if baseline CTA-SI ASPECTS predicts futile recanalization after reperfusion therapies.

**Methods:** Data are from the prospective observational study FUN-TPA. Included were acute ischemic stroke patients with identified proximal arterial occlusion in anterior circulation, undergoing reperfusion therapies. Clinical characteristics, baseline non-contrast CT and CTA-SI ASPECTS, time-lapse to image acquisition, occurrence and timing of recanalization, were recorded. Outcome measures were NIHSS, mRS score and mortality at 90 days. Recanalization was considered as futile when it was associated with mRS > 3.

**Results:** 113 patients, baseline NIHSS 17 (11; 22) [median (IQR)], treated with iv thrombolysis (IVT) (46%), primary endovascular treatment (EVT) (16%) or combined IVT + EVT (38%). Recanalization rate in the whole sample was 70.5% with a median delay of 285 minutes (215; 355). In 23% of cases recanalization was futile. In an adjusted model, baseline CTA-SI ASPECTS was inversely related with futile recanalization with odds ratio (OR: 0.3; 95% CI: 0.15 to 0.7; p = 0.002), whereas non-contrast CT ASPECTS was not (OR: 0.7; 95% CI: 0.3 to 1.69; p = 0.4). Our data defines a score ≤5 in CTA-SI ASPECTS as the best cut-off to predict futile recanalization (S 94%, E 67%).

**Conclusions:** CTA-SI ASPECTS strongly predicts futile recanalization. It may be useful to assign patients to conservative treatment in cases of uncertain risk/benefit ratio of reperfusion therapies.

## ESOC-0885

### 19. Imaging

#### Aspects on CT-angiography source images correlates with final infarct volume and clinical improvement after reperfusion in ischemic stroke

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**Aim:** To assess if CT-angiography source images ASPECTS (CTA-SI ASPECTS) may predict response to reperfusion in ischemic stroke, investigating its relationship with infarct volume and clinical improvement at 24-h follow-up.

**Methods:** Retrospective study of anterior circulation stroke patients undergoing reperfusion therapies that had CT-perfusion (CTP) and CTA pre-treatment, and assessment of vessel recanalization post-treatment. Clinical characteristics and baseline CTA-SI ASPECTS were registered. Tissue-at-risk was considered as that with reduced cerebral blood flow (CBF), infarct core was the region of reduced cerebral blood volume (CBV), the mismatch region being salvageable tissue. Volumes of core and mismatch region were measured. Outcome variables were the volume of the hypodensity in the NCCT and the NIHSS score at 24 hours.

**Results:** Forty-two consecutive patients, age 68 (60; 76), baseline NIHSS score 17 (12; 22) [median (IQR)]. Sixteen underwent iv thrombolysis (IVT), eight mechanical thrombectomy (MT) and eighteen IVT + MT. Core volume was 10 cc (2; 18); mismatch 88% (76; 95); lesion volume in 24-h NCCT 14 cc (8, 56). CTA-SI ASPECTS correlates with the core volume ( $r = -0.71$ ,  $p = 0.0001$ ) and mismatch volume ( $r = 0.73$ ,  $p = 0.0001$ ) and predicts the final lesion extent and the neurological improvement at 24-h if recanalization occurred, i. e. the lesion at 24-h was 12 cc smaller for every point of CTA-SI ASPECTS (95% CI = -16.6 to -7.9)  $p = 0.0001$ , and NIHSS at 24-h 1.3 points lower for every point of CTA-SI ASPECTS (95% IC = -2.5 to -0.13),  $p = 0.031$ .

**Conclusions:** CTA-SI ASPECTS could help predict the degree of improvement following successful reperfusion.

## ESOC-0951

### 19. Imaging

#### Diagnostic and volumetric agreement between bold signal delay and bolus-tracking MRI on perfusion deficits in acute ischemic stroke

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**Aims:** In this study, we assessed the agreement between dynamic susceptibility contrast MRI (DSC-MRI) and the Time Shift Analysis (TSA) of resting-state functional MRI (rsfMRI) data for the assessment of perfusion deficits in acute ischemic stroke patients.

**Methods:** Maps of Tmax (>6 seconds) and TSA (relative delay in local versus average BOLD signal), derived from DSC-MRI and rsfMRI data respectively, were generated for 52 patients scanned within 24 hours of acute ischemic stroke onset. The maps were independently evaluated for perfusion deficits by two raters.

**Results:** TSA and Tmax maps agreed on the presence or absence of perfusion deficits in 63.5% (rater 1) and 65.4% (rater 2) of cases. In 36.5%



(rater 1) and 32.7% (rater 2), TSA maps showed a BOLD delay lesion in the absence of a Tmax lesion. BOLD delay lesions were on average 61 ml (rater 1, 95% limits of agreement = -70 to 192 ml) and 51 ml (rater 2, 95% limits of agreement = -82 to 184 ml) larger than Tmax lesions. We found moderate agreement between raters on the presence of BOLD delay (Cohen's kappa = 0.466,  $p = 0.001$ ) and hypoperfusion (Cohen's kappa = 0.618,  $p < 0.0001$ ). Lesion volumes between raters were similar (intraclass correlation coefficient = 0.966 for TSA maps,  $p < 0.0001$  and 0.985 for Tmax maps,  $p < 0.0001$ ).

**Conclusion:** BOLD delay consistently coexists with hypoperfusion in acute stroke patients, but also often occurs without substantial perfusion delay. BOLD delay lesions tend to be considerably larger than Tmax perfusion lesions. Diagnostic and volumetric agreement between observers is moderate for TSA maps.

## ESOC-1218

### 19. Imaging

#### Early reversible and late inflammatory blood-brain barrier disruption in human acute ischemic stroke

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<sup>1</sup>Intramural Stroke Branch, National Institute of Neurological Disorders and Stroke, Bethesda, MD, USA

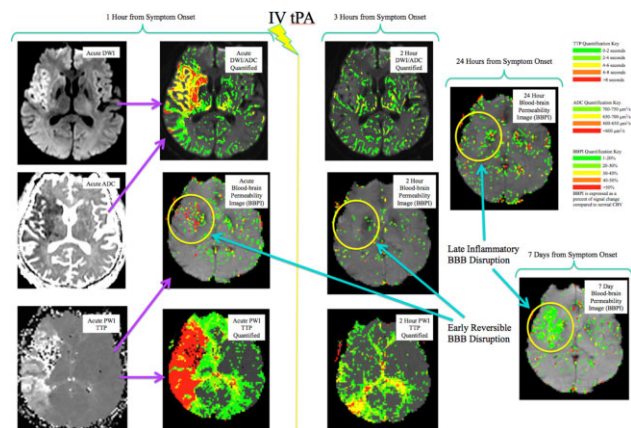
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**Background:** Animal models of acute ischemia have revealed two distinct patterns of blood-brain barrier (BBB) disruption. An early reversible BBB disruption takes place within minutes of ischemia onset, while a late inflammatory BBB disruption is typically seen days after the acute ischemia. This biphasic BBB disruption has not previously been demonstrated in human acute stroke.

**Methods:** A case report of a patient who demonstrated early reversible and late inflammatory BBB disruption is presented (Fig.). A 77-year-old gentleman presented to our institution with an acute right middle cerebral artery syndrome. MRI was performed 70 minutes after onset of symptoms demonstrating occlusion of the M1 segment of the MCA with a large severe perfusion deficit. Post processing of the PWI source images revealed leakage of gadolinium into the DWI lesion consistent with BBB disruption. The patient received IV tPA 97 minutes after the onset of symptoms. Repeat MRI 171 minutes after onset revealed recanalization of the MCA with resolution of the PWI deficit and reversal of the BBB disruption. MRI performed 24 hours later began to show a secondary inflammatory BBB disruption and MRI a week later demonstrated frank BBB disruption.

**Conclusion:** Biphasic BBB disruption as described in animal models can also be seen in human stroke.



## ESOC-1230

### 19. Imaging

#### Earlier serial MR imaging is associated with a greater rate of T2 signal change in acute stroke

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**Background:** Qualitative T2 signal change on FLAIR imaging of acute stroke is currently being tested as a way to select patients with an unknown time of onset for treatment. While there is a presumed time dependence of T2 signal change, a quantitative analysis using multiple time points has been lacking.

**Hypothesis:** T2 signal change in an acute stroke imaged at two early time points will be significantly associated with the time between MRI scans.

**Methods:** MRIs were co-registered. ROIs were defined by ADC < 600 and TTP > 6 seconds. Mean T2 signal was calculated within the ROI at both time points on FLAIR. Linear regression was used to compare variables.

**Results:** 24 patients enrolled in our natural history study in 2013 had the necessary clinical and imaging data to perform the analysis and were included in this study. All patients received IV tPA in between the two MRI scans. Mean time from onset to first MRI was 101 minutes and the mean time between MRIs was 135 minutes. The amount of time between MRIs was not significantly associated with the amount ( $p = 0.46$ ) or rate ( $p = 0.34$ ) of T2 signal change. However the time from onset to the first MRI was significantly associated with both amount ( $p = 0.033$ ) and rate ( $p = 0.032$ ) of T2 signal change, with earlier MRI scanning resulting in larger and faster changes in T2.

**Conclusions:** Quantitative change in T2 signal in acute stroke may be greater at earlier time points. The relationship between T2 signal change and time may be nonlinear.

## ESOC-0787

### 19. Imaging

#### Blood-brain barrier breakdown after acute ischemic stroke: Does permeability imaging add to clinical evaluation and multimodal CT?

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**Background:** Hemorrhagic transformation (HT) after IV thrombolysis is associated with poorer functional outcomes and blood-brain barrier compromise. We investigated the predictive value of permeability measures derived from CT perfusion (CTP) for HT.

**Methods:** We undertook retrospective analysis of all IV rtPA-treated patients from 3 acute ischemic stroke studies that acquired CTP < 6 h after onset and repeat CT at 24–72 h, including the ATTEST trial that compared alteplase with tenecteplase. Permeability maps for five permeability parameters were generated using MiStar software (Melbourne, Australia). The extent of permeability abnormalities was graded using a modified ASPECTS score, deducting 1 point for each abnormal region on visual analysis, and a grade of severity of impaired permeability assigned (0 = no abnormality, 3 = severe). CT at 24 h was graded for HT using ECASS-2 criteria by raters blind to permeability analyses. The relationship between permeability and HT was assessed by binary logistic regression.

**Results:** We included 158 patients of whom 20.3% (n = 32) had HT of any kind and 4.4% (n = 7) had PH2. Of the 5 permeability parameters assessed, only total ASPECTS score for VE (extravascular and extracellular volume in a certain volume of tissue) was related to HT in univariate analysis (p = 0.001), but none was significant in a multivariate model. Admission blood glucose (p = 0.044), core (r DT > 2 s, r CBF < 40%), volume (p = <0.0001) and which tPA received (p = 0.008) were independent associations in a multivariate model for any hemorrhage. Prior dual antiplatelet therapy (p = 0.004) was associated in a multivariate model for PH2 only.

**Conclusion:** CTP-derived permeability abnormalities were not independently associated with subsequent HT.

## ESOC-1390

### 19. Imaging

#### Cluster-based arterial input functions improve penumbral flow detection in acute stroke

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**Introduction:** Dynamic susceptibility-weighted contrast-enhanced magnetic-resonance-imaging (DSC-MRI) is used to assess penumbral flow in acute ischemic stroke. However, validated automated post-processing methods are lacking. For these, the choice of the arterial input function (AIF) is a major confounder, and has not been validated so far by an imaging gold-standard.

**Materials and methods:** In 18 (sub)acute stroke patients with MRI and H2O15 positron-emission-tomography (PET) performed at the Max-Planck-Institute in Cologne, the optimal AIFs were calculated based on the kinetic model of DSC-MRI customly adapted to individual PET and MRI data. Cerebral-blood-flow (CBF), cerebral-blood-volume (CBV), mean-transit-time (MTT) and time-to-maximum (Tmax) were computed applying 3 methodologies: 1) GLOBAL AIF: One median AIF. 2) CLUSTER AIF: A cluster analysis approach identified voxels with similar AIFs. 3) MANUAL AIF selection. Non-deconvolved Time-to-peak (TTP) maps were created. All maps were tested for their performance in penumbral flow detection (<20 ml/100 g/min) on a voxel level by receiver operating characteristics (ROC) curve analysis.

**Results:** Optimal PET validated AIF curves showed a wide distribution, suggesting that one single AIF for all voxels of one patient might not be adequate. Accordingly, the GLOBAL AIF methodology performed similarly (AUC 0.72–0.85) to MANUAL AIF (AUC 0.73–0.85). CLUSTER AIF, however, as a multiple-AIF approach, showed significantly better performance (AUC 0.82–0.90), surpassing even the high performance of TTP (AUC 0.87).

**Discussion:** Our results challenge the widely used Global AIF approach. The CLUSTER AIF concept was superior over single voxel approaches and over TTP. The findings support multiple-AIF approaches and might enhance the performance of deconvolved parameters.

## ESOC-1217

### 19. Imaging

#### Decreased volume of subcortical structures in minor stroke patients

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**Introduction:** Transient neurological events provide a diagnostic challenge in the clinic setting, but accurate diagnosis of TIA or minor stroke is important to prevent serious recurrent ischemic events. Neuroimaging provides a promising means of seeking potential biomarkers and prognostic indicators. In this study we compare the volume of subcortical structures in minor stroke patients relative to healthy controls.

**Methods:** Recruitment was approved by the relevant ethics committee, all participants provided written informed consent after the experimental procedures were explained. High-resolution T1-weighted scans were obtained as part of a diagnostic protocol from 22 patients with a final diagnosis of minor stroke (mean age: 54 ± 14, 25–82) and 22 healthy controls with no known history of ischemic events (mean age: 35 ± 8, 21–47). Automatic subcortical segmentation was performed using FreeSurfer. SPSS 22 was used to perform an ANCOVA with age and total intracranial volume included as covariates.

**Results:** Significant differences (p < 0.05) were found between the control and patient groups. Specifically the volumes of the left hippocampus (F = 6.5526, p = 0.015), right thalamus (F = 4.199, p = 0.047), right hippocampus (F = 5.246, p = 0.027), cortex volume (F = 4.949, p = 0.032), and total grey matter volume (F = 4.927, p = 0.032) were significantly lower in the minor stroke group relative to the healthy controls.

**Conclusion:** The results accord well with previous research showing lower hippocampal volumes in minor stroke patients compared to healthy controls, while the thalamus is known to be associated with regulating motor function and sensory perception. Further work is required to investigate these changes more fully, in particular whether the differences in the thalamus correlate with clinical data.

## ESOC-1286

### 19. Imaging

#### Intra-aneurysmal thrombus: Morphology, behavior, and contribution to aneurysm hemodynamics and behavior; extrapolation from CFD models

O. Mansour<sup>1</sup>

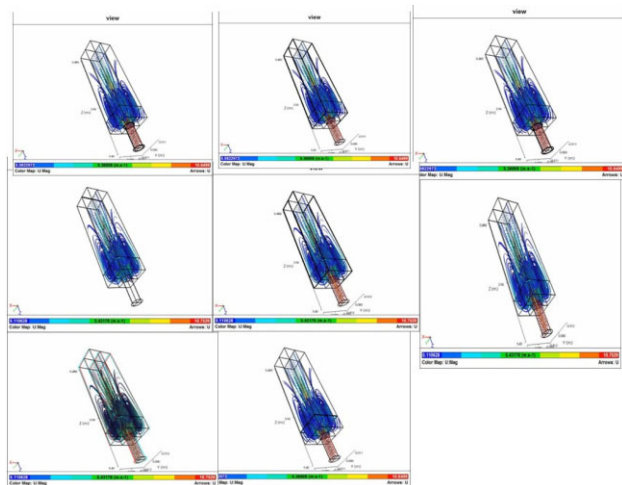
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**Background:** Review of the literature suggests that complete thrombosis of intracranial aneurysms is uncommon. It most frequently occurs after subarachnoid hemorrhage and in fusiform or giant saccular aneurysms. In autopsy series thrombosis of intracranial aneurysms has been found in 9% to 13% of cases. Aneurysm thrombosis after subarachnoid hemorrhage has a reported incidence of 1–2%. This may be as high as 3% in patients treated with antifibrinolytic agents or may be a delayed event after subarachnoid hemorrhage. Spontaneous thrombosis of giant intracranial aneurysms may be evident in up to 55% of lesions demonstrated on CT scans. Thrombosis is usually partial, with complete thrombosis occurring in 13% to 20% of cases.

**Aim:** of the current work is to extrapolate different predictive scenario by using different flow analysis models simulating the intra-aneurysmal thrombus – aneurysm relationship. And to try to predict the thrombus genesis, behavior, contribution to aneurysm hemodynamics and growth or regress behavior

**Materials and results:** By using “pipe to-fro box” model and usage of this model as prototype simulating for the thrombus-aneurysm. We could extrapolate 8 scenario predicting these possible contribution of the intra-aneurysmal thrombus to the aneurysm hemodynamics and behavior of growth and regress.

**Conclusion:** this simple 3d model simulation shed a new focus on the importance of intra-aneurysmal thrombus and its contribution for the behavior of the aneurysm itself.



### ESOC-1371

#### 19. Imaging

##### Temporal evolution of symptomatic intracranial atherosclerotic plaque post-contrast enhancement: A serial high-resolution MRI study

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**Objectives:** Post-contrast enhancement (PCE) in high-resolution magnetic resonance imaging (HR-MRI) has been proposed as a marker of intracranial atherosclerotic plaque activity. We aimed to describe the temporal evolution of PCE and other structural parameters in symptomatic intracranial plaques under aggressive medical therapy.

**Methods:** We prospectively studied consecutive patients with a first-ever ischemic stroke attributable to a symptomatic intracranial atherosclerosis. Symptomatic intracranial plaques were studied with 3Tesla HR-MRI during admission and three months thereafter, using 2mm-slices and the following sequences: proton-density, T1, T2 and post-contrast (PC) T1. Atherosclerotic plaque area was calculated on T2 images. The plaque was then demarcated as a region of interest where mean and maximal signal intensities were calculated on T1 and PC-T1 sequences. Intraplaque signal intensity was compared to adjacent white matter's intensity.

**Results:** We studied four stroke patients (two women, mean age 60). Symptomatic plaques were located in M1 segment of middle cerebral artery (2), intracranial vertebral (1) and basilar (1) arteries. PCE was visible in all patients on initial PC-T1, with a relative mean intensity

ranging from 1.3 to 1.8. Mean plaque signal intensity on PC-T1 decreased during follow-up, showing a wide interindividual variation ranging from a 4% to a 62% intensity reduction. Both plaque area and mean plaque signal intensity on non-contrast T1 diminished also in all patients, showing mean reductions of 29% and 11% respectively.

**Conclusion:** Intracranial atherosclerotic plaque's PCE on PC-T1, signal intensity on non-contrast-T1 and area decreased during the first three months after stroke. The clinical implication of these findings warrants further study.

### ESOC-1465

#### 19. Imaging

##### CT angiography in acute ischemic stroke: A validated case archive based on an audit of local practice

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**Introduction:** Recently there have been a few positive thrombectomy trials. CT angiograms (CTA) are mostly performed in tertiary centers. In light of the new thrombectomy trials, there is a need for patients presenting with acute ischemic stroke (AIS) to obtain a CTA at the presenting hospital. Depending on the findings, further management could be done locally or the patient can be referred to a tertiary center.

**Purpose:** We developed a validated case archive of CTAs to help with teaching and training of the regions radiologists with the aim that this will drive clinical practice change in the management of AIS across the north east of England. There is an emerging need for CTAs to be performed and interpreted in a district general hospital setting.

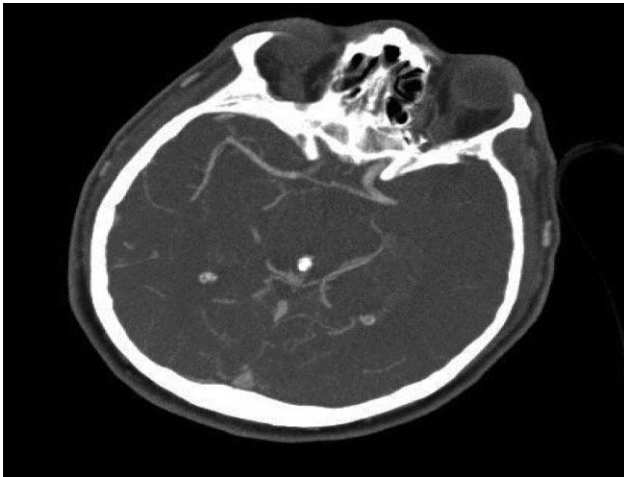
**Methods:** A retrospective review of 364 patients presenting over a period of 7 months was performed. From this audit data 100 CTA cases were collected and these scans are being reviewed by 3 neuroradiologists for a validated case archive.

**Results:** From the audit data, CTA was indicated in 153/364 (43%) patients and performed in 115/153 (69%) patients. Reasons behind failure to obtain CTA's in remaining 38/153 patients were evaluated. 40 (11%) patients underwent thrombolysis, 6 (2%) underwent thrombectomy and carotid endarterectomy was performed in 7 (2%) patients.

**Conclusion:** A validated case archive of CTA's used for training will hopefully result in a positive clinical practice change in hyperacute management of stroke. Illustrative teaching cases from the archive will be presented.



IMAGES: Left MCA infarct.



We recruited patients with mild stroke, performed brain MRI, classified WMH, normal-appearing white matter (NAWM), and markers of white matter integrity (diffusion fractional anisotropy (FA), mean diffusivity (MD)), water content (T1 relaxation time), and a potential marker of blood-brain barrier (BBB) leakage (uptake slope of dynamic contrast-enhanced MRI). We divided the patients into age groups (Fig. 1) and analyzed variation in MRI parameters by tissue type and age using ANCOVA and ROC analysis.

Amongst 204 patients (age 34.3–90.9 y), all parameters differed significantly between tissues across all age groups ( $p < 0.001$  for FA, MD and T1;  $p = 0.003$  for slope). There was a significant age effect on MD, T1 ( $p < 0.001$ ) and slope ( $p = 0.022$ ) in both tissues; age and tissue interacted for FA ( $p < 0.001$ ), Fig. 1. MD best discriminated WMH from NAWM. The discriminant ability of FA and T1 decreased with age, but increased for BBB leakage, Fig. 2.

NAWM deteriorates diffusely with age not just in WMH. ROC analysis suggests increased tissue water is the primary pathology in WMH, with BBB leakage being more obvious at older age.

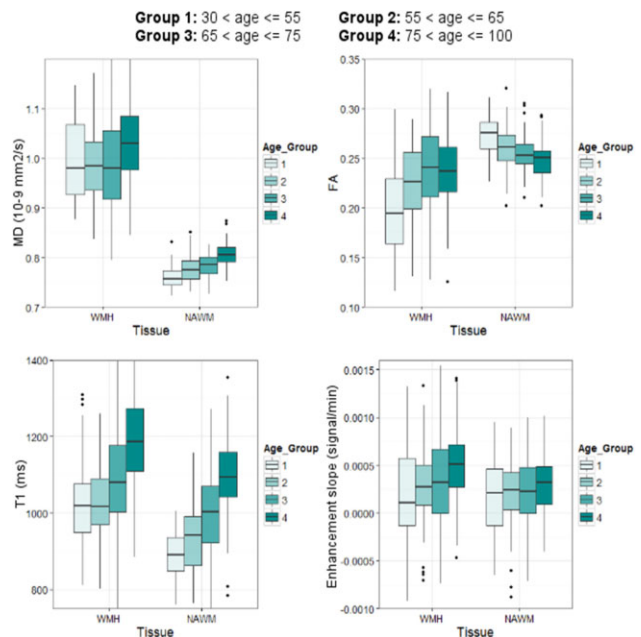


Fig. 1

ESOC-1023

19. Imaging

Quantitative MR imaging of white matter hyperintensities shows a prevailing role of increased water content at all ages with increased BBB leakage at older age

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White matter hyperintensities (WMH), commonly seen in brain images of stroke patients, were characterized at different age ranges using quantitative MRI.

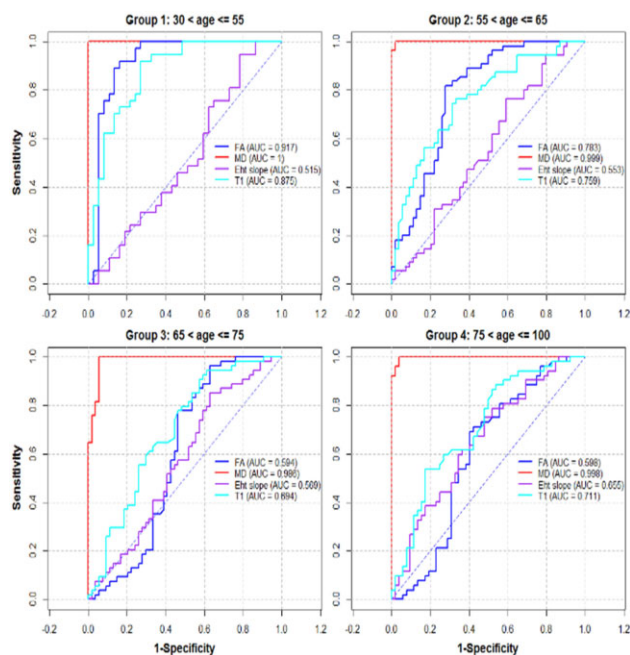


Fig. 2

## ESOC-1522

## 19. Imaging

## Prevalence of acute silent brain infarction in retinal artery occlusion and amaurosis fugax

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**Objective:** There is some evidence that acute monocular visual loss of presumed ischemic origin (MVL) is accompanied by acute ischemic stroke. We sought to determine the prevalence of acute silent brain infarction in unselected patients with branch and central retinal artery occlusion (BRAO/CRAO) and amaurosis fugax (AF).

**Methods:** Due to local conditions, within a radius of approximately 50 km all patients with acute MVL are admitted to our stroke unit and receive MRI after emergency examination by an ophthalmologist. We retrospectively analyzed 227 consecutive patients with AF (31.7%), BRAO (19.8%) and CRAO (48.5%) who were treated between 2008 and 2013.

**Results:** DWI was obtained after 34.9 (+/-80.6) hours from symptom onset. Acute ischemic stroke was detected in 48 (21.1%) of patients. Of these only 5 (10.4%) patients presented with additional neurologic symptoms, whereas silent brain infarctions were seen in 43 (89.6%) patients. Higher age ( $p < 0.001$ ), additional stroke symptoms ( $p = 0.002$ ), atrial fibrillation ( $p = 0.05$ ), hypertension ( $p < 0.02$ ), and type of retinal artery occlusion (AF 9.7%, CRAO 22.7%, BRAO 35.6%,  $p = 0.003$ ) were associated with DWI lesion. In multivariate analysis only age and type of occlusion remained positive predictors for silent brain infarction. Etiology was undetermined in most cases (43.2%) followed by large artery atherosclerosis (35.7%) and cardioembolism (18.5%).

**Conclusion:** Acute silent brain infarction on DWI is a frequent finding in unselected patients with RAO and AF. Because silent brain infarctions bear a high risk of future stroke, these patients should be treated on stroke unit and effort should be made to identify underlying etiology.

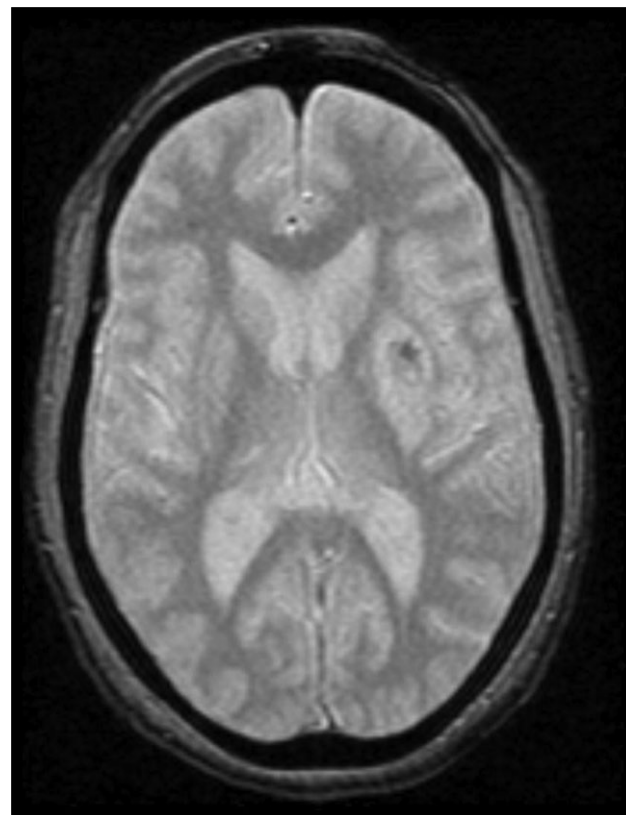
## ESOC-0942

19. Imaging  
Neuroimaging of hyperacute ischemic stroke: Post-thrombolysisR Renganathan<sup>1</sup>, N Moussa<sup>1</sup>, K A Siddiqui<sup>1</sup><sup>1</sup>Department of Neurology, Al Ain Hospital, AL AIN, United Arab Emirates

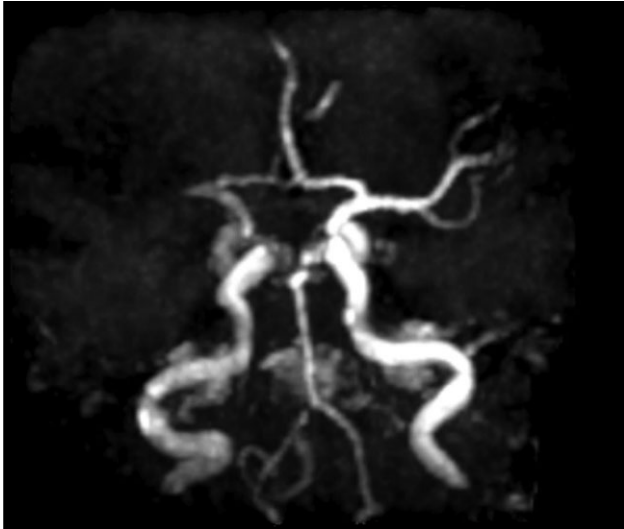
**Background:** CT brain is done in hyperacute ischemic stroke patients post-thrombolysis to rule out hemorrhage and also to decide on further anti-thrombotic and/or anticoagulant therapy. In this study we observed neuroimaging findings on MRI Brain done in hyperacute ischemic stroke patients within 24 hours post-IV thrombolysis.

**Methods:** We retrospectively analyzed data from our Stroke registry over a two-year period. All stroke patients who were thrombolysed were included. Demographics, clinical presentation, NIHSS pre-thrombolysis and findings on brain imaging were analyzed. CT Brain, MRI-DWI/ADC, FLAIR, GRE sequences and MR Angiogram of Circle of Willis (MRA-COW) were reviewed. Stroke subtypes viz. infarcts were identified based on location: cortical-subcortical, deep-subcortical and brainstem.

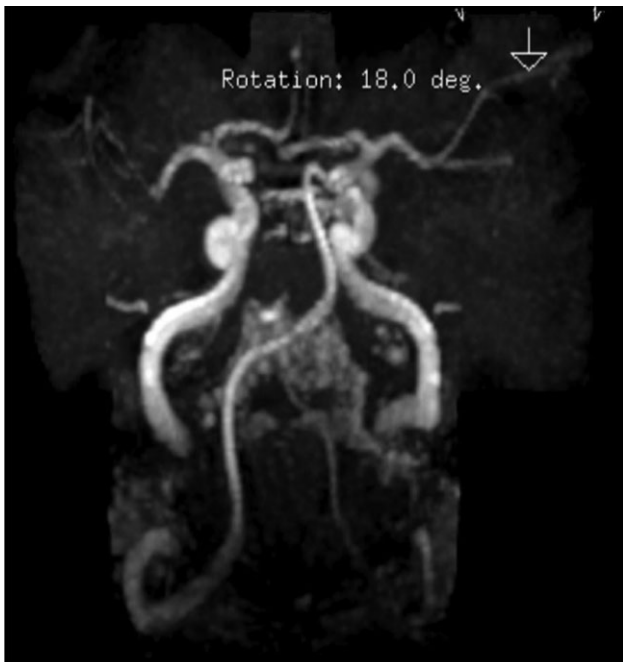
**Results:** 68 patients with ischemic stroke had IV-thrombolysis. 24 of these patients had MRI brain done within 24 hours post-thrombolysis. There were 20 males and 4 females. Mean age was 54 years. Eleven patients had dense hemiplegia, 8 had hemiparesis, 3 had hemiataxia and 2 had aphasia. Mean NIHSS score was 9 on admission. MRI brain (DWI/ADC and FLAIR) showed cortical-subcortical infarcts in 8, deep-subcortical infarcts in 12 and brainstem infarcts in 4 patients.



MRI brain (GRE sequence) showed microbleeds in lentiform nucleus in 3 patients.



MRA-COW showed MCA-M1 occlusion in 4 patients.



MRA-COW showed MCA-M2 occlusion in 5 patients.

**Conclusion:** In hyperacute ischemic stroke post-thrombolysis, MRI brain done within 24 hours identifies the extent and location of stroke, detects microbleeds and provides information about cerebral vasculature early on.

## ESOC-1021

### 19. Imaging

#### Diagnosing extracranial vertebral artery stenosis: Duplex ultrasonography versus CT angiography

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**Introduction:** Vertebrobasilar stenosis is often found in patients with posterior circulation stroke and it increases risk of stroke recurrence. We investigated feasibility and accuracy of duplex ultrasonography (DUS) as a screening tool for the detection of proximal vertebral artery (VA) stenosis compared with CT angiography (CTA).

**Methods:** We gathered data on all patients who had to undergo DUS because of a posterior circulation stroke or TIA. Matching CTA studies were retrieved and used as "gold standard." VA stenosis of  $\geq 50\%$  on CTA was considered significant. For each segment of the VA, Receiver Operating Characteristic (ROC) curves were drawn and the area under the ROC curve (AUROC) was determined. We also calculated which DUS Peak Systolic Velocity (PSV) cut-off value resulted in highest sensitivity with acceptable specificity.

**Results:** We included 338 patients with 676 V1- and 676 V2-segments. Of the 619 adequate measurements with CTA at the V1-segment, only 370 corresponding measurements with DUS were adequately made. DUS detected a stenosis in 49 V1-segments (13%, PSV cut-off 140 cm/s). CTA showed corresponding significant stenosis in 11 (22%) of these segments (AUROC 0.76; 95% CI 0.67–0.86). A PSV cut-off value of 90 cm/s resulted in best sensitivity (89%) with acceptable specificity (47%). For the V2-segment there were too few stenoses to allow reliable assessment of diagnostic characteristics of DUS.

**Conclusion:** Given the technical difficulties in proper assessment of the proximal VA and the modest accuracy, we think that usefulness of DUS as a screening tool for proximal VA stenosis is limited.

## ESOC-1270

### 19. Imaging

#### Comparison of multi- versus single-phase CTA for collateral circulation evaluation on acute stroke

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Good collateral circulation (CC) associates favorable outcomes on acute stroke. Single-phase CTA (sCTA) is widely used, but lacks temporal resolution, and may mislabel CC. We aim to evaluate a new-not post processing-time resolved technique to evaluate CC: multiphase CTA (mCTA).

**Methods:** Consecutive  $< 4.5$  h stroke patients with confirmed M1-MCA or TICA occlusion by sCTA were included. Additional cerebral CTA acquisitions with 10- and 20s-delay were performed for mCTA. CC evaluation is described in the Fig. sCTA and mCTA were compared as outcome predictors. Recanalization (REC) was assessed by TCD at 24 h.

**Results:** 78 patients were included. Mean age:  $66.3 \pm 13.6$  y, median NIHSS 17.5 (IQR 6.3), 52(66.7%) M1- and 26 (33.3%) TICA-occlusions.

Mean time from onset to CTA: 2:32 ± 1:31 h. On sCTA, 61.8% patients presented good CC whereas on mCTA, 54.7%.

Only on mCTA good CC was an independent predictor of low infarct volume at 24 h (OR 3.6, CI 95% 1.3–10.5, p = 0.017). Only on mCTA, CC status was associated with lower 24 h median NIHSS (good CC: 5 vs poor CC: 17, p < 0.001), and 3 mo favorable outcome (mRS 0–2: good CC 57.1% vs poor CC 11.5%, p < 0.001).

Poor mCTA-CC status was especially significant in patients without REC, with 0% of mRS 0–2 (mRS 0–2 = 50% in REC with poor CC) (p < 0.01). In a logistic regression model including age, NIHSS, ASPECTS and REC, only good CC on mCTA predicted favorable outcome (OR 6.8, CI 95% 1.6–29.2, p = 0.009).

**Conclusion:** CC evaluation on mCTA improves outcome prediction as compared with sCTA. CC on mCTA is an independent predictor of infarct volume and functional outcome, especially if REC is not achieved.

University of Calgary Collateral Scoring on Multiphase-CTA*		Collateral Scoring on single-phase CTA	
Score	Description	Score	Description
5	Compared to asymptomatic contralateral hemisphere, there is no delay and normal or increased prominence of peripheral vessels/normal extent within the occluded arterial territory within the symptomatic hemisphere.	3	Equal or >100% collateral supply of the occluded MCA territory
4	Compared to asymptomatic contralateral hemisphere there is a delay of one phase in filling in of peripheral vessels but prominence and extent is the same.	2	Collateral supply filling >50% but <100% of the occluded vascular territory
3	Compared to asymptomatic contralateral hemisphere there is a delay of two phases in filling in of peripheral vessels but prominence and extent is the same; there is a one phase delay and decreased prominence (thinner vessels) / reduced number of vessels in some part of the territory occluded.	1	Collateral supply filling <50% but >0% of the occluded vascular territory
2	Compared to asymptomatic contralateral hemisphere there is a delay of two phases in filling in of peripheral vessels and decreased prominence and extent; a one phase delay and some regions with no vessels in some part of the territory occluded.	0	Absence of collateral supply on the affected vascular territory
1	Compared to asymptomatic contralateral hemisphere there are just a few vessels visible in any phase within the occluded vascular territory.		
0	Compared to asymptomatic contralateral hemisphere there are no vessels visible in any phase within the occluded vascular territory.		

From Tan EC, et al. Systemic comparison of perfusion-CT and CT-angiography in acute stroke patients. *AnnNeurol*.2007

■ Good collateral circulation  
■ Poor collateral circulation

\* Multiphase CTA has been developed by the University of Calgary. Patent pending.

From aspectsinstroke.com. Understanding Alberta Stroke Program Early CT Score (ASPECTS)

### ESOC-0956

#### 19. Imaging

#### Difference of thrombus attenuation between CT and CT angiography measured in patients with acute ischemic stroke: An expression of thrombus porosity?

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**Background:** It has been demonstrated that a thrombus could be porous rather than fully compact, and that porosity is associated with the speed of fibrinolysis such as it may improve intravenous treatment success in acute ischemic stroke. We hypothesize that CT contrast agent may penetrate a porous thrombus, ensuring that the porosity could be measured by assessing thrombus attenuation differences between ncCT and CTA imaging.

**Objective:** We aim to characterize thrombus attenuation changes between ncCT and CTA images as a potential imaging biomarker of thrombus porosity.

**Methods:** From the MR CLEAN trial database, 125 consecutive acute ischemic stroke patients with good quality admission thin-slice ncCT and CTA imaging were included. The ncCT and CTA images were co-registered, and independent observers placed 3 small standardized regions of interest in each thrombus such that the attenuation on ncCT and CTA was simultaneously measured. CTA-based thrombus density

measurement larger than 1.96 times the standard deviation of the corresponding ncCT measurement was classified as porous.

**Results:** Thirty-seven out of 125 thrombi (29.6%) were classified as porous with a paired average increase of +27.7 (+/-12.9) HU on CTA. The overall mean thrombus attenuation was 50.1 (+/-7.4) for ncCT and was 60.7 (+/-13.4) for CTA images. Six patients (4.8%) had an increase in thrombus density of more than 40 HU.

**Conclusion:** CTA-based measurements can demonstrate quantifiable increases in attenuation value compared to ncCT assessments. This contrast penetration in CTA likely reflects thrombus porosity, and could be investigated as a potential imaging biomarker for treatment response to fibrinolysis.

### ESOC-1258

#### 19. Imaging

#### Absolute thrombus density measurement on non-contrast CT in patients with acute ischemic stroke has superior interobserver agreement than relative ratio

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**Background:** Thrombus density is increasingly considered as predictive characteristic for acute ischemic stroke (AIS) treatment success. However, its value is still under debate since the published studies are not exclusive. The used thrombus density measurement method varies widely between studies, which could explain the variations in associations with outcome success.

**Aim:** This study compares the observer variability of four common thrombus density manual measurements: absolute HU and relative HU using either one or three measures.

**Method:** From the MR CLEAN trial database, for 104 consecutive AIS patients with thin-slice ncCT, three expert observers and a trained observer placed three small standardized regions of interest (ROI) in the thrombus and in the contralateral vessel. The middle ROI was used as the reference single measure. Based on these measurements the average absolutes (aHU) and average relatives (rHU) thrombus densities were determined aHU1, rHU1 and aHU3, rHU3 for single and triple measure respectively. The interobserver variations were evaluated by the calculation of the intraclass correlation coefficient (ICC) and performing Bland & Altman analysis.

**Results:** The results for the Bland & Altman analysis showed and the ICCs are showed in the table below.

	Expert observer				Trained observer			
	aHU <sub>1</sub>	rHU <sub>1</sub>	aHU <sub>3</sub>	rHU <sub>3</sub>	aHU <sub>1</sub>	rHU <sub>1</sub>	aHU <sub>3</sub>	rHU <sub>3</sub>
Average difference	3.7	-0.01	4.7	0.03	1.3	0.03	1.0	-0.01
Standard difference	5.0	0.25	8.9	0.35	4.6	0.23	7.1	0.41
Maximum difference	18.6	0.49	40.6	1.20	14.6	0.54	20.8	1.01
Minimum difference	-12.5	-1.15	-21.7	-1.23	-14.1	-0.80	-16.4	-1.69
Lower limit of agreement	13.7	0.49	22.5	0.73	10.5	0.49	15.3	0.82
Upper limit of agreement	-6.3	-0.52	-13.1	-0.66	-8.0	-0.43	-13.2	-0.83
ICC	0.71 *	0.51 *	0.49 *	0.43 *	0.82 *	0.50 *	0.70 *	0.29 +

\*p-value < .001, +p-value = .002

**Table** Bland & Altman analysis and intraclass correlation coefficients

**Conclusions:** The interobserver variability for absolute density measurement is superior to relative ratio. We therefore advise researchers to use relative ratio measurement with care when studying imaging biomarker in non-contrast CT images.

## ESOC-1215

## 19. Imaging

## Permeable thrombi on CT perfusion have shorter thrombus length and recanalize early with IV tPA

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**Introduction:** In middle cerebral artery (MCA) occlusions, we have previously shown that thrombus permeability is a robust determinant of early recanalization with IV tPA. In this project, we seek to test if permeable thrombi are shorter in length.

**Methods:** From the PROVE-IT stroke image database, MCA M1 occlusions treated with intravenous tPA were analyzed. Using perfusion CT and a delay insensitive algorithm (T0 map), a "positive sloped regression line of T0 values" measured along artery silhouette distal to thrombus was defined as marker of permeable thrombus. Length of thrombus was measured on axial CT angiography images (thickness 0.625 mm) co-registered on CT perfusion average maps. Early recanalization was assessed on first angiography of subsequent IA procedure or on 4-hour CTA.

**Results:** In 38 MCA M1 stroke patients (intravenous tPA: 19, additional IA: 19), early recanalization was achieved in 11 (28.9%). Measured median thrombus length was 17 mm (IQR 11–25). Thrombus length in those who recanalized early was shorter vs. those who did not (10 mm vs. 20 mm,  $p = 0.04$ ). Patients with permeable thrombus ( $n = 11$ ) had higher early recanalization rates vs. without (54.5 vs. 18.5%,  $p = 0.02$ ). Patients with permeable thrombus had shorter thrombus length (10 mm vs. 21 mm,  $p = 0.002$ ). Thrombus length threshold that best discriminates permeable thrombi was 13 mm (sensitivity: 0.91, specificity: 0.81, AUC: 0.82).

**Conclusions:** In MCA stroke, permeable thrombi are associated with short thrombi length and recanalize early with IV tPA.

## ESOC-0915

## 19. Imaging

## Subclinical ischemic lesions in patients with intracranial hemorrhage

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**Background and purpose:** Subclinical ischemic lesions on diffusion weighted MR imaging (MRI-DWI) have been recently described in patients with spontaneous intracerebral hemorrhage (ICH) and convexity subarachnoid hemorrhage (cSAH). Such lesions are postulated to be part of the amyloid angiopathy spectrum. We hypothesized that the frequency of these MRI-DWI lesions may differ between patients presenting with cSAH, lobar ICH and basal ganglia ICH.

**Methods:** Retrospective study of patients presenting between 2011–2014 with cSAH and/or ICH and subsequent MRI. Patients with an aneurysm, arteriovenous malformation, or hemorrhagic infarct were excluded. ICH

topography was classified as lobar or basal ganglia; MRI-DWI lesions were classified as subclinical if there were no associated symptoms; contrast enhanced scans were assessed for leptomeningeal contrast enhancement. **Results:** Of 115 eligible patients, 56 patients had MRI within 14 days of hemorrhage (mean age  $69.4 \pm 11.5$  years; 48% male). Overall, 21% ( $n = 12/56$ ) patients with cSAH and/or ICH had subclinical MRI-DWI lesions. MRI-DWI lesions occurred more frequently in patients with cSAH than basal ganglia ICH ( $n = 5/12$  vs  $2/30$ ;  $p = 0.006$ ) and in patients with lobar ICH than basal ganglia ICH ( $n = 5/18$  vs  $2/30$ ;  $p = 0.04$ ). There was no significant difference in MRI-DWI lesions between cSAH and lobar ICH. Patients with MRI-DWI lesions had more frequent adjacent leptomeningeal contrast enhancement ( $p < 0.001$ ).

**Conclusion:** Subclinical ischemic lesions occur more frequently in patients with cSAH and lobar ICH than basal ganglia ICH. More frequent leptomeningeal contrast enhancement in these patients may point to a common underlying amyloid-related small vessel vasculopathy.

## ESOC-1449

## 19. Imaging

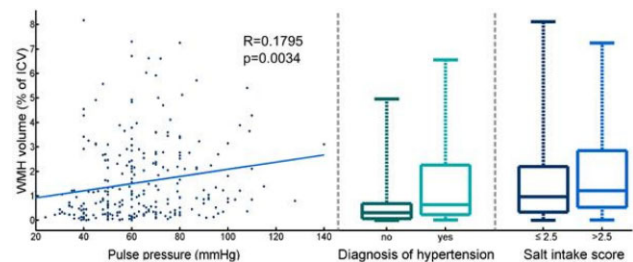
## Added dietary salt intake is associated with increased white matter hyperintensity volume

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Dietary salt intake and hypertension are associated with increased risk of cardiovascular disease including stroke. We aimed to explore the influence of these factors in cerebral small vessel disease. 264 patients with non-disabling cortical or lacunar stroke were recruited. Patients answered questions regarding their salt intake from which a semi-quantitative score was derived, and plasma sodium concentration was measured; brain tissue volume and white matter hyperintensity volume were measured using MRI. Multiple linear regression with correction for age, stroke subtype and vascular risk factors revealed that salt intake score ( $p = 0.021$ ), brachial pulse pressure ( $p = 0.036$ ) and diagnosis of hypertension ( $p = 0.0093$ ) were all associated with increased white matter hyperintensity volume. Plasma sodium concentration did not predict white matter hyperintensity volume but was negatively associated with brain tissue volume ( $p = 0.019$ ). Our results confirm previous findings that raised blood pressure and pulse pressure are associated with white matter hyperintensities and raise the possibility of an independent role for dietary salt in the development of cerebral small vessel disease.



**Fig. 1** Relationship of white matter hyperintensity volume with pulse pressure, diagnosis of hypertension and salt intake score (range: 1–5, with 5 indicating maximum added salt).



## ESOC-1213

## 19. Imaging

**Perfusion CT-derived blood–brain barrier permeability strongly predicts low risk of hemorrhagic transformation after intravenous thrombolysis in acute stroke**

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**Background and purpose:** Blood–brain barrier (BBB) permeability has been proposed as an imaging predictor of hemorrhagic transformation (HT) after tissue plasminogen activator (tPA) administration; however, perfusion computed tomography (PCT) permeability imaging has not yet been established as a reliable technique for stroke treatment. We aimed to determine the performance of PCT-derived BBB permeability surface using different volume thresholds in predicting HT after intravenous tPA administration in patients with acute stroke.

**Materials and methods:** We retrospectively studied consecutive patients with acute middle cerebral artery stroke treated with tPA. We used delayed-acquisition to calculate admission PCT-derived BBB permeability surface. Nine volume thresholds were applied (from 3 to 7 mL/100 g/min, every 0.5 units). HT was graded according to the European-Australasian Acute Stroke Study II criteria. ROC curves selected optimal volume threshold, and multivariate logistic regression analysis identified independent predictors of HT.

**Results:** Of 68 patients, 18 (26.4%) developed HT (4 PH1 and 9 PH2). None of the permeability surface volume thresholds was better than the others at predicting HT. Permeability surface >618.958 mm<sup>2</sup> at 3-mL threshold yielded sensitivity, specificity, and positive and negative predictive values 44.4%, 94.0%, 72.7% and 82.5%, respectively, for HT (AUC 0.686, CI 0.526–0.845) and 55.6%, 89.8%, 45.5% and 93%, respectively, for PH2 (AUC 0.718, CI 0.503–0.932). The volume threshold of 3-mL was the only independent predictor of PH2 (OR 1.30; AUC 0.72, CI 1.04–1.63, P = 0.016).

**Conclusions:** Lower PCT-derived BBB permeability surface predicts lower risk of HT after thrombolysis in acute stroke patients.

## ESOC-1378

## 19. Imaging

**CT perfusion and multiphase CT angiography in malignant brain edema prediction in patients with acute ischemic stroke**

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**Background:** Several studies using different CTP parameters provide varying results in terms of malignant brain edema prediction. We explore the predictive ability of multiphase CT angiography (mCTA) and CT perfusion (CTP) at admission in development of malignant brain edema in patients with acute proximal occlusion of middle cerebral artery (MCA).

**Methods:** Patients from multicenter prospective study PROVE-IT with proximal MCA+–terminal ICA occlusion were analyzed. Admission CTA was evaluated for clot localization, leptomeningeal collaterals and dural sinuses morphology. Admission CTP parameters were calculated (permeability, cerebral blood flow, cerebral blood volume) within the ischemic territory and contralateral mirror regions and tested using ROC. Recanalization was evaluated by TIC1 score in patients undergoing mechanical thrombectomy or CTA in IV-tPA group. Outcome was evaluated by midline shift and final volume of infarction on follow-up CT/MRI within 24–32 hours.

**Results:** Of 200 patients, 7 patients (3.5%) had midline shift  $\geq 5$  mm (2 were excluded for poor-quality imaging). Five patients with midline shift  $\geq 5$  mm and 5 matched patients without shift were analyzed. Six patients were treated by IV tPA (0% recanalization) and 4 were treated by mechanical thrombectomy (100% TIC12b). Three of 5 (60%) with midline shift  $\geq 5$  mm had ipsilesional hypoplasia of dural sinuses vs. 0/5 without shift. Mean CBF, CBV, PS within ischemic and contralateral regions were not different. CBV threshold of 1.7 ml/100 g had the highest AUC (0.72) with sensitivity and specificity of 0.83 and 0.67 respectively for midline shift.

**Conclusion:** Our data did not show significant difference in analyzed CTP parameters between both groups.

## ESOC-1005

## 19. Imaging

**TTP versus TMAX to define the PWI/DWI mismatch profile**

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**Background:** Perfusion MRI (PWI) together with diffusion (DWI)-maps, are widely used to select stroke-patients for endovascular therapy. The time to maximum of the residue function (Tmax) perfusion measure, with delays of >6 seconds(s), has been shown to be a good predictor of critically hypoperfused tissue. Theoretically, since Tmax is a measure of hemodynamic delay, a time to peak (TTP)-map should contain similar

properties with potentially being less sensitive to artifacts related to the arterial input function (AIF). We aimed to compare the observed response to reperfusion in subgroups selected by TTP and Tmax.

**Methods:** In this retrospective analysis of the DEFUSE 2-trial, Tmax-maps were automatically calculated using RAPID-software and relative TTP (rTTP)-maps were calculated using the concentration-time-curve, normalized to the contralateral hemisphere. The rTTP-threshold was adjusted by maximizing the lesion volume correspondence between Tmax >6 s and >10 s and rTTP. For both perfusion parameters the effect of reperfusion and presence of the PWI/DWI mismatch-profile on favorable clinical response (FCR) was assessed.

**Results:** rTTP thresholds of >4.5 s and >9 s corresponded best with Tmax thresholds of >6 s and >10 s. The rTTP-maps required removal of imaging artifacts in 18 patients (16%), compared to 24 (22%) for the Tmax-maps. The odds ratio (OR) for FCR in patients with reperfusion was 7.4 (95% CI 2.3–24.1) and 6.0 (95% CI 2.0–18.4) for the TMM-profile for Tmax and rTTP respectively.

**Conclusion:** rTTP-maps appear to be comparable to Tmax-maps for selecting stroke patients who respond favorably to endovascular reperfusion and may be less prone to imaging artifacts.

## ESOC-1529

### 19. Imaging

#### Is perfusion-weighted imaging penumbral flow detection dependent on the deconvolution method? A validation with 15O-water positron emission tomography

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**Background and purpose:** Perfusion weighted (PW) magnetic resonance imaging (MRI) is used to identify penumbral flow in acute stroke but its validity remains a matter of debate. One issue is the choice of the best singular value decomposition (SVD) deconvolution method to calculate PW maps. Two major SVD procedures exist: the standard (sSVD) and the block-circulant (bSVD) method. By comparative positron emission tomography (PET), we evaluated the influence of the SVD methods on penumbral flow detection.

**Methods:** PW-MRI and 15O-water-PET was performed in acute stroke patients. Maps of time to maximum (Tmax), cerebral blood flow (CBF), cerebral blood volume (CBV) and mean transit time (MTT) were created using sSVD and bSVD deconvolution and analyzed in a region-of-interest (ROI) and voxel-of-interest (VOI) based analysis. We compared the performance of both deconvolution methods to detect penumbral flow with a receiver-operating-characteristics (ROC) curve analysis.

**Results:** 20 patients were included (ROI: n = 10 and VOI: n = 20); time MRI to PET: 62/79 min. Tmax and CBF performed best in detecting penumbral flow (median highest area under the curve [AUC] of sSVD/bSVD): Tmax (ROI: 90/92 and VOI: 86/82), CBF (89/91 and 80/81) and MTT (82/88 and 65/75). Only MTT penumbral flow detection improved significantly (p < 0.01) with bSVD deconvolution.

**Conclusion:** The good performance of Tmax and CBF to detect penumbral flow did not differ between the underlying SVD methods. The use of the faster sSVD method seems justified in acute stroke.

## ESOC-0724

### 19. Imaging

#### Dual source CT-angiography (DSCTA) for non-invasive and more accurate imaging following intracranial aneurysm repair

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**Objective:** The invasiveness and risk of thromboembolic complications of catheter angiography underline the role of non-invasive imaging modalities, but especially for patients following intracranial aneurysm (IA) repair image quality is often low due to superimposed clip or coil artifacts. We prospectively investigated the potential role of dual-source CT angiography (DSCTA) for the more accurate assessment of aneurysm occlusion degree and parent vessel integrity in this respect.

**Methods:** Thirteen patients underwent DSCTA imaging following ruptured or unruptured IA repair. These datasets were matched for 13 patients, who underwent single source CT angiography (SSCTA) imaging for similar IAs following aneurysm repair. Image quality was objectively rated by quantifying beam hardening artifacts as the volume of a prolate ellipsoid. Subjective image quality at the site of aneurysms and corresponding parent vessels was rated by 2 independent neuroradiologists on a scale from 4 (excellent, no artifacts) to 1 (poor, severe artifacts).

**Results:** Patients undergoing surgical (8) or endovascular (5) aneurysm repair received DSCTA imaging. The beam hardening artifact volumes were significantly lower for DSCTA (mean: 2.55 vs. 135.1 ml; p < 0.0023), compared to SSCTA images in the matched IA patient cohort. Subjective image quality was good or excellent in 11 out of 13 patients in the DSCTA cohort, compared to 1 out of 13 patients in the SSCTA cohort.

**Conclusion:** DSCTA imaging quality is markedly superior to SSCTA and should be considered as an alternative, non-invasive imaging modality in patients treated for their IA and who have an increased cardiovascular risk profile.

## ESOC-0629

### 19. Imaging

#### Extent and pattern of thrombosis as predictors of parenchymal lesions in patients with cerebral venous thrombosis

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**Background and purpose:** Parenchymal lesions in patients with cerebral venous thrombosis (CVT) are associated with a worse prognosis. There are no established imaging predictors of brain lesion in CVT. We aim to determine if the extent(1) or topographical pattern(2) of venous thrombosis are associated with parenchymal lesions in a large sample of patients with CVT.

**Methods:** Data from the “International Study on Cerebral Vein and Dural Sinus Thrombosis,” a prospective cohort with 624 patients. **Numerical scoring of the extent of thrombosis. Classification of lesions as non-hemorrhagic or hemorrhagic (ICH).** Descriptive analysis and testing for an association between the presence of brain lesion, type, size and number of lesions, and extent or topographical pattern of venous thrombosis.

**Results:**

1) Extent of thrombosis

Significant association of the thrombosis extent with: parenchymal lesion (Rho = 0.9; p = 0.034); multiple lesions (Rho = 1; p = 0.0); ICH (Rho = 0.9; p = 0.037).

2) Topographical pattern of thrombosis

Topographical patterns most strongly associated with brain lesion: deep venous system- 88%; cortical veins- 87%; straight sinus- 67%, combined thrombosis of superior sagittal and both lateral sinus- 52%.

Presence of multiple lesions: thrombosis of the deep venous system- 39%; combined thrombosis of superior sagittal and both lateral sinus- 19%.

Presence of brain lesions with >5 cm: thrombosis of the deep venous system- 39%, cortical veins -30%, straight sinus -25% and combined thrombosis of superior sagittal and both lateral sinus- 13%.

**Conclusion:** The extent of thrombosis is an imaging feature associated with brain lesions in CVT. Some patterns of thrombosis are associated with higher risk of parenchymal lesion.

## ESOC-0195

### 19. Imaging

#### Structural plasticity of remote cortical brain regions is determined by connectivity to the primary lesion in subcortical stroke

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Cortical atrophy as demonstrated by measurement of cortical thickness is a hallmark of various neurodegenerative diseases. In the wake of an acute ischemic stroke, brain architecture undergoes dynamic changes that can be tracked by structural and functional magnetic resonance imaging studies in the early chronic stage. Although few studies of cortical plasticity post-stroke exist, it remains largely unknown how these changes are related to the primary ischemic lesion in space and time.

In this study, we prospectively measured changes of cortical thickness in cortical areas connected to subcortical stroke lesions in fifteen patients with upper extremity paresis combining white matter probabilistic tractography and semi-automatic measurement of cortical thickness using Freesurfer software. In addition, reference surfaces connected to a mirrored subcortical region on the contralateral hemisphere were constructed.

Three months post-stroke, significant cortical thinning of 2.4% (median, upper / lower boundary of 95% confidence interval 4.1% / 0.7%) was detected in areas connected to ischemic lesions, whereas cortical thickness in unconnected cortical surface areas remained largely unchanged. In addition, regional increases of cortical thickness were observed in the contralateral hemisphere surrounding the hand area on the precentral-gyrus. There was no significant correlation of changes in cortical thickness with clinical outcome parameters.

Our results demonstrate a specific impact of subcortical lesions on remote, yet connected cortical areas explainable by secondary neuro-axonal degeneration of distant areas. In addition, findings of increased cortical thickness in functionally relevant cortical areas point towards mechanisms of structural plasticity after stroke.

## ESOC-0251

### 19. Imaging

#### Do multimodal CT scans change clinicians initial decisions to thrombolysise acute stroke patients?

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**Background:** Time is brain and thrombolysis decisions in acute ischemic stroke should be made without delay. Multimodal (MMCT) scans including CT angiogram (CTA) and CT perfusion (CTP) are becoming increasingly common to guide thrombolysis decision making, but image acquisition and analysis may significantly and unnecessarily delay thrombolysis initiation.

**Aim:** To examine whether MMCT scans change the clinicians initial decision to thrombolysise acute stroke patients.

**Methods:** This prospective study examined clinicians initial thrombolysis treatment decisions based on primary patient assessment and non-contrast CT scans, and compared this to the final decision made following MMCT scans.

**Results:** Ninety-two cases were examined. There was a high correlation between the initial and final treatment decision (r = 0.77). Eight patients (9%) had a treatment change recorded following the use of MMCT scans: seven patients initially not for thrombolysis had a CTP deficit and received alteplase, and one patient initially for treatment had a large core on CTP and was subsequently not treated. NIHSS scores were significantly lower in those patients with an initial decision not to treat (median NIHSS 2 (IQR = 4) vs. 10 (IQR = 11), p = 0.009). Of the twenty-nine thrombolysed patients, twenty-eight had a discharge diagnosis of stroke.

**Conclusions:** Despite rapid door-to-decision times, clinicians initial thrombolysis decisions correlate highly with the final decision made following MMCT scans. However, these advanced images may act to reassure clinical decision making.

## ESOC-0327

### 19. Imaging

#### High-resolution intracranial vessel wall MR imaging in angiogram-negative subarachnoid hemorrhage: A pilot study

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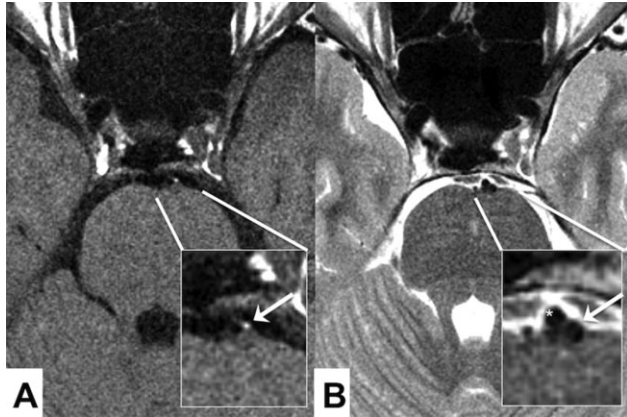
**Introduction:** In 10% of patients with an aneurysmal-type subarachnoid hemorrhage (SAH), the cause of hemorrhage is not apparent. Our aim was to determine feasibility and potential utility of high-resolution intracranial vessel wall MR imaging (VW-MRI) in these patients.

**Methods:** From 2012–2014, we performed VW-MRI in patients with a spontaneous aneurysmal-type SAH and no identifiable cause on minimally 3 angiographies, including at least CT-angiography and 6-vessel catheter angiography. We excluded patients with a perimesencephalic pattern. We performed VW-MRI of the circle of Willis on a 3-Tesla system using T1-, T2-, and gadolinium-enhanced T1-weighted two-dimensional black-blood sequences in multiple planes (voxel size 2.0 × 0.4 × 0.4 mm). Two neuroradiologists independently scored abnormalities of the arterial wall.

**Results:** Eleven patients (mean age 59 years) underwent VW-MRI. 8/11 patients had WFNS grade 1 SAH and 3/11 grade 2. One patient had a 2 mm focus of T1-hyperintensity (Fig. A) and T2-hypointensity (Fig. B) contiguous with the outer margin of the basilar artery wall (\*) which disappeared at follow-up. Diagnostic possibilities were dissection, thrombosed or blood blister-like aneurysm, or conceivably extramural blood from elsewhere. A similar abnormality was found in a second patient. Two

patients had concentric wall enhancement of multiple arteries, possibly secondary to SAH.

**Conclusion:** Our preliminary study suggests VW-MRI is feasible and potentially useful in patients with an angiogram-negative SAH. Further investigation is warranted.



**ESOC-0072**

**19. Imaging**

**Comparison of CT rating scales for cerebral white matter lesions in a large cohort of acute ischemic stroke patients**

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**Objective:** Cerebral white matter lesions (WMLs) are typically evaluated from magnetic resonance images. There are, however, several computed tomography (CT)-based rating scales. Since no consensus exists on superiority of any of the CT rating scale, we aimed to compare their interclass correlation.

**Methods:** We included 50 random patients out of 2485 consecutive pre-thrombolysis CT scans treated at the Helsinki University Central Hospital. WMLs were scored according to five previously published CT visual rating scales: The Gorter, the van Swieten, the Blennow, and the Wahlund rating scales. Single measure (SM) and average-measures (AM) interclass correlation (ICC) for consistency in a two-way mixed model with fully crossed design and eight raters were calculated for all used four visual rating scales at different cutoffs.

**Results:**

	SM ICC (CI)	AM ICC (CI)
Any WMLs	0.67 (0.59–0.78)	0.95 (0.92–0.97)
Gorter WMLs	0.78 (0.70–0.85)	0.97 (0.95–0.98)
Gorter WMLs 2	0.80 (0.72–0.86)	0.96 (0.95–0.98)
van Swieten anterior	0.76 (0.68–0.84)	0.96 (0.94–0.98)
van Swieten posterior	0.77 (0.69–0.84)	0.96 (0.95–0.98)
van Swieten	0.82 (0.75–0.88)	0.97 (0.96–0.98)
van Swieten 3 or 4	0.75 (0.66–0.83)	0.95 (0.93–0.97)
Blennow extension	0.82 (0.75–0.88)	0.97 (0.96–0.98)
Blennow intension	0.76 (0.68–0.83)	0.96 (0.95–0.98)
Blennow	0.81 (0.74–0.87)	0.97 (0.96–0.98)
Blennow over 2	0.66 (0.56–0.76)	0.94 (0.91–0.96)
Wahlund sum	0.87 (0.82–0.92)	0.98 (0.97–0.99)
Wahlund any WMLs	0.69 (0.60–0.78)	0.95 (0.92–0.97)
Wahlund any site score >1	0.69 (0.60–0.78)	0.95 (0.92–0.97)

**Interpretation:** The inter-rater agreement for the visual rating scales of WMLs ranged from substantial to perfect (0.66–0.87).

**ESOC-0523**

**19. Imaging**

**Visual rating of white matter lesions and atrophy in research studies: CT versus MRI**

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**Introduction:** In research, MRI is the preferred modality for analysis of structural age-related brain changes. However, feasibility and cost may render this impractical in large clinical studies. Here, we compared CT and MRI white matter hyperintensity (WMH) and atrophy ratings, and also examined inter-rater reliabilities of CT measures.

**Method:** Two raters independently completed visual rating scales in paired CT and MRI scans from a stroke trial (n = 70, median age 80). WMHs were scored according to the Fazekas, van Swieten and the Age-Related White Matter Changes (ARWMC) scales. Superficial and deep atrophy were scored on a five-point validated scale. Inter-rater reliability of CT measures was also assessed.

**Results:** Kappa statistics for intra-rater (CT-MRI) agreement indicated moderate to substantial CT-MRI agreement for most WMH scales (0.55–0.75). Relatively poor CT-MRI agreement in ARWMC scale basal ganglia ratings (0.18 and 0.44) was due to differences in the interpretation of the scale with regard to whether lesions were confluent and the presence of clusters of enlarged perivascular spaces appearing as focal lesions on CT. Atrophy scales also showed moderate to substantial CT-MRI agreement (0.44–0.70). Inter-rater (CT only) reliability results were similar to intra-rater scores with frontal and parieto-occipital ratings from the ARWMC scale producing the best agreement (0.74 and 0.75, respectively). McNemar’s tests showed some differences between raters reflecting systematic higher rating by one rater compared to the other.

**Discussion:** Use of these scales to assess WMHs and atrophy for research is feasible in CT. Periventricular WMH rating was more reliable than deep lesion scoring.

**ESOC-0525**

**19. Imaging**

**Comparison of CT and MRI for detection of old infarcts**

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**Introduction:** Old infarcts may indicate risk for stroke. The preferred method for classifying these in research studies is on MRI. However, in clinical cohorts, feasibility and cost may make this modality impractical.

**Methods:** We compared detection of old infarcts in paired CT and MRI scans from a large stroke trial (n = 70, median age 80) using a scheme for coding cortical and lacunar infarcts based on location and size. For lacunar infarcts, cavitation and volume estimations were recorded.

**Results:** Cortical infarcts were correctly identified more frequently (48%) than cavitated (33%) or non-cavitated lacunar infarcts (12%). Old infarcts were missed on CT primarily because they fell below the size criteria for inclusion (cortical 26%; cavitated lacunar 35%, non-cavitated lacunar 31%). The average volume of lacunar infarcts coded only on MRI was 107 mm<sup>3</sup> while lacunar infarcts detected in both modalities were

smaller when measured on CT than MRI (240 mm<sup>3</sup> versus 314 mm<sup>3</sup>) reflecting signal changes in the surrounding tissue visible on MRI but not CT and making MRI lesions appear larger. Some small cortical lesions were apparent as signal changes on MRI without structural changes and were therefore not visible on CT. Some lacunar lesions were detected but attributed to different locations. Non-cavitated lacunar lesions in particular were confused with white matter hyperintensities, enlarged periventricular spaces or acute lesions.

*Discussion:* Detection of larger cortical infarcts and cavitated lacunar lesions on CT was good and would be expected to be better in cohorts without acute lesions. Classification of small and non-cavitated lesions was not reliable.

## ESOC-0528

### 19. Imaging

#### Linear measurements on CT as an alternative to visual rating scales for atrophy: Reliability and correlations

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*Introduction:* Quantitative methods may be preferable to subjective atrophy rating scales in clinical research. We aimed to validate linear measurements in CT and to examine correlations between those and qualitative atrophy ratings.

*Methods:* Anonymized scans from a large stroke trial (n = 103) were analyzed using a DICOM reader. Superficial and deep atrophy were scored separately on a 5-point validated scale. Linear measurements were made blind to atrophy ratings and included right-to-left and anterior-to-posterior intracranial dimensions (for ratios), maximal frontal horn, third ventricle and frontal subarachnoid dimensions, minimal intercaudate and lateral ventricular body dimensions and the sums of the widths of the central sulci and Sylvian fissures.

*Results:* Most linear measures were very highly correlated when repeated within CT (Spearman's rho's 0.72–0.98, p < 0.001). The maximal frontal subarachnoid dimension was unreliable (Spearman's rho = 0.37, ns); better defined methodology may improve the reliability of this measurement. All ratios were significantly correlated with atrophy ratings (Spearman's rho = 0.34–0.76; all p < 0.01) with the exception of the frontal subarachnoid ratio with deep atrophy scores (Spearman's rho = 0.15, ns). Generally, linear measures relating to ventricular size correlated higher with deep atrophy ratings and measurements of sulcal width correlated better with superficial atrophy ratings (e.g. for central sulci ratio: Spearman's rho = 0.76 with superficial atrophy and 0.34 with deep atrophy).

*Discussion:* Linear measurements correlate highly with regionally specific visual ratings, and show high intra-rater reliabilities. Such measurements can therefore be reliably used for the assessment of deep and superficial atrophy in CT scans.

## ESOC-0659

### 19. Imaging

#### Sample size estimates for modifiers of white matter hyperintensities in ageing and stroke

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*Introduction:* White matter hyperintensities (WMH) are common and are associated with increased risk of stroke. Sample size estimates are required for clinical trials in ageing and stroke that use WMH progression as an intermediary outcome.

*Methods:* 459 community-dwelling subjects from the Lothian Birth Cohort 1936 had baseline brain magnetic resonance imaging (MRI) at mean age 72.7 ± 0.7 years and follow-up at 76.4 ± 0.6 years. 197 patients had brain MRI at presentation with stroke (mean age 66.9 ± 11.8 years) and at follow-up (mean age 67.0 ± 11.1 years). All subjects gave approved written-informed consent and were scanned on the same scanner. WMH volumes were measured using a validated multispectral segmentation method, masking out index stroke lesions. Sample sizes were calculated (alpha 0.05, power 0.9) to detect a 20% reduction in WMH progression. *Results:* Mean WMH volume increased from 11.92 ± 11.70 ml to 15.92 ± 14.62 ml over three years in the community-dwelling subjects (mean change 4.00 ± 4.32 ml), and from 21.96 ± 24.84 ml to 23.23 ± 23.28 ml over one year in stroke patients (mean change 1.27 ± 8.46 ml). The sample size per arm to detect a 20% reduction in WMH progression was 293 for community-dwelling subjects (over 3 years) and 23420 for stroke patients (over 1 year). The large sample size for stroke patients reflected the wide variance in WMH progression.

*Discussion:* Variability in WMH in stroke patients versus community-dwelling older subjects may limit their use as an intermediary end point to reduce sample sizes for clinical trials. High power may be achieved in clinical trials of modifiers of WMH progression in ageing with relatively modest sample sizes.

## ESOC-0372

### 19. Imaging

#### The role of microvascular dysfunction in CADASIL

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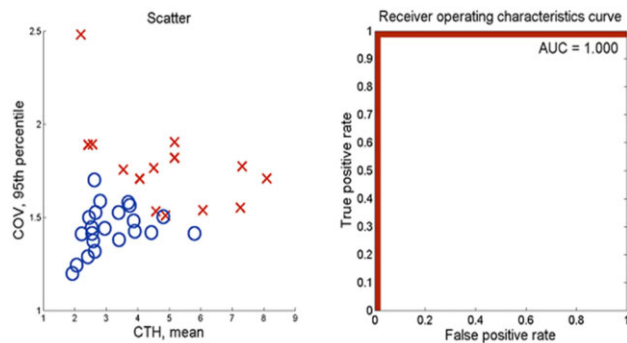
*Objectives:* Cerebral autosomal dominant arteriopathy with subcortical infarctions and leucoencephalopathy (CADASIL) is associated with microvascular dysfunction. We hypothesized that physiological shunting of oxygenated blood caused by capillary flow disturbances might result in tissue hypoxia in CADASIL patients. We used MRI to compare microvascular perfusion in healthy controls and CADASIL patients.

*Methods:* Dynamic susceptibility contrast MRI was acquired in 15 CADASIL patients and 22 healthy controls. Subject-wise whole-brain perfusion characteristics were derived to evaluate microvascular flow. Capillary transit time heterogeneity (CTH) was introduced as the standard deviation of intra-voxel transit times, and the coefficient of variance (COV) as the ratio between CTH and the mean transit time. Clinical characteristics were obtained in CADASIL patients.

*Results:* Mean CTH was higher in CADASIL patients vs controls (5.0 vs 3.2, p < 0.001). As COV values were distinctly right-skewed only in

CADASIL patients, the 95th percentile was selected as a possible biomarker of capillary dysfunction. Combined, CTH and COV were highly predictive of CADASIL (Fig.). Within CADASIL patients, CTH<sub>mean</sub> was correlated with high age, number of lacunar infarcts, and increased processing speed.

**Conclusions:** We observed evidence of disturbed microvascular flow patterns in CADASIL patients. Additionally, perfusion markers correlated with disease severity and clearly discriminated CADASIL patients and controls. We propose that microvascular dysfunction leads to hypoxia, tissue damage, and ultimately disabling cognitive impairment in these patients.



CADASIL patients (X) and controls (O). Receiver operating characteristics curve created using CTH<sub>mean</sub> and COV<sub>95th percentile</sub> as predictors of CADASIL in a logistic regression.

## ESOC-0519

### 19. Imaging

#### Effect of thin-section diffusion-weighted imaging on the detection of acute ischemic lesion in transient ischemic attack patients

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**Background and purpose:** Diffusion-weighted image (DWI) thin-section method was reported to be more sensitive to small acute ischemic lesions in stroke patients than conventional method. Thin-section method may increase DWI positive rate in TIA and affect the diagnosis of tissue-based TIA. We examined the influence of thin-section method on DWI positivity in time-based TIA patients.

**Methods:** We retrospectively enrolled consecutive 110 TIA patients (61 men, mean age 74 years) hospitalized to university hospital of Kyoto prefectural university of medicine (K group) and Saiseikai Shiga hospital (S group) within 7 days of onset, from 2010 to 2014. TIA was defined as focal neurologic symptoms ascribable to a vascular etiology lasting less than 24 hours. Thin-section method (3 mm section thickness, 0 mm intersection gaps) was performed in K group, and conventional method (5 mm thickness, 1 mm gaps) was performed in S group.

**Results:** DWI positive rate of all patients was 28.2%, and it was significantly higher in K group (41.0% vs 21.1%,  $p = 0.028$ ). Smoking habits, NIHSS at admission, and onset to MRI time also showed the significant difference between two groups. After adjustment for age, sex, and these factors, multivariable analysis showed that thin-section method was independently associated with DWI positivity (OR: 3.24; 95% CI: 1.26–8.56).

Of the DWI positive 16 cases in thin-section method, six cases exhibited small ischemic lesions (<5 mm diameter).

**Conclusions:** Thin-section method increased DWI positive rate in time-based TIA patients. When using the diagnostic criteria for tissue-based TIA, the diagnosis may be affected by imaging methods of DWI.

## ESOC-0661

### 19. Imaging

#### Bilateral carotid artery dissection following an exercise boot camp: The role of CT for detection

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It is well understood that early detection and treatment of stroke reduces the associated morbidity and mortality. The etiology of stroke caused by carotid artery dissection can be explained by several mechanisms, occlusion of the true lumen by thrombus or the expanding vessel itself causes distal hypo-perfusion. Most commonly, embolism from thrombus within the lumen can cause infarction; therefore early detection of carotid artery dissection is imperative for successful early treatment or intervention.

We present a 43 year old gentleman, who came to the emergency department with headache, paresthesia of both the left arm and face, accompanying a left-sided Horner's syndrome. The day before he had attended an exercise boot camp, undertaking extreme physical activity which was unusual for him. The left-sided dissection was confirmed with MRA imaging after initial CT scanning revealed no abnormality, treatment with 300 mg of aspirin was started. The bilateral dissection was discovered two weeks later on further MRI imaging. Retrospective analysis of the CT head revealed a clear image of the bilateral carotid artery dissections.

This case, which provides us with typical symptoms and signs of carotid artery dissection, emphasizes the importance of CT scanning. We have learnt that thorough review of CT images can lead to early diagnosis and encourage swift progression to further imaging and treatment. This case highlights the value of analyzing both carotid arteries routinely even if the clinical symptoms do not suggest bilateral pathology.

## ESOC-0288

### 19. Imaging

#### CT or MRI in evaluation for I.V. thrombolysis:

#### A single-center quasi randomized trial

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**Background:** The issue if Computer Tomography (CT) or Magnetic Resonance Imaging (MRI) is the 'best' primary image modality in evaluation of patients with symptoms of acute stroke has been discussed by stroke scientists for more than a decade. Access to primary acute MRI evaluation is frequently regarded as a token of high treatment quality; nevertheless, few centers worldwide are really primarily MRI based. MRI is superior in detecting acute ischemia and CT is faster and has no contraindications. As the efficacy of thrombolysis decreases with time to treatment one must ask if use of MRI is only of academic interest.

**Aim:** The aim of this ongoing study is to determine if choice of primary imaging modality (CT versus MRI) affects efficacy and safety of i.v. thrombolysis.

**Method:** An open quasi-randomized design, where imaging allocation is based on the date of admission. The 3 following items will be compared: Safety; Exclusion of other causes of symptoms than acute cerebral ischemia and contraindications to scanning method. Effect; Delay to treat-

ment, acquisition of imaging in diagnostic quality and identification of stroke mechanism. Applicability; Patient experience, experience of decision support for treating physician, deviation from radiological Standard Operational Plan (SOP) and use of resources.

**Inclusion and exclusion criteria:** Clinical suspicion of stroke <4.5 hours, NIHSS  $\geq 1$ , admission in the daytime and informed consent by patient or proxy.

**Time schedule:** The project was initiated in December 2013 and is expected to comprise 600 patients. By December 2014 298 patients had so far been evaluated.

## ESOC-0168

### 19. Imaging

#### Assessment of collateral blood flow with 4-dimension 3t-MR imaging in acute stroke patients

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**Purpose:** Four-dimensional MR angiography (4D-MRA) is a time-resolved sequence that enables the hemodynamic study of cerebral blood vessels. We evaluated the ability of 4D-MRA to determine the grade of occlusion and collateral blood flow in acute ischemic stroke patients.

**Methods:** 21 consecutive patients (mean age, 63; mean NIHSS, 17) underwent 3T-MR within 12 h of anterior arterial occlusion defined as TIMI 0–1 on TOF-MRA. Two independent readers evaluated grade of occlusion (mTICI) and arterial collateral grade (ACG) on 4D-MRA. Collateral status was dichotomized into incomplete (ACG 0–2) or complete (ACG 3–4) filling. We measured DWI and PWI (Tmax > 6 s) lesion volumes and calculated the collateral circulation deficit index: Tmax > 2 s volume x (Tmax > 6 s volume/volume of tissue with Tmax > 2 s and Tmax < 6 s). **Results:** Inter-reader agreement for mTICI and ACG was  $k=1$  and  $k=0.93$ . Site of occlusion according to 4D-MRA was M1 in 14 patients, tandem ICA-M1 in 2, tandem ICA-terminal ICA in 2, and isolated extracranial ICA in 3. TOF-MRA was unable to detect 3 of 4 tandem occlusions. Despite all patients had TIMI 0–1 on TOF-MRA, 4D-MRA showed mTICI 2a in 2, and mTICI 2b in 1. Complete collateral filling, observed in 9 patients (42.9%), was associated with smaller DWI lesion volume ( $p=0.012$ ), smaller hypoperfused brain volume ( $p=0.028$ ), and less collateral circulation deficit ( $p=0.009$ ).

**Conclusion:** 4D-MRA seems more sensitive detecting tandem occlusions and determining grade of occlusion than TOF-MRA. This technique is a fast, direct, feasible, noninvasive, reliable way to assess collateral circulation. It provides profound insights into hemodynamic alterations in acute stroke.

## ESOC-0482

### 19. Imaging

#### Characteristics of transient ischemic attack patients with positive lesions on diffusion-weighted imaging: Promise-TIA registry

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**Background:** The purpose of this study was to clarify factors associated with the presence of acute ischemic lesions on diffusion-weighted imaging (DWI) in transient ischemic attack (TIA) patients, using data of a multi-center prospective TIA registry.

**Methods:** Subjects of this registry were TIA patients within 7 days of onset between June 2011 and December 2013 from a prospective register in 57 hospitals. A total of 1414 patients were consecutively enrolled. Of these, 103 patients were excluded as a result of either final diagnoses of diseases other than TIA ( $n=42$ ), incomplete data ( $n=19$ ), or no magnetic resonance imaging (MRI) examination ( $n=42$ ). We analyzed the associations of DWI lesions with baseline characteristics.

**Results:** We studied 1311 patients with TIA (848 men, mean age of  $69.3 \pm 12.3$  years). DWI lesions were found in 429 patients (32.7%), and divided into single lesion (286 patients, 21.8%) or multiple lesions (143 patients, 10.9%). Multivariate analyses revealed that lower body mass index (BMI), atrial fibrillation (AF), hemiparesis, speech disturbance, symptom duration  $\geq 10$  minutes, intracranial arterial stenosis were associated with patients having DWI lesions. When considered single and multiple DWI lesion separately, AF, speech disturbance, symptom duration  $\geq 10$  minutes, higher diastolic blood pressure were associated with patients having single DWI lesion. Lower BMI, history of myocardial infarction, AF, smoking, alcohol, hemiparesis, MRI examination over 24 hours from onset, and intracranial arterial stenosis were associated with patients having multiple DWI lesions.

**Conclusion:** We identified some differences in relating factors between TIA patients with single and multiple DWI lesions.

## ESOC-0537

### 19. Imaging

#### Emissary vein thrombosis-clinical and neuroimagic features

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**Introduction:** Emissary veins are remains of fetal life, which are rarely accounted in adulthood, causing non-specific clinical manifestations.

**Purpose:** To assess the clinical features and neuroimaging data in patients with an emissary vein thrombosis.

**Patients and methods:** Cerebral venous and sinus thrombosis were defined in five patients according to the EFNS Guidelines (2011); the diagnosis was confirmed on the basis of history, neurological evaluation, cerebral CT scan/CT-Angiography (Aura Philips spiral single slice), MRI/MR-

Angiography (Signa Horizon Lx 1.0T), and laboratory data. They were examined at admission and after three months, using the mRS scores.

**Results:** Clinical aspects were represented by recent headache due to intracranial hypertension, associated with a peculiar sensibility of the temporo-mandibular joint. Laboratory findings consisted in signs of non-specific inflammation, without thrombophilia. CT and MRI detected an exterior convex channel situated at the level of the premeatic squamae, which ended at the superior part of the temporo-mandibular joint. We used mannitol and steroids (for reducing the intracranial pressure), and antithrombotic therapy (low molecular weight heparin), with a favorable outcome (mRS score = 0, at 90 days) for all five patients.

**Conclusions:** The prompt diagnosis of emissary veins thrombosis is essential, because the early initialization of an efficient therapy has a great impact on the evolution of this disease.

## ESOC-0643

### 19. Imaging

#### Focal grey matter atrophy after subcortical infarct of pyramidal tract: A longitudinal study of 21 patients

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**Introduction:** Subcortical infarcts are associated with cortical atrophy which mechanism remains unknown. This remote consequence on gray matter may be explained by two phenomena. First by a retrograde degeneration of injured neurons, and secondly by a coexistence of microcortical lesions occurring in parallel of subcortical ones.

In order to highlight a retrograde degeneration of motor pathway after its injury and determine its onset time, we longitudinally studied grey matter volume after subcortical stroke of the pyramidal tract.

**Method:** Consecutive patients with subcortical infarct of pyramidal tract and NIHSS  $\geq 2$  were recruited from the Purpan's stroke center (Toulouse, France). They underwent clinical examination and MRI right after stroke and three months (M3) later. Our primary aim was to find focal atrophy of ipsilesional (i) primary motor cortex (M1) at M3. We used voxel-based morphometry (VBM) to determine grey matter density.

**Results:** 21 subjects were included. At 3 months, there was no significant atrophy of M1 (FWE,  $p \leq 0,05$ ,  $k \geq 100$ ) but there was significant atrophy of Caudate and Thalamus (i).

There also was significant hypertrophy of Premotor and Insular cortices (i), Cingular anterior and Cingular middle cortices (i and c), and Precuneus (i and c).

**Discussion:** Our study highlights remote consequences induced by subcortical infarct of pyramidal tract, in regions directly related to it such as Premotor cortex and in associative cortices such as Cingular and Insular. These cortical hypertrophy may be a compensatory mechanism. We couldn't confirm precocious retrograde degeneration of pyramidal tract.

## ESOC-0545

### 19. Imaging

#### Fluid-attenuated inversion recovery (FLAIR) signal intensity as a proxy for lesion age in acute stroke

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**Background:** In many centers, patients with wake-up stroke or unknown time of onset stroke are excluded from thrombolytic treatment. However, current studies indicate that some magnetic resonance (MR) sequences can help predict time from symptom onset. Our goal was to assess the value of FLAIR signal intensity ratio (SIR) as a surrogate for stroke time of onset.

**Materials and methods:** We studied 95 acute stroke patients with known time of onset who underwent MR imaging within 48 hours of symptom onset. The SIR was calculated as the value of the FLAIR signal intensity of the visible lesion or the identified area of infarction corresponding to the diffusion weighted images divided by the FLAIR signal intensity in the homologous contralateral side of the brain.

**Results:** Fifty-seven patients (60%) had MRI within 4.5 hours of stroke onset. We found a positive correlation between FLAIR SIR and time from symptom onset (Pearson correlation coefficient, 0.34). The FLAIR SIR showed a negative correlation with the NIH Stroke Scale (NIHSS) when controlling for stroke duration. Receiver operating characteristic curves indicated that FLAIR SIR  $\leq 1.11$  could identify patients within 4.5 hours of symptom onset with 76% sensitivity (95% CI: 62–86%) and 67% specificity (95% CI: 52–79%). Visualization of FLAIR hyperintensity can predict the lesion outside of 4.5-hour treatment window with a sensitivity of 84% (95% CI: 66–94%).

**Conclusion:** Qualitative and quantitative assessment of FLAIR sequence can be used as a proxy for lesion age among patients with wake-up stroke or unknown time of onset stroke.

## ESOC-0207

### 19. Imaging

#### Features of symptomatic intracranial stenosis correlated with functional outcome of affected patients at 1 year: Clinical application of the computational fluid dynamics modeling technique

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**Background:** We aimed to investigate the correlations between features of symptomatic intracranial atherosclerotic stenosis (ICAS) and functional outcome of affected stroke patients, using routine CT angiography (CTA) and computational fluid dynamics (CFD) modeling technique.

**Methods:** Ischemic stroke patients with symptomatic ICAS of 50–99% luminal stenosis, revealed by CTA performed within 1 month of ictus, were recruited. CFD models of the index ICAS lesions were built based on CTA source images. Anatomic and hemodynamic features of the index ICAS lesions were respectively evaluated on CTA and CFD models. The correlations between these features of the ICAS lesions and improved functional outcome at 1 year, defined as reduced modified Rankin Scale (mRS) at 1 year compared as that at baseline, were assessed.

**Results:** In total, 32 patients were recruited (median age 65; male 59.4%), with 6 (18.8%) having improved functional outcome at 1 year, and 26 (81.2%) having stable or worse functional outcome at 1 year. In univariate analysis, the index ICAS lesions in patients with improved functional outcome at 1 year had less severe luminal stenosis on CTA (median: 53% versus 70%;  $P = 0.014$ ), and less severe pressure drop across the lesions as measured on the CFD models (median distal to proximal pressure ratio: 0.8 versus 0.4;  $P = 0.029$ ).

**Conclusions:** Not only the anatomic but also the hemodynamic features of symptomatic ICAS lesions might be correlated with the functional outcome of affected stroke patients at 1 year. Future studies are needed to further validate these findings, and to uncover the underlying mechanisms.



## ESOC-0039

## 19. Imaging

### How often does multimodality imaging change the diagnosis in patients presenting with stroke like symptoms?

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**Introduction:** Stroke is common, however 1/3 of patients presenting with stroke-like symptoms have stroke mimics. Use of multimodality imaging in assessing stroke patients is increasing. Both non-contrast computed tomography (NCCT) and magnetic resonance imaging (MRI) have roles. Patients who have an uncertain clinical diagnosis and a non-diagnostic NCCT often require further imaging with MRI. We sought to determine how often diagnosis/management of patients was changed when they had multimodality imaging to investigate stroke-like symptoms.

**Methods:** We retrospectively evaluated inpatients from within the Acute Stroke Unit at Monklands Hospital, Lanarkshire, who had dual imaging performed and who had a clinical suspicion of acute stroke over a 6 month period in 2014. Information was gathered from clinical letters, electronic records and radiology reporting systems.

**Results:** Mean age was 56.6, 62% were female. 25 inpatients had both NCCT and MRI. Of these, 18 (72%) had NCCT which did not show acute ischemic stroke. The remainder (7) had NCCT findings of alternative pathology. Of these 18 patients with non-diagnostic NCCT, 12 (67%) had normal MR imaging, and stroke was ruled out as a diagnosis, 5 had a stroke diagnosis confirmed (28%), and 2 had alternative pathology found on MR. 78% of patients had their diagnoses and treatment changed following multimodality imaging.

**Conclusion:** MR in addition to NCCT in patients with stroke like presentation changes clinical diagnosis in three quarters of patients. This has implications for cost, quality of life and avoidance of unnecessary investigations.

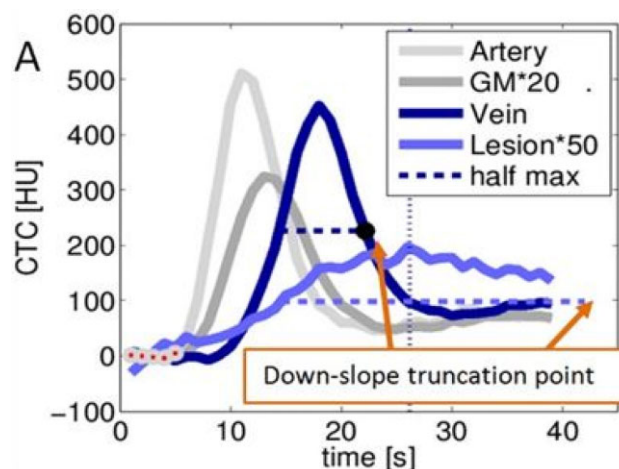
## ESOC-0377

## 19. Imaging

### Biased visualization of hypoperfused tissue by computed tomography due to short imaging duration: Improved classification by vascular models

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**Objectives:** Lesion detection in acute stroke by computed-tomography perfusion (CTP) can be impaired by incomplete bolus coverage in veins and hypoperfused tissue, so-called *bolus truncation* (BT)<sup>1</sup>, see Fig. 1. We examined the BT-frequency and hypothesize that a vascular model (VM) for perfusion calculation improves classification of normo- and hypoperfused tissue under bolus truncation.

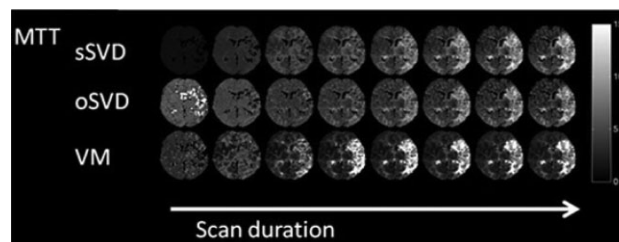


**Fig. 1** Contrast concentration-time-curves (CTC) in vessels and hypoperfused tissue. Imaging may have ended before CTCs reach the down-slope point.

**Methods:** CTP datasets from 40 acute stroke patients were retrospectively analyzed for BT. In 16 patients with hypoperfused tissue but no BT, reduced scan duration was simulated, and the *minimum scan-duration*, at which the estimated lesion volumes came within 10% of their true volume, was compared for VM<sup>2</sup> and state-of-the-art perfusion algorithms.<sup>3-4</sup>

**Results:** BT in veins and hypoperfused tissue were observed in 9/40 (22.5%) and 17/40 patients (42.5%), respectively.

VM reduced minimum scan-duration, providing reliable maps of cerebral blood-flow and mean transit-time, by 5 s ( $p = 0.03$ ) and 7 s ( $p < 0.0001$ ), respectively. See Fig. 2



**Fig. 2** The estimated lesion volume depends in imaging duration. Here mean transit-time (MTT) for VM and two state-of-the-art algorithms. VM detects lesions at shorter scan duration than SVD methods.

**Conclusions:** BT is not uncommon in stroke CTP with 40 s scan duration. Using VM improves tissue classification under BT.

## References

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## ESOC-0086

## 19. Imaging

## CT perfusion imaging in wake-up stroke

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**Background and purpose:** Wake-up stroke (WUS) patients are typically excluded from reperfusion treatment, as the time of symptom onset is unknown. The purpose of this study is to evaluate the efficacy and safety of intravenous thrombolysis with rt-PA in patients with WUS eligible for therapy using computed tomography perfusion criteria (CTP), in comparison with patients treated with rt-PA within 4.5 h of symptom onset (non-WUS).

**Methods:** This is an experimental, open label trial, controlled against the best therapy currently in use. **Primary endpoints** were functional independence after 3-months (mRS  $\leq 1$ ) for efficacy and symptomatic intracerebral hemorrhage (SICH) for safety. **Secondary endpoints** were no or only mild disability after 3-months (mRS  $\leq 2$ ) for efficacy, total intracerebral hemorrhage (TICH) and contrast-induced-nephropathy (CIN) for safety.

**Results:** 170 patients were treated, 143 non-WUS patients and 27 patients with WUS. Strokes of cardioembolic origin were most common in WUS patients ( $p < 0.001$ ). **Primary endpoints:** mRS  $\leq 1$  was found in 35.8% (non-WUS: 36.2% vs WUS 34.2%;  $p = 0.62$ ) and SICH was observed in 3.4% of non-WUS patients and in no WUS patients ( $p = 0.32$ ). **Secondary endpoints:** mRS  $\leq 2$  was observed in 66.4% of patients (non-WUS: 67.8% vs WUS 65.5%;  $p = 0.67$ ), TICH in 13.5% of patients (13.9% non-WUS vs 11.1% WUS –  $p = 0.69$ ). CIN was documented in 3.7% of WUS patients.

**Conclusion:** rt-PA treatment carried out in WUS patients selected on the basis of CTP data demonstrated comparable safety and efficacy with respect to non-WUS patients. The study supports the hypothesis that a selected group of WUS patients may be suitable for thrombolysis.

## ESOC-0180

## 19. Imaging

## Clinical application of arterial spine labeling MR imaging

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**Purpose:** Arterial spine labeling (ASL) MR imaging sequence enables cerebral blood flow (CBF) evaluation with magnetically labeled blood water. The purpose of this study is to present the clinical application of ASL MRI.

**Methods:** ASL MRI using a pseudocontinuous ASL pulse sequence conducted for suspected ischemic stroke. We categorized ASL abnormalities into decreased, increased, and mixed CBF disorders and demonstrated the specific examples in addition to ASL artifacts.

**Results:** ASL abnormalities due to decreased CBF include stroke, vasospasm, hydrocephalus, and neurodegeneration, but those due to increased CBF include hypercapnea, vascular shunts, and aggressive tumors. Mixed CBF disorders include seizure and migraine.

ASL using magnetically labeled arterial blood protons enables initial and follow-up evaluation of tumors. Vascular artifacts in acute ischemic stroke due to long transit time, facilitate the detection of arterial occlusion. ASL could detect vascular shunt lesions because of venous signals with short

transit time. Localized hyperperfusion is seen in the occipital region by visual activation, and in the internal frontal region, residual vascular signal. Localized hypoperfusion from the frontal and occipital horns to the frontal and parieto-occipital cortex, corresponds to arterial borderzones. Susceptibility artifacts may be seen at skull base, hematomas, calcifications and metals. Hemispheric perfusion defect could be developed due to saturation failure from carotid stent. Movement artifacts may produce strips at the periphery of the brain.

**Conclusions:** In conclusion, ASL MRI could provide a specific diagnosis or functional information critical to patient. Clinical application of ASL MRI in brain imaging is presented with specific examples.

## ESOC-0359

## 19. Imaging

## Hyperintense vessel signal on arterial spin labeling MR image in acute ischemic stroke, comparing with susceptibility vessel sign on susceptibility weighted image

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**Purpose:** Susceptibility vessel sign by the susceptibility effect of intravascular clot on susceptibility weighted image (SWI) depends on the clot composition, which is significantly more common in RBC dominant and mixed clots than fibrin-dominant clots. Meanwhile, the hyperintense vessel signal on arterial spin labeling (ASL) depends on the delayed arterial transit time of magnetically labeled blood water. The purpose of this study is to evaluate the hyperintense vessel signal on ASL in acute ischemic stroke, comparing with susceptibility vessel sign on SWI.

**Methods:** All images of patients who performed MRI for suspected acute ischemic stroke were analyzed with the respect to followings: hyperintense vessel signal on ASL, susceptibility vessel sign on SWI, arterial occlusion on time-of-flight MR angiography, and diffusion restricted area on diffusion weighted image.

**Results:** Hyperintense vessel signal on ASL was significantly more identified in groups with arterial occlusion and territorial-pattern diffusion restricted area than in groups without arterial occlusion and cortical-pattern small diffusion restricted area (79% [22/28] versus 31% [16/51], 64% [30/47] versus 38% [21/55], respectively;  $P < 0.05$ ). Hyperintense vessel signal on ASL had a significantly higher sensitivity for the detection of occlusion than the susceptibility vessel sign (79% [22 of 28] versus 57% [16 of 28],  $P < 0.05$ ).

**Conclusions:** Hyperintense vessel signal on ASL could identify arterial occlusion and acute territorial-pattern infarct in patients with acute ischemic stroke, which may be associated with stagnant flow at occlusion sites.

## ESOC-0078

## 19. Imaging

## High resolution molecular magnetic resonance imaging of the endothelial adhesion molecule, P-selectin for the diagnosis of transient ischemic attack

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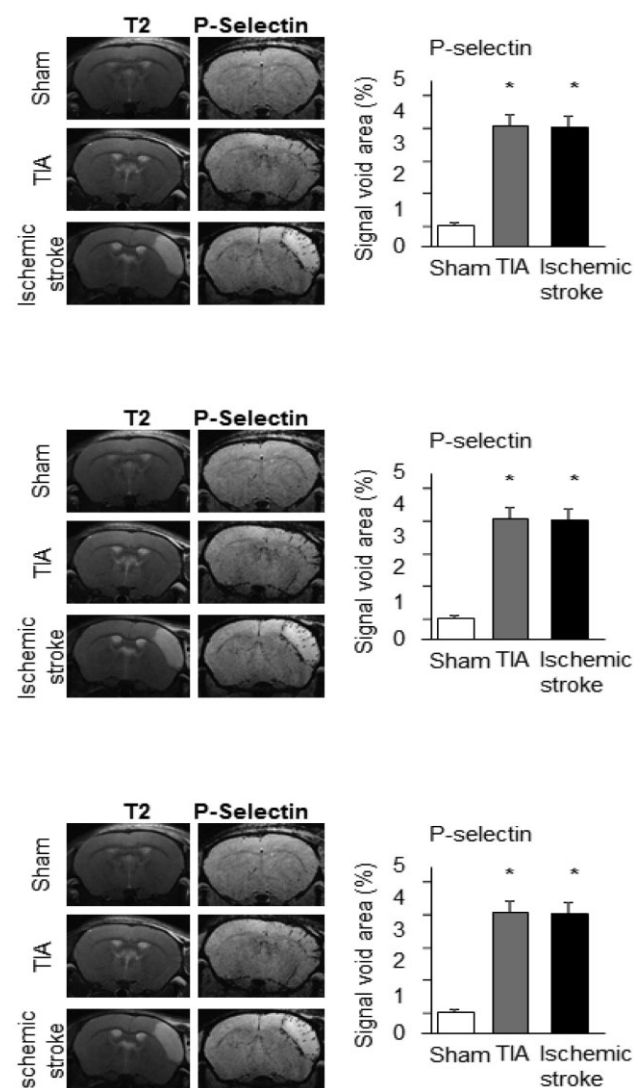
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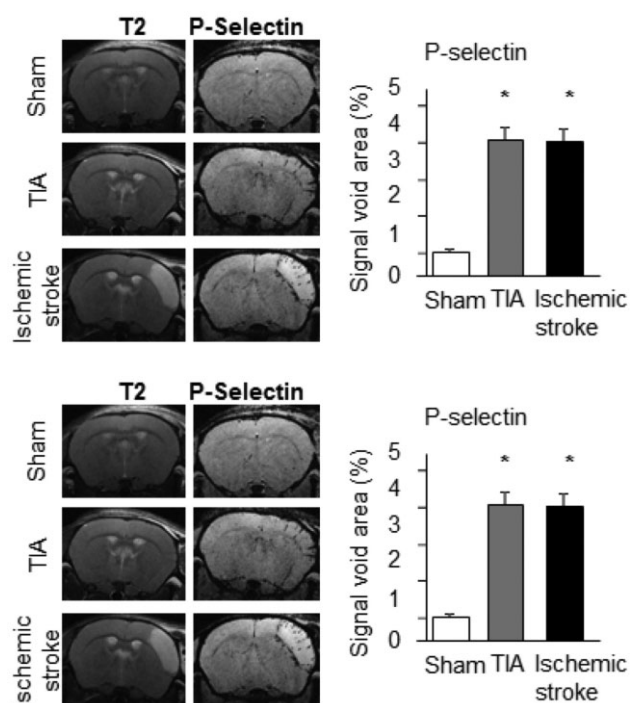
Transient ischemic attack (TIA) is a transient episode of neurologic dysfunction due to brain ischemia without infarction on imaging. TIA is a risk factor for ischemic stroke. Thus, failure to diagnose TIA is a wasted opportunity to prevent permanent disability. Unfortunately, diagnosing TIA remains challenging.

We first developed an original model of TIA in mice displaying all the features of TIA in humans, as measured by laser doppler, somatosensory evoked potentials and 7T MRI.

Then, an analysis of endothelial adhesion molecules identified P-selectin as a putative biomarker for TIA. However, ELISA assays for plasmatic P-selectin proved to be not sensitive enough to diagnose TIA in both mice and humans. By contrast, molecular MRI with antibody-based particles of iron oxide targeting P-Selectin appeared as an excellent and highly sensitive tool to diagnose TIA (Fig.), and even discriminate this disease from ischemic stroke and stroke mimics in experimental models. High resolution molecular magnetic imaging is thus a powerful technic to diagnose discrete pathogenic events during diagnostically challenged brain diseases like TIA.



**Fig.** High-resolution molecular imaging of P-selectin identifies sequelae inflammatory areas after TIA, while regular MRI evidences no brain lesion



Representative images of brain infarction (T2 images), and molecular imaging of P-selectin 24 hours post-surgery in mice and corresponding quantifications ( $n = 5$  mice per group; Mann-Whitney's U-test,  $*p < 0.05$  versus sham).

## ESOC-0103

### 19. Imaging

#### Hyperacute prediction of stroke outcome using diffusion tensor imaging

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**Background:** Fractional anisotropy (FA) is known to be an effective marker of motor prediction at the sub-acute and chronic stage of stroke, yet proves to be less efficient at early time points. The present study aims to determine which diffusion metric is the best marker by assessing ischemic damage in different levels of the corticospinal tract (CST) with DTI at 24 h post-stroke.

**Methods and materials:** 28 thrombolysed patients underwent DTI at 24 hours post-stroke onset. Ipsilesional and contralesional FA, mean (MD), axial (AD), and radial diffusivities were calculated in regions of interest (ROIs) of the corticospinal tract: (1) The white matter of the precentral gyrus (M1), (2) the corona radiata (CR), (3) the posterior limb of the internal capsule (PLIC), and (4) the cerebral peduncles. NIHSS scores were acquired at the time of scanning (day one) and at day 7 as well as modified Rankin Scores (mRS) at 3 months.

**Results:** Significant differences were found in FA, MD and AD of the PLIC, CR, and M1. The ratio of axial diffusivity (rAD) correlated strongly with motor items of the NIHSS at day 7, as well as with the mRS. A

Receiver-Operator Curve analysis yielded an accurate model for the rAD of the corona radiata to predict “good” and “poor” outcome based on upper limb NIHSS motor scores and mRS scores. FA values were not correlated with clinical outcome.

**Conclusion:** Axial diffusivity from clinical DTI at 24 h post-stroke is the most appropriate diffusion metric for quantifying stroke damage related to outcome.

## ESOC-0106

### 19. Imaging

#### B-mode ultrasonography of carotid artery plaque can be used to select patients eligible for carotid magnetic resonance imaging

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**Objective:** To explore whether carotid artery ultrasonography can select patients eligible for carotid artery MRI.

**Methods:** B-mode ultrasonography and 3T-MRI of the carotid plaque were performed in patients with recent TIA/stroke and 30–99% ipsilateral carotid stenosis. Ultrasonography assessed plaque morphology using the normalized grey-scale median (GSM, ranging from 0 (echolucent) to 255 (echointense)). MRI evaluated vulnerable plaque components (i.e. lipid-rich necrotic core (LRNC), intraplaque hemorrhage (IPH) and presence of a thin/ruptured fibrous cap (TRFC)).<sup>1</sup> Median GSM (interquartile range) was compared for different plaque components using the Mann-Whitney-test. Since IPH and TRFC can only be scored if LRNC is present, the ROC-curve was drawn to determine area-under-curve (AUC) for GSM to distinguish between plaques with and without LRNC.

**Results:** We included 55 patients (67 ± 8 year, 41 males). Median GSM was significantly smaller in plaques with LRNC versus without LRNC (31 (19–51) vs. 63 (43–78),  $p=0.017$ ). Median GSM was also smaller in plaques with TRFC versus a thick fibrous cap (29 (19–46) vs. 58 (28–70),  $p=0.045$ ), but it failed to discriminate plaques with and without IPH (32 (19–61) vs. 42 (21–66),  $p=0.437$ ).

AUC for detecting stable plaques with LRNC was 0.74 (95% CI 0.59–0.89,  $p=0.007$ ). A GSM cut-off of  $\leq 40$  to refer patients for subsequent MRI results in a sensitivity and specificity of 80% and 65%, respectively.

**Conclusion:** Carotid ultrasonography can identify patients with LRNC plaques with good sensitivity and reasonable specificity, which require subsequent carotid MRI to identify vulnerable plaque features.

## Referen

1 Truijman et al. Int J Stroke 2014 (9); 747–54.

## ESOC-0623

### 19. Imaging

#### Validity of acute stroke lesion volume estimation by DWI-ASPECTS depends on lesion location in 496 MCA stroke patients

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**Background:** There have been several attempts to use Alberta Stroke Program Early CT Score (ASPECTS) to estimate diffusion weighted imaging (DWI) lesion volume in acute stroke. We aimed to assess correlations of DWI-ASPECTS with lesion volume in different MCA subregions and reproduce existing ASPECTS thresholds for a lesion volume  $\geq 100$  ml.

**Methods:** We analyzed data of patients with middle cerebral artery (MCA) stroke from a prospective observational study of DWI and FLAIR in acute stroke (PRE-FLAIR). DWI-ASPECTS and lesion volume were calculated. The population was divided into subgroups based on lesion localization (superficial MCA territory, deep MCA territory, or both). Correlation of ASPECTS and infarct volume was calculated and receiver-operating characteristics (ROC) curve analysis was performed to identify the optimal ASPECTS threshold for  $\geq 100$  ml lesion volume.

**Results:** 496 patients were included. There was a significant negative correlation between ASPECTS and DWI lesion volume ( $r=-0.78$ ,  $p<0.0001$ ). With regards to lesion localization, correlation was weaker in deep MCA region ( $r=-0.19$ ,  $p=0.038$ ) as compared to superficial ( $r=-0.72$ ,  $p<0.001$ ) or combined superficial and deep MCA lesions ( $r=-0.72$ ,  $p<0.001$ ). ROC analysis revealed ASPECTS  $\leq 6$  as best cut-off to identify  $\geq 100$  ml DWI lesion volume, however positive predictive value was low (0.35).

**Conclusion:** ASPECTS has limitations when lesion location is not considered. Identification of patients with “malignant profile” by DWI-ASPECTS seems to be unreliable. ASPECTS may be a useful tool for the evaluation of non-contrast CT. However, if MRI is used ASPECTS appears dispensable as lesion volume can easily be quantified on DWI maps.

## ESOC-0634

## 19. Imaging

**Headache in acute ischemic stroke – A lesion mapping study**

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**Background:** Headache occurs frequently in acute ischemic stroke, but the underlying mechanisms are incompletely understood. The aim of this lesion mapping study was to identify brain regions, which are associated with the development of headache in acute ischemic stroke.

**Methods:** 100 patients with ischemic stroke underwent cerebral MRI including diffusion weighted imaging. 50 patients with stroke suffered from headache at the time of symptom onset and 50 patients reported no headache. Infarcts were manually outlined and the according regions of interest were transformed into standard stereotaxic space. Voxel-wise overlap and subtraction analysis of lesions and non-parametric statistics (MRICron) were conducted. All analyses were carried out with and without flipping of left-sided lesions.

**Results:** The headache group as well as the non-headache group did not differ in infarct volumes, in the distribution of affected vascular beds nor in clinical severity. The headache phenotype was mostly tension type-like. Subtraction analysis revealed more frequent infarction within two areas of the central pain matrix, namely in the insula and the somatosensory cortex, which was confirmed in the flipped analysis. This was also confirmed by non-parametric statistical testing (whole brain corrected P-value < 0.05).

**Conclusion:** To our knowledge, this is the first lesion mapping study investigating the association between acute headache and ischemic stroke. Insular infarcts turned out to be strongly associated with the occurrence of headache. The insular cortex is a well-established region in pain processing and our results suggest that at least in a subgroup of patients, acute stroke-headache may be centrally driven.

## ESOC-0664

## 19. Imaging

**18FDG-PET-CT predicts occurrence of stroke, TIA or and/or need for revascularization in patients with carotid stenosis**

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**Background and purpose:** We investigated whether uptake of (18) fluoro-2-deoxy-d-glucose (18FDG) positron emission tomography-computed tomography (PET-CT) and presence of microembolic signals (MES) detected by transcranial Doppler (DTC) predicted the occurrence of stroke, TIA and/or need for revascularization inpatients with carotid stenoses.

**Methods:** 18FDG-PET-CT and MES detection were performed in consecutive patients with 50% to 99% carotid stenoses. Uptake index was defined by a target to background ratio (TBR) between maximum standardized uptake value of the carotid plaque and the mean standardized uptake value of the jugular veins. All patients were followed every 3 months. Outcome endpoints were occurrence of stroke, TIA and/or need for revascularization during the follow-up period.

**Results:** We included 117 stenosis derived from 106 patients, 56 symptomatic and 61 asymptomatic. Of these 43 were operated within the first month and 74 were followed during a mean period of 24 months. Seven patients(10%) presented at least one of the three outcome endpoints. Median TBR value was of 2.4 in the event positive(+) and of 1.79 in the event negative (–) group (p < 0.01). MES were present in one of the 7(14%) event + (14%) and in 8 (12%) of the event- patients (p < 0.9). In a logistic regression model including age, degree of stenosis, presence of MES and TBR, only TBR resulted to be an independent predictive factor (OR 18,4 95% CI 2.11 to 161, p = 0.008).

**Conclusions:** In patients with carotid stenoses, 18FDG-PET-CT predicted the occurrence of stroke, TIA and/or need for revascularization during follow-up

## ESOC-0389

## 19. Imaging

**How representative of the burden of small vessel disease imaging markers is the ipsilateral hemisphere after a lacunar ischemic stroke?**

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**Background:** In structural Magnetic Resonance Imaging (MRI) of patients with a recent small subcortical infarct (RSSI), white matter hyperintensities (WMH), lacunes, remnants of previous micro-/macro-hemorrhages and, previous cortical stroke lesions may coexist with the acute lesion. The distribution and prevalence of these small vessel disease (SVD) imaging markers with respect to the location of the RSSI is not yet known.

**Methods:** From brain MRI from 187 patients with an acute lacunar ischemic stroke clinical syndrome and a relevant DWI-positive lesion, we semi-automatically extracted the RSSI, micro-/macro-hemorrhages, lacunes, old cortical infarcts and WMH using optimized thresholding in the relevant sequences. We used Wilcoxon and  $\chi^2$  tests to compare the volumes and frequencies of occurrence, respectively, of the SVD markers in both hemispheres throughout the sample.

**Results:** 51.9% patients (n = 97) had the RSSI in the left hemisphere, 41.7%(n = 78) in the right, 2.7%(n = 5) in both and 3.7%(n = 7) in the cerebellum or brainstem. There was no significant difference in RSSI frequency between left and right hemispheres (p = 0.10). The median percentage volume of the RSSI in intracranial volume was  $5.33 \times 10^{-4}$  (IQR =  $2.7 \times 10^{-4}$ – $8.9 \times 10^{-4}$ ). There was no inter-hemispheric differences on the volumes of the RSSIs (p = 0.16). Neither was there a significant difference between hemispheres in the volume of any of the SVD markers assessed.

**Conclusions:** The load of SVD imaging markers was balanced between both hemispheres regardless of the location of the RSSI. Therefore, assessment of SVD imaging markers only on the contralateral hemisphere could be used as a proxy for the SVD load in the whole brain.

## ESOC-0357

## 19. Imaging

## Blood–brain barrier assessment in stroke using T1 dynamics: A pilot study

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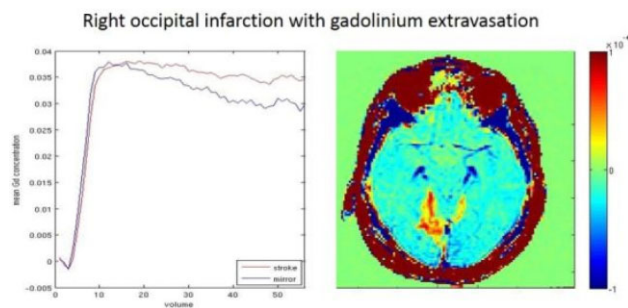
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**Objective:** Blood–brain barrier (BBB) dysfunction is believed to be a precursor of hemorrhage and worse outcome after stroke. HARM sign reflects BBB dysfunction though only qualitatively. However, it would be preferable to assess BBB function quantitatively and thus enabling the monitoring of drug delivery to the infarction. We aimed to assess BBB function in stroke patients using dynamic quantitative T1 measurements.

**Methods:** We included 28 patients with ischemic strokes and a median delay of 35 hours between symptom onset and MRI examination. Thirteen patients received rt-PA, 10 showed hemorrhagic transformation. T1 weighted images at different flip angles were acquired for quantification purposes, followed by T1 measurements after contrast agent application. After preprocessing linear fit maps were generated resulting in median slopes characterizing Gadolinium wash-in/wash-out for each voxel. Values within the infarction were compared to the contralateral side.

**Results:** Median slope and median subtraction values were significantly different between infarction and contralateral regions ( $p < 0.001$ ). No correlation was found between median slope and T1 post contrast values ( $r = 0.078$ ), time of onset ( $r = 0.277$ ), lesion size ( $r = 0.078$ ). Six patients with repetitive measurements demonstrated significantly higher median slopes ( $p = 0.028$ ) at follow-up. There was no significant difference between patients with hemorrhagic transformation and ischemic stroke (median slope:  $p = 0.175$ ).

**Conclusion:** BBB dysfunction in infarcted tissue can be visualized and quantified with dynamic T1 measurements.



## ESOC-0194

## 19. Imaging

## Can advanced CT imaging predict the high-risk carotid plaque?

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**Introduction:** 20–30% of ischemic strokes are caused by carotid atherosclerosis. Currently, the severity of stenosis is the determining factor for surgical intervention. Histology has identified a number of plaque features that are associated with an increased risk of stroke and contribute to the ‘vulnerable’ plaque. Other plaque characteristics available for analysis

on CTA 3D visualization software may correlate with these and help identify patients at high risk of stroke.

**Materials and method:** Nineteen symptomatic patients (14 men, 5 women) were selected. Computed Tomography Angiography (CTA) images were analyzed for carotid plaque features using TeraRecon 3D visualization software. Results were validated by interobserver agreement, comparison with Duplex Ultrasound (DUS) recordings and ex vivo measurements. Carotid plaques were histologically processed, classified and high-risk features were detected. A CTA risk score was produced based on the degree of each characteristic analyzed and compared to a histology risk score.

**Results:** CTA measurements for degree of stenosis, plaque length and irregularity correlated well with DUS and ex vivo results. However, there was no correlation between the high-risk plaques identified by each risk score ( $\chi^2 = 0.059$ ,  $p < 0.8$ ). Irregularity on CT correlated with plaque histology, no other clear correlations were seen.

**Conclusion:** Currently, the use of routinely available imaging software is insufficient to identify the high-risk carotid plaque. There is a need to continue research specific plaque scans.

## ESOC-0568

## 19. Imaging

## Greater transmission of aortic pulsatility to the brain on propranolol versus amlodipine: Novel MRI method to measure concurrent beat-to-beat brachial and cerebral arterial pulsatility

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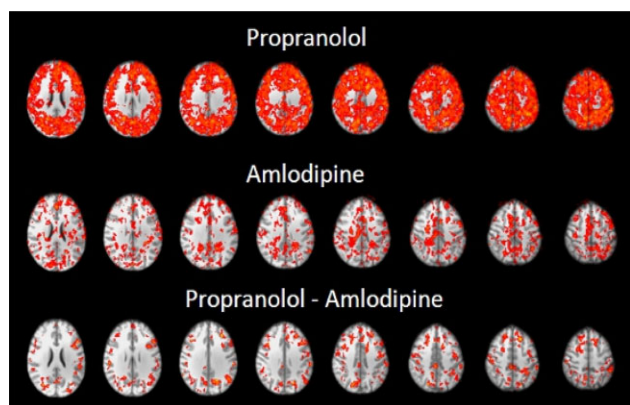
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**Background:** Cerebral arterial pulsatility is dependent upon aortic pulsatility and is associated with leukoaraiosis, stroke and dementia. The effect of antihypertensive drugs on aortic pulsatility and its transmission to the cerebral circulation is unknown due to limited methods of assessment.

**Methods:** In a randomized cross-over study in 10 healthy volunteers, aortic (Sphygmocor) and middle cerebral artery pulsatility (DWL-transcranial ultrasound) were measured during sequential treatment with amlodipine and propranolol. On each drug, 3-tesla multiband BOLD MRI (32 channel, MB factor 6) was performed with whole brain coverage every 0.43 s and concurrent continuous non-invasive brachial BP monitoring, to simultaneously assess systemic and parenchymal cerebral arterial pulsatility. Differences in drug effects on the strength of association between cardiac cycle oscillations in BP and BOLD signal were determined by general linear modeling (FMRIB Software Library-FEAT).

**Results:** Despite no significant difference in aortic pulsatility between amlodipine (27.3 mmHg) and propranolol (27.9 mmHg,  $p$ -diff = 0.33), MCA pulsatility was increased from baseline on propranolol (+6%, 95% CI 0.2–11.7%,  $p = 0.04$ ) but not on amlodipine (+2.7%, –3.0–8.7%,  $p = 0.21$ ). On MRI, there was a significantly stronger association between systemic arterial pulsatility and parenchymal cerebral pulsation on propranolol than amlodipine (Fig.).

**Conclusions:** Novel methods of high-frequency BOLD MRI and concurrent non-invasive BP monitoring demonstrated enhanced transmission of systemic arterial pulsation to the cerebral circulation with beta-blockers, potentially explaining differences in effect on stroke risk.



**Fig.** Strength of association (red voxels indicate significant associations) between systemic arterial pulsatility and cerebral pulsatility by drug, and the difference between the two drugs.

## ESOC-0689

### 19. Imaging

#### The usefulness of FLAIR/DWI mismatch in timing of stroke

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The DWI/FLAIR imaging mismatch, i.e. the presence of a hyperintense signal in MR DWI without a relevant change in FLAIR is a potential marker for the timing of stroke onset. The aim of the study was to assess if it can identify patients with lacunar and nonlacunar acute ischemic stroke within 4.5 h of onset. The authors analyzed admission MR imaging data from 86 ischemic stroke patients with a known time of symptom onset. The presence of lesions was correlated with the duration and type of the stroke.

The time from stroke onset to neuroimaging was significantly shorter in patients with lesion visible only in the DWI (mean 2.78 h, n = 24) as compared to patients with radiological signs of ischemia in DWI + FLAIR, (mean 8.6 h, n = 62) (p = 0.0001, Kruskal-Wallis ANOVA).

The sensitivity, specificity, PPV and NPV of DWI/FLAIR imaging in determining whether the patients remained within the 4.5 h thrombolysis time window was presented in the table:

	Sensitivity	Specificity	PPV	NPV
General population	58% (95% CI: 40,7 to 74,4%)	94% (95% CI: 83,4% to 98,6%)	87.5% (95% CI: 67,6% to 97,2%)	76% (95% CI: 63,2% to 85,7%)
Nonlacunar stroke	58% (95% CI: 39% to 75,4%)	94% (95% CI: 80,8% to 99,1%)	90% (95% CI: 68,2% to 98,4%)	72% (95% CI: 56,5% to 84%)
Lacunar stroke	50% (95% CI: 12,4% to 87%)	92.8% (95% CI: 66% to 98,8%)	75% (95% CI: 20,3% to 95,9%)	81.2% (95% CI: 54,3% to 95,7%)

The presence of acute ischemic lesions only in DWI help identify both lacunar and nonlacunar stroke patients in the 4.5 h time window for intravenous thrombolysis with high specificity and PPV.

## ESOC-0432

### 19. Imaging

#### Clinical spectrum, underlying etiologies and radiological characteristics of cortical superficial siderosis

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**Background:** Cortical superficial siderosis (cSS) is an increasingly recognized MR-imaging marker most probably caused by focal convexity subarachnoid hemorrhage (SAH). There is accumulating evidence that cSS represents an important risk factor for previous and subsequent intracranial hemorrhages. Here we aimed to determine clinical symptoms, underlying etiologies, and radiological characteristics of cSS in a large patient cohort.

**Methods:** We performed an electronic database search on all patients who presented between 2002 and 2013 to the university hospital Munich with non-traumatic and non-aneurysmal cSS. T2\*-weighted gradient-echo sequences were analyzed regarding localization and extent of cSS as well as of acute SAH, intracerebral hemorrhages (ICH) and microbleeds. Besides, all available clinical, laboratory, imaging and histological data was analyzed.

**Results:** 113 subjects matched the inclusion criteria. cSS was focal in 56 (50%) and disseminated in 57 (50%) patients. The following etiologies for cSS were identified: cerebral amyloid angiopathy (CAA): 109 (97%); reversible cerebral vasoconstriction syndrome: 2 (2%); central nervous system vasculitis: 1; and hyperperfusion syndrome: 1. Acute ICH was evident in 55 (49%) cases. Other clinical manifestations were: transient focal neurological episodes (TFNE): 38 (34%); cognitive impairment: 14 (12%); generalized seizure: 4 (4%); and headache: 2 (2%). Cognitive impairment was more frequent in disseminated cSS while TFNE was more often found in focal cSS (p = 0.042).

**Conclusion:** Our data indicates CAA to be the most common etiology of cSS. In absence of symptomatic ICH, patients with focal cSS frequently present with TFNE, while those with disseminated cSS commonly manifest clinically with cognitive impairment.

ESOC-0092

**19. Imaging****Contralesional thalamic atrophy and functional disconnection after stroke: A multimodal mri study**

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*Background:* Remote structural and functional changes have been described after stroke and may have an impact on clinical outcome. We aimed to use multimodal MRI to investigate contralesional subcortical structural and functional changes 3 months after anterior circulation ischemic stroke.

*Methods:* Fifteen patients with acute ischemic stroke had multimodal MRI imaging (including high resolution structural T1-MPRAGE and resting state fMRI) within 1 week of onset and at 1 and 3-months. Contralesional subcortical structural change was assessed using an automated segmentation algorithm in FMRIB's Integrated Registration and Segmentation Tool (FIRST). Functional connectivity changes were assessed using the intrinsic connectivity contrast (ICC), which was calculated using the functional connectivity toolbox for correlated and anticorrelated networks (Conn).

*Results:* Mean patient age was 70.8 years (range 51–83 years). Median baseline NIHSS was 9 (interquartile range [IQR] 5–13). Contralesional thalamic volume was significantly reduced at 3 months compared to baseline (median change –2.1%, IQR –3.4–0.4,  $p < 0.05$ ), with the predominant areas demonstrating atrophy geometrically appearing to be the superior and inferior surface. The degree of longitudinal thalamic atrophy was correlated with baseline stroke severity (Spearman's rho –0.54,  $p < 0.05$ ). Concurrently, there was a significant linear reduction in the mean ICC of the contralesional thalamus over the imaging time points ( $F(1,14) = 10.85$ ,  $p < 0.01$ ,  $\eta^2 = 0.44$ ), indicating reduced connectivity to the remainder of the brain.

*Conclusions:* This study has demonstrated longitudinal atrophy and functional disconnection in the contralesional thalamus after ischemic stroke. Similar methods have the potential to be used as imaging biomarkers of stroke recovery.



## Neurosonology

ESOC-0729

### 20. Neurosonology

#### Association between cerebrovascular reactivity and severity of diabetic retinopathy in patients with diabetes mellitus

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**Objective:** To investigate the association between severity of diabetic retinopathy and alterations in cerebral vasomotor reactivity in patients with diabetes by using Transcranial Doppler and breath-holding index

**Methods:** 43 patients with diabetic retinopathy who applied Bezmialem Vakif University Neurology clinic between Jan 2013–Jan 2014 were enrolled. Patients were classified into three categories according to grade of diabetic retinopathy and all patients underwent Transcranial Doppler examination during voluntary breath holding. Physical examination and laboratory findings were recorded for each patient and breath-holding index was calculated.

**Results:** The mean age of patient population was  $56,51 \pm 9,34$  years and the mean time from diabetes diagnosis to study enrollment was  $14,49 \pm 8,06$  years. 12 out of 43 patients (27.9%) had mild retinopathy, 15 patients (34.9%) had moderate and 16 (37.2%) patients had severe diabetic retinopathy at the enrollment. Both calculated right and left breath-holding indexes were significantly lower in patients with severe retinopathy compared to the patients with mild or moderate disease (right;  $p < 0,01$ , left;  $p < 0,05$ ). Both right and left breath holding indexes were significantly lower in patients with moderate retinopathy compared to the patients with mild retinopathy ( $p < 0,01$ ).

**Conclusion:** This study has shown an association between severity of diabetic retinopathy and the magnitude of cerebral vascular reactivity alterations in patients with diabetes mellitus

ESOC-0743

### 20. Neurosonology

#### Association between cerebrovascular reactivity and white matter changes in patients with diabetes mellitus

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**Objective:** The aim of this study was to evaluate cerebral autoregulation in patients with DM using transcranial doppler (breath-holding test) and analyzing their correlation to cerebrovascular reactivity and white matter lesions in MRI.

**Methods:** 38 patients had consulted our clinic who had been diagnosed with Diabetes Mellitus were included the study. The sociodemographic characteristics, physical examination symptoms and laboratory results of the individuals were recorded. The breath-holding test was done using TCD and the breath-holding index (BHI) was calculated. The Fazekas scale was used to evaluate the white matter lesions in the cranial MRI.

**Results:** The BHI evaluated using TCD was found to be in correlation with age ( $p = 0,019$ ), DM duration ( $p = 0,016$ ) and periventricular white matter lesions ( $p = 0,019$ ). The prevalence of white matter lesions in MRI was 71,1% (27 patients). The prevalence of periventricular white matter lesions in different locations (grade 1–3 Fazekas scale) was 60,5%, the prevalence of deep white matter lesions (grade 1–3 Fazekas scale) was 50%. A relation between periventricular white matter lesions and age ( $p < 0,001$ ), blood glucose ( $p = 0,004$ ), history of hyperlipidemia

( $p = 0,039$ ) and BHI ( $p = 0,012$ ) was found. The deep white matter lesions were found to have relations to age ( $p < 0,001$ ), fasting blood glucose ( $p = 0,006$ ), HbA1c ( $p = 0,006$ ) and a history of hypertension ( $p = 0,022$ ). No statistical relationship was determined between deep white matter lesions and the BHI ( $p = 0,35$ ).

**Conclusion:** This study has shown the connection between impairment of cerebral autoregulation and periventricular white matter lesions in patients with DM using transcranial doppler ultrasonography.

ESOC-0562

### 20. Neurosonology

#### Transcranial color-coded duplex for the noninvasive monitoring of patients with acute intracerebral hemorrhage

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**Background:** Spontaneous Intracerebral Hemorrhage (sICH) is related to high mortality within the first hours due to progressive mass effect and increase of intracranial pressure. We sought to determine the prognostic value of bedside monitoring with transcranial color-coded duplex (TCCD) in patients with acute sICH.

**Methods:** Prospective study of patients with sICH presenting within 24 hours from symptoms onset. Serial TCCD exams were performed at admission, 24 and 48 hours. The following neurosonological variables were recorded: hematoma volume (HV), midline shift (MLS), third ventricle diameter (IIIVD), lateral ventricles diameter and pulsatility index (PI) in both middle cerebral arteries. We correlated these data with the radiological information from the CT scans, the early clinical course and the functional outcome at 3 months. Early Neurological Deterioration (END) was defined as an increase in the NIHSS  $\geq 4$  and poor functional outcome as mRS  $\geq 3$ .

**Results:** We included 34 patients with a mean age of  $71,8 \pm 12,7$  years. Median baseline ICH volume was 10.2 mL (IQR = 5.5–77.2). We found an excellent correlation between TCCD and CT scan in HV ( $r = 0,79$ ;  $p < 0,01$ ), IIIVD ( $r = 0,86$ ;  $p < 0,01$ ) and MLS ( $r = 0,84$ ;  $p < 0,01$ ). HV and MLS at baseline measured with TCCD were significantly associated with END and mortality ( $p < 0,05$ ). Additionally, HV (baseline and 24 h), MLS (baseline), ipsilateral PI (baseline and 24 h) and contralateral PI (24 h) were associated with poor functional outcome ( $p < 0,05$ ).

**Conclusions:** In patients with acute sICH, HV, MLS and PI measured with TCCD are associated with END and poor outcome. TCCD is a promising tool for the noninvasive monitoring of these patients.

ESOC-1498

### 20. Neurosonology

#### Duplex ultrasound is not sufficient to detect high-risk patient prior to carotid endarterectomy

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**Introduction:** Prophylactic carotid endarterectomy in patients with carotid stenosis can prevent long-term stroke. Indication for operation is

based on clinical judgment and severity of stenosis. The benefit of the operation could be increased if one could identify high-risk plaque prior to surgery, especially in case of moderate stenosis (50–69%) which endarterectomy is subject to debate. Plaque ulceration is associated with high-risk plaque, may be identified on routine non-invasive imaging.

**Methods:** A prospective observational study over a one year period in a central London HASU. All patients underwent preoperative Duplex and all plaques removed underwent routine AHA grading that includes histological analysis for intra-plaque hemorrhage and ulceration.

**Results:** 82 consecutive patients with histology available for analysis were included. Median age was 74 years old (50–91). 70 had recent symptoms and 12 had asymptomatic carotid stenosis. On Duplex, median stenosis was 70% (40–95) and 34 patients had moderate carotid stenosis (50–69%). Preoperative Duplex showing ulceration or irregularity was present in 32 patients (44%). There was no overall difference in terms of ulceration on histology or presence of symptoms in respect to ulceration/irregularity status on Duplex. Predictive positive (PPV) and negative values (PNV) of Duplex for histology ulceration prediction was 44% and 54% respectively. For patients with moderate carotid stenosis, results were similar (no difference in term of histology or presence of symptoms considering Duplex results; VPP was 36%, VPN was 56%)

**Conclusion:** Duplex ultrasound alone is not sufficient to assess patient likely to have high-risk plaque.

## ESOC-0442

### 20. Neurosonology

#### Carotid artery intima-media thickness as a marker of small or large vessel disease in ischemic stroke

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**Objectives:** Some studies relate the carotid intima media thickness (IMT) to small vessel disease (SVD) whilst others relate it to atheromatous large vessel disease (LVD). Our objective was to study the impact that has IMT in each of these entities, analyzing their relationship in patients with cerebral infarction (CI)

**Methods:** Observational cohort study including CI patients. Study period: 2010–2014. Duplex carotid ultrasonography was performed in all patients during the first 48 hours after admission and mean IMT as well as the presence of atheroma plaques were recorded. SVD was defined as the presence of lacunar infarcts or moderate-important leukoariosis in neuroimaging, and LVD as extra/ intracranial brain arteries atheromatosis. Patients were classified into 4 groups: 1) SVD, 2) LVD, 3) SVD + LVD and 4) not SVD nor LVD. Multiple linear regression analyses were conducted to evaluate the association between SVD/LVD and IMT.

**Results:** Overall, 823 patients were included, 57,2% male, mean age 70.9 years. Multivariate analysis showed that SVD (beta coefficient [ET] = 0.050 [0.0197]) as well as LVD (Beta coefficient [SE] = 0.048 [0.0167]) were related to mean IMT, being this association higher in case of SVD + LVD group (beta coefficient [SE] = 0.065 [0.0171]). Bonferroni test showed that the greatest difference was between the SVD + LVD and the group without SVD or LVD.

**Conclusion:** Both SVD and LVD are associated with mean IMT and this association is greater when they coexist. This non-invasive and easily reproducible measure is a useful tool to estimate vascular damage what could contribute to a more effective prevention.

## ESOC-0174

### 20. Neurosonology

#### Assessment of clinical hands-on training in carotid and vertebral duplex and transcranial Doppler: Impact of experience on diagnostic inter-observer agreement

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**Background:** Diagnostic tests performed in Neurosonology laboratories are observer-dependent. We sought to evaluate the required number of examinations to be performed during the training to reach a kappa index of 0.8, while assessing if the prevalence of pathological studies influences the learning curve.

**Methods:** Prospective cohort study. Ultrasound scans were done in consecutive patients referred to our Laboratory over three years. Trainees were assessed at baseline and after a period of supervised training. Interstage experience studies were counted for every trainee. Statistical analyses included linear and exponential general estimating equation models.

**Results:** Number of patients assessed during training, 1527; in stage 1: 136, in stage 2: 150. It was considered a normal study in 81 carotid duplex (28,32%), in 249 vertebral duplex (87,06%), and in 112 TCD (39,16%). The most frequent pathological categories were carotid atherosclerosis, vertebral hypoplasia and intracranial microangiopathy.

At stage 2, kappa index achieved in the relevant categories in carotid duplex and TCD was 0.80, and 0.60 in vertebral duplex.

The minimum number of required examinations to be done under supervision to achieve a kappa index of 0.80 is, for our Neurosonology Laboratory, according to the linear model 66, above 102 and 102 for carotid duplex, vertebral duplex and TCD, respectively; according to the exponential model 76, above 102 and higher than 102.

**Conclusions:** With the training, the concordance index improves in all the modalities.

Neurosonology training places should report their pathology prevalence to calculate the required number of studies to achieve a 0.80 kappa index.

## ESOC-0387

### 20. Neurosonology

#### Risk reduction of brain infarction during cardiovascular surgery using sonolysis – A pilot study

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**Background:** Heart surgery is burdened with significant risk of ischemic stroke. Moreover, asymptomatic brain infarctions can be detected in up to 32% patients after heart surgery. Aim of the study is to examine if

intraoperative sonolysis alters the risk of new brain infarction during open heart surgery.

**Methods:** Patients indicated to isolated coronary artery bypass graft or heart valve surgery were included into the study. Patients were randomized 1:1 to sonolysis group (right middle cerebral artery was continually monitored by continual transcranial Doppler using 2-MHz diagnostic probe during the procedure) and to control group without sonolysis. All patients underwent brain magnetic resonance (MR) before and 24 hours after surgery and number of new ischemic lesions, their location and volume were evaluated.

**Results:** Totally 87 patients were enrolled to the study (62 males, mean age  $63.0 \pm 15.8$  years); 44 patients were randomized to sonolysis group and 46 patients to control group. New brain infarctions on control MR were found in 11 (25.0%) patients in sonolysis group; 6 (13.6%) patients had infarction in the right MCA territory and only 2 (4.5%) patients had new ischemic lesion  $>0.5$  mL. In control group, new brain infarctions were found in 12 (27.3%) patients; 9 (19.6%) had infarction in the right MCA territory and 5 (10.9%) patients had new ischemic lesion  $>0.5$  mL ( $P > 0.05$  in all cases).

**Conclusion:** Pilot study results showed a trend in reduction of number and volume of new ischemic infarctions in patients treated using sonolysis during heart surgery.

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## ESOC-0533

### 20. Neurosonology

#### Clinical and ultrasonographic features in anterior ischemic optic neuropathies

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**Introduction:** Anterior ischemic optic neuropathies (AIONs) represent a segmental infarction of the optic nerve head (ONH) supplied by the posterior ciliary arteries (PCAs).

**Purpose:** To investigate the characteristic clinical features and ultrasound findings of the orbital vessels and of the superficial temporal and the carotid arteries, which help differentiate newly diagnosed non-arteritic (NA)-AIONs from arteritic forms (A-AIONs), which require immediate steroid treatment.

**Patients and methods:** In this prospective comparative observational study, 62 consecutive patients with clinical suspicion of unilateral AION were examined at admission, and at each follow-up visit, following a complex protocol including color Doppler imaging (CDI) of orbital vessels.

**Results:** The final diagnoses were A-AION due to giant cell arteritis in 12 patients, and 50 patients with NA-AION. A combination of a history of amaurosis fugax before abrupt, painless, and severe vision loss in the involved eye, and a diffuse pale optic disc edema was extremely suggestive of A-AION. However, none of these symptoms were ever found in NA-AION. CDI of the orbital vessels in A-AION revealed undetectable or diminished blood flow velocities in the PCAs, (especially on the affected side, and high resistance index (RI) in all retrobulbar vessels, in both

orbits). By contrast, in NA-AION, blood velocities and RI in PCAs were preserved.

**Conclusions:** CDI data of retrobulbar vessels supported the evidence of involvement of the entire PCA trunk in A-AION. By contrast, impaired flow to the ONH was distal to the PCAs themselves, possibly at the level of the paraoptic branches in NA-AION cases.

## ESOC-0535

### 20. Neurosonology

#### Ultrasonographic features in central retinal artery obstruction

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**Introduction:** Central Retinal Artery Obstruction (CRAO) represents an abrupt diminution of blood flow through the CRA that is severe enough to cause ischemia of the inner retina with permanent unilateral visual loss.

**Purpose:** To assess the role of Color Doppler Imaging (CDI) of orbital vessels and Extracranial Duplex Sonography in the etiological diagnosis of CRAO.

**Patients and methods:** Three patients with clinical suspicion of unilateral right CRAO were examined following a protocol including CDI of orbital vessels.

**Results:** All patients had no emboli visible on ophthalmoscopy. The B-scan ultrasound (US) evaluation of the first two patients found a small round, moderate reflective echo within the right optic nerve, 3 millimeters behind the optic disc. Both had normal right ophthalmic artery hemodynamic parameters, but no arterial flow signal on CDI on a distance of 3 millimeters behind the right optic disc (embolus of cholesterol). By contrast, their left eye had a normal aspect on CDI of retrobulbar vessels. Right internal carotid artery US revealed in both cases an ulcerated atheromatous plaque, as emboli source. The third patient had characteristic CDI findings for giant cell arteritis (GCA) with eye involvement: high resistance index in all retrobulbar vessels (with severe diminished blood flow velocities in the affected CRA). She had no systemic symptoms or signs of GCA.

**Conclusions:** Ultrasound investigation enables prompt differentiation between CRAO of embolic mechanism and CRAO caused by vasculitis from GCA. The second group requires immediate steroid treatment in order to protect the fellow eye from going blind.

## ESOC-1471

## 20. Neurosonology

## Accuracy of transcranial duplex sonography, compared with CT angiography, for detection of intracranial arterial occlusions in acute stroke

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**Objective:** To analyze the accuracy of the transcranial color-coded duplex sonography (TCCD) for the detection of the middle cerebral artery occlusions, according to TIBI criteria, in patients with ischemic stroke, comparing it with CT angiography (CTA).

**Methods:** Multicenter retrospective cross-sectional study including acute stroke patients (<8 h) that underwent a TCCD and a CTA (<60 minutes apart) (2010–2013). Variables: clinical data; TCCD results: M1 complete occlusion if TIBI 0–1, (0–2 for M2), M1 incomplete occlusion if TIBI 2–3 (3 for M2); and results of brain CTA establishing three degrees of obstruction: no obstruction or mild (0–50%), moderate-severe (50–99%) and occlusion (100%). The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of TCCD were analyzed, comparing with CTA, for detecting complete/incomplete MCA occlusions.

**Results:** 65 patients, 60% men, mean age 63.8 years. TCCD showed complete/incomplete occlusion of the MCA in 90.7% (59/65) of cases: 8 T obstructions (ICA + MCA), 42 M1 (with / without M2) and 9 M2 isolated. CTA showed complete/incomplete occlusion of the MCA in 90.7% (59/65) of cases: 10 T obstructions, 37 M1 (with/without M2) and 13 M2 isolated. The sensitivity, specificity, PPV and NPV (95% CI) of TCCD for detection of complete/incomplete MCA occlusion was 100% (93.9–100%), 100% (61–100%), 100% (93.9–100%) and 100% (61–100%), respectively

**Conclusions:** TCCD accuracy for the detection of MCA occlusions, compared with CTA, is very high and seems to be an excellent tool for the screening of arterial obstructions in acute stroke.

## ESOC-0400

## 20. Neurosonology

## Hemodynamic correlates of transient cognitive impairment after TIA and minor stroke: A transcranial Doppler study

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**Background:** Transient cognitive impairment (TCI), previously defined as a transient decline in Mini Mental State Evaluation (MMSE) score, is common early after a TIA/minor stroke, and is associated with increased risk of dementia on subsequent follow-up. We aimed to validate TCI using

the Montreal Cognitive Assessment (MoCA), which is more sensitive to vascular cognitive impairment, and to determine any associated changes in cerebral hemodynamics.

**Methods:** Consecutive TIA/minor stroke (NIHSS ≤ 3) patients attending an emergency clinic were enrolled from 2011–2014 and underwent transcranial Doppler sonography (TCD) with bilateral MCA flow velocities, BP recording and cognitive testing with MoCA acutely and at 1-month follow-up visits, together with MRI/MRA at baseline. TCI was defined as MoCA score increase of ≥2 points at 1-month in patients scoring <26 at baseline.

**Results:** Of 226 patients undergoing repeated TCD and cognitive assessments, 74 (33%) had TCI by the MoCA definition. The TCI group was older (mean age/SD 72.3/11.8 vs 65.5/13.1,  $p < 0.001$ ), but did not differ from the non-TCI one in terms of BP, DWI positive lesions on acute MRI, or type of event (TIAs in 45/74 TCI patients vs 103/152 non-TCI patients,  $p = 0.18$ ). After age correction, cerebral blood flow velocities were not significantly different between the 2 groups at either time-points.

**Conclusions:** We validated the concept of TCI with the MoCA, but we did not find any acute cerebral hemodynamic correlates to explain the phenomenon.

## ESOC-1300

## 20. Neurosonology

## Micro-embolic signals (MES) detection by means of transcranial Doppler in acute stroke patients: TCDX versus standard recording

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**Background:** Previous studies reported a low prevalence of MES among acute stroke patients, with an overall low sensitivity (31%) and a good specificity (95%).

**Aim:** To compare a new TCDX system, allowing a longer recording time, with the standard method using a DWL (TCD) machine in acute stroke/TIA patients.

**Methods:** We performed sequential recordings of MCA Doppler-signal: a 45 minutes bilateral recording by means of the standard machine (DWL) and two 60 minutes unilateral recordings (one for each side) using the non-validated TCDX.

**Results:** We included 31 patients; ten of them (32%) were MES+. The recordings were performed  $44 \pm 28$  hours after stroke onset. There were: 3 (30%) large-artery, 2 (20%) cardio-embolic; 0 (0%) small-vessels and 5 (50%) of other etiology (2 carotid dissections, 1 anti-phospholipid syndrome, 1 hemochromatosis; 1 protein S deficiency). In 2 cases the detection was positive during both standard and TCDX recording; the other positive cases were detected by TCDX only (80%).

**Conclusions:** The prevalence of MES in our study was high and situated among Literature's extremes of 9.3% and 71%. This wide variability may be explained by differences in the time interval between stroke onset and TCD recording as well as in the duration of recording.

TCDX was not inferior to the conventional system in detecting MES; it was more easily tolerate for long-lasting recordings and less prone to displacement.

More extensive studies and larger number of patients are needed in order to confirm our preliminary results.

## ESOC-0463

## 20. Neurosonology

## Intracranial collaterals in cases of chronic symptomatic carotid occlusion: A TCCD-based novel grading system

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**Objectives:** To establish a novel TCCD-based grading system for collateral circulation in cases of symptomatic chronic total carotid occlusion (TCO). Also to correlate this new grading system to cerebrovascular reserve capacity measured by SPECT.

**Methods:** 34 patients with symptomatic chronic TCO diagnosed by color-coded duplex were subjected to: clinical assessment, grading of cerebral using a new TCD criteria (table 1), SPECT brain with dipyridamole stress.

**Results:** The new grading system for cerebral collateral circulation showed a significant positive correlation with CVR (P value < 0.001 & Spearman correlation coefficient 0.686) (Fig. 1).

**Conclusion:** The current study showed that this new TCCD grading system for cerebral collaterals may be a good index for cerebral perfusion and reserve capacity in cases of chronic symptomatic TCO.

Table 1 Grading of cerebral collaterals

Grade	Description
5	Primary collateral flow + 2 secondary
4	Primary collateral flow + 1 secondary
3	Primary collateral flow only
2	Two secondary collaterals
1	One secondary collateral
0	No collaterals

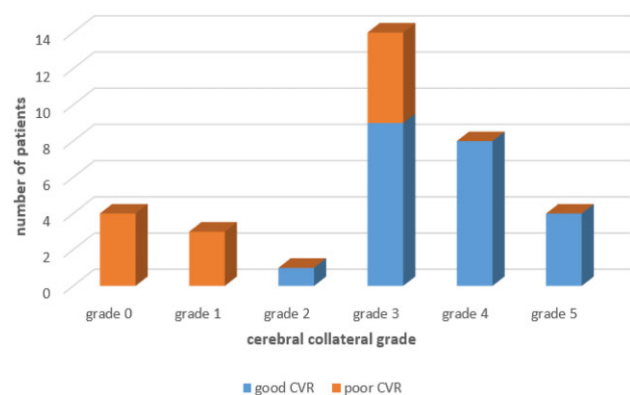


Fig. 1 Relation between collateral grading and cerebrovascular reserve.

## ESOC-1356

## 20. Neurosonology

## Diagnostic yields and cost analysis of I and II level neurovascular study in ischemic stroke patients

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**Background:** Neurovascular study is essential in defining stroke etiology and therapy. In order to define the better cost-effective diagnostic work-

up, we measured concordance between I and II level tests for vessels assessment and the impact on direct hospital cost.

**Materials and methods:** We selected ischemic stroke patients who underwent both Ultrasounds (I level) and CTA and MRA (II level) and measured the unweight Cohen's k in according to the presence and grade of extracranial and intracranial vessels stenosis. Cost analysis was performed accounting for direct cost of I and II level neurovascular study.

**Results:** 692 patients out of 1287 stroke patients fulfilled the inclusion criteria. The agreement between DUS and II level for ICA was moderate (DUS-CTA k = 0,578; DUS-MRA k = 0,528), fair for VA (DUS-CTA k = 0,067; DUS-MRA k = 0,158) for MCA (DUS-CTA k = 0,385; DUS-MRA k = 0,267) and for BA (DUS-CTA k = 0,382; DUS-MRA k = -0,02). I level neurovascular studies with cervical vessels DUS was performed on 692 patients and transcranial DUS in 229, yielding a total cost of € 42.532. II level neurovascular study was performed on 485 patients for a total cost of € 107.507, accounting for 16% of global diagnostic costs. Overall 25% of II level tests added new information with respect to Ultrasound, while 4% had a therapeutic yield.

**Conclusions:** Ultrasound appeared to remain the first line neurovascular study, while II level tests should target intracranial vessels. Cost-effective diagnostic work-up might include both cervical Ultrasound and Intracranial MRA or CTA only unless X-RAY exposure is not a concern.

## ESOC-0987

## 20. Neurosonology

## Transcranial ultrasound predictors of recurrent ischemic stroke in symptomatic internal carotid artery occlusion

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**Introduction:** Occlusion of the internal carotid artery (ICA) puts patients at risk of recurrent ischemic events due to hemodynamic compromise. Our goal was to characterize duplex parameters that could indicate patients at risk of recurrent ipsilateral ischemia.

**Methods:** We screened our clinical database for patients with symptomatic proximal ICA occlusions. Collateral networks as well as flow velocities in extra- and intracranial vessels were analyzed along with clinical and epidemiological characteristics.

**Results:** Of 69 patients, 16 (23.2%) experienced a recurrent ischemic event such as transient ischemic attack (TIA), retinal ischemia or stroke within the same vascular territory during the mean follow up of 16 months (range 1–138). Smoking, female sex and previous TIA were associated with a recurrent event; while stroke etiology or severity of initial stroke symptoms was not. Flow within the ipsilateral MCA tended to be smaller in patients with a recurrent event ( $74.8 \pm 29.5$  cm/s vs.  $93.7 \pm 35.7$  cm/d; 70% vs. 87% of contralateral M1), which was, however, not significant. Flow in the posterior cerebral arteries was higher in patients who experienced a recurrent event at a later time point ( $p = 0.017$  for contralateral P2), as was flow in the ipsilateral external carotid artery (ECA;  $p = 0.015$  for PDV).

**Conclusion:** Increases in contralateral P2 and ipsilateral ECA flow suggest compensatory efforts through vertebrobasilar and ECA-collaterals. Further refinement of these predictors in conjunction with clinical and imaging information has the potential to identify patients at risk of hemodynamic failure.

## ESOC-0431

## 20. Neurosonology

**Correlation of severity of autonomic dysfunction with dynamic cerebral autoregulation after acute ischemic stroke**L Xiong<sup>1</sup>, J Liu<sup>2</sup>, G Tian<sup>1</sup>, H Leung<sup>1</sup>, X Chen<sup>1</sup>, T Leung<sup>1</sup>, Y Soo<sup>1</sup>, K S Wong<sup>1</sup><sup>1</sup>Medicine & Therapeutics, The Chinese University of Hong Kong, Shatin N.T., Hong Kong, China<sup>2</sup>Chinese Academy of Sciences, Shenzhen Institutes of Advanced Technology, Shen zhen, China

*Background and objectives:* Ischemic stroke may lead to impaired dynamic cerebral autoregulation (CA) and autonomic dysfunction, and both are related with unfavorable clinical outcomes. However, the correlation between them after acute ischemic stroke is unknown.

*Methods and patients:* Consecutive acute ischemic stroke patients were enrolled. Autonomic function was assessed by Ewing's battery tests. We dichotomized the severity of autonomic dysfunction into two groups: severe (definite, severe or atypical) and minor (normal or early). CA was assessed by autoregulatory parameters (autoregulation index (ARI)/phase/gain) using transfer function analysis from spontaneous oscillations of cerebral blood flow velocities (CBFV) in bilateral middle cerebral arteries (MCAs) by transcranial Doppler (TCD) and mean arterial blood pressure (ABP).

*Results:* 12 acute ischemic stroke patients (6 patients with anterior circulation infarct and 6 patients with posterior circulation infarct) were recruited. In patients with anterior circulation infarct, only ARI in affected hemisphere was borderline significantly lower in severe autonomic dysfunction group (n = 2 patients) than that in minor group (n = 4) ( $4.25 \pm 0.33$  vs.  $6.70 \pm 1.21$ ,  $P = 0.064$ ). In patients with posterior circulation infarct, ARI in both sides was similar in severe group (n = 4) to that in minor group (n = 2) (left side,  $3.82 \pm 2.72$  vs.  $4.77 \pm 0.08$ ; right side,  $4.27 \pm 3.11$  vs.  $5.15 \pm 0.52$ ; all  $P > 0.05$ ).

*Conclusions:* This pilot study showed a trend that severe autonomic dysfunction is related to worse dynamic CA in affected infarct side in patients with anterior circulation infarct.

will be evaluated and correlated to clinical symptoms prior to inclusion and following a two-years follow-up.

*Results:* The results of this on-going study will firstly enable a comparison of the different methods used to assess neovascularization (Ultrasound examination using CEUS, SMI, carotid MRI and histological assessments). Secondly to determine their correlation to ischemic events prior to inclusion and during a 2 years follow-up.

*Discussion:* This study will hopefully advance the possibility for identifying unstable carotid artery plaque non-invasively using carotid ultrasound and Superb Microvascular Imaging.

## ESOC-0843

## 20. Neurosonology

**The assessment of neovascularization in carotid artery plaques and ischemic stroke risk using superb microvascular imaging**M Zamani<sup>1</sup>, K Ryeng Skagen<sup>1</sup>, M Skjelland<sup>1</sup>, D Russell<sup>1</sup><sup>1</sup>Neurology, Oslo University Hospital Rikshospitalet, Oslo, Norway

*Introduction:* Carotid plaque neovascularization is associated with plaque instability and increased ischemic stroke risk. Conventional Doppler examinations filter out low-flow signals preventing the visualization of small blood vessels but this may be improved using contrast-enhanced ultrasound (CEUS). Superb Microvascular Imaging (SMI) is a new Doppler technique that allows the visualization of very small low-flow vessels without the use of contrast agents. The aim of this study is to assess level of agreement between the quantification of neovascularization using Doppler ultrasound with CEUS and SMI and to compare these findings with carotid MRI and histological assessments and ischemic symptoms.

*Methods:* 30 consecutive patients with symptomatic and 30 with asymptomatic >50% carotid stenosis will undergo a neurological examination. Color Doplex ultrasound investigation with CEUS, SMI and carotid MRI will be carried out to quantify neovascularization. Plaques removed at endarterectomy will also be assessed histologically with regard to amount of neovascularization. The level of agreement between the ultrasound examinations using CEUS, SMI, carotid MRI and histological assessments

## Nursing and Carers

### ESOC-1560

#### 21. Nursing and Carers

##### Dietary knowledge, compliance, and educational needs of stroke patients in Korea

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**Background:** Many stroke patients do not meet recommended dietary guidelines for secondary prevention and often have misconceptions about dietary therapy. The purpose of this study was to examine dietary knowledge, compliance, and educational needs of stroke patients and to analyze the related factors that affect the level of dietary knowledge.

**Methods:** This was a cross-sectional descriptive study. The patients were recruited from Seoul National University Hospital visiting outpatient stroke clinic between April and June 2014. The data were collected using questionnaires and patients' medical records. Dietary compliance, dietary knowledge and educational needs were also measured. Data were analyzed using Windows SPSS 21.0.

**Results:** The level of dietary knowledge was different according to subjects' BMI ( $p = 0.006$ ) and exercise status ( $p = 0.007$ ). Thirty-seven percent of the participants did not follow dietary therapy and 36% moderately met the guidelines. There were significant differences in mini dietary assessment(MDA) score according to age ( $p = 0.003$ ), exercise status ( $p = 0.013$ ), and smoking ( $p = 0.028$ ). Dietary educational needs had positive correlation with the level of dietary knowledge ( $r = 0.415$ ,  $p < 0.001$ ) and had negative correlation with MDA ( $r = -.172$ ,  $p = 0.038$ ).

**Conclusion:** Our results indicated that the level of dietary knowledge was relatively high although dietary compliance were low, suggesting there were discrepancies between dietary knowledge and compliance in some items. Since dietary compliance was different among the patients with different characteristics, patient-specific dietary educational program to enhance compliance should be developed.

### ESOC-0020

#### 21. Nursing and Carers

##### Incorporating stroke rehabilitation techniques in routine nursing practice: What can be achieved? findings from case study research

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**Introduction:** Recent focus on hyper-acute care and reductions in length of stay mean it is particularly important all staff adopt consistent approaches to post-stroke rehabilitation, provide the same advice and teach the same techniques to enable patients to ameliorate or overcome impairments. Research indicates nurses and therapists believe stroke rehabilitation techniques can and should be routinely incorporated in nurses' practice. However, few nurses receive structured competency-based training in rehabilitation techniques. Case study methods were used to explore and characterize ways nurses and therapists in two stroke units were working to integrate rehabilitation techniques in nurses' practice.

**Method:** In-depth qualitative case studies in an integrated and rehabilitation stroke unit.

**Results:** Ninety-six hours of observations of nursing and therapy practice and thirty-nine interviews were completed. Planned joint working in which nurses, healthcare assistants and therapists routinely completed patient activities together, including washing and dressing practice, transfers from bed to chair, and mobility practice, increased nurses' rehabili-

tation knowledge and skills. A shared understanding of how to facilitate and enable activity using structured therapeutic approaches developed. There was consistent evidence of carryover of rehabilitation techniques and an increase in confidence in stroke specific skills, particularly amongst healthcare assistants who provided most patient support. Inconsistency in carryover was most evident in inexperienced nurses' practice and was related to difficulties in establishing and sustaining routine joint working activities.

**Conclusion:** Planned, routine joint working with therapists enabled nurses and healthcare assistants develop competence in and to consistently employ rehabilitation techniques in integrated and rehabilitation stroke units.

### ESOC-0038

#### 21. Nursing and Carers

##### Poor stroke risk perception despite moderate public stroke awareness: Insight from a cross-sectional national survey in Greece

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**Background and purpose:** Although stroke is the fourth cause of death in western societies, public stroke awareness remains suboptimal. The aim of this study is to estimate stroke risk perception and stroke awareness in Greece through a cross-sectional telephone survey.

**Methods:** A trained interview team conducted this cross-sectional telephone survey between February and April 2014 using an online structured questionnaire. Participants were selected using random digit dialing of landline and mobile telephone numbers with quota sampling weighted for geographical region based on the most recent General Population Census (2011).

**Results:** Between February and April 2014, 723 individuals [418 (58%) females,  $47.4 \pm 17.8$  years] agreed to respond. Among all respondents, 642 (88.8%) were able to provide at least one stroke risk factor. 673 (93.08%) respondents were able to provide correctly at least one stroke symptom or sign. When asked what would they do in case of acute onset of stroke symptoms, 497 (68.7%) responded that they would either call the ambulance or visit the closest emergency department. Only 35.3%, 18.9%, 17.2%, 20.7%, 15.0% of respondents with atrial fibrillation, arterial hypertension, dyslipidemia, diabetes mellitus and current smoking respectively considered themselves as being in high risk for stroke

**Conclusions:** Stroke risk perception in Greece is low despite moderate public stroke awareness.

### ESOC-1186

#### 21. Nursing and Carers

##### How well do we communicate?

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**Introduction:** It is a duty of NHS trusts and stroke services to ensure that people who have suffered a stroke and their families are kept well informed'. The National Sentinel Audit for Stroke highlighted poor communication as the foremost cause of dissatisfaction and reason for complaint.

We therefore audited our department to see if we were meeting the gold standard of '100% of all families should be informed of diagnosis, management and prognosis after a stroke within 72 hours' (National Clinical Guideline for Stroke recommendation 7.6.1).

*Method:* We reviewed 50 consecutive acute admissions. The time from admission to first documented discussion, grade of doctor, and nature of discussion were recorded. We also looked at whether there was any relationship between NIHSS score, (a surrogate of stroke severity), and grade of doctor.

*Results:* Percentage with documented discussion <72 hours = 62%  
Most common themes documented = diagnosis (21%), mortality and morbidity (18.5%).

Initial discussions by FY1 (31%) and consultant (28%). This was not affected by NIHSS score. However, consultants were more likely to discuss DNAR.

*Discussion:* Is it appropriate for FY1 doctors to have initial discussions? Are they prepared to discuss DNAR?

With faster transfer of patients between units it is increasingly important that documentation is clear to aid clarity for clinicians as well as patients / relatives.

We have introduced a new communication form and review its impact. In the longer term we will see if this affects patient / carer satisfaction.

## ESOC-1010

### 21. Nursing and Carers

#### The stroke clinical nurse specialist role – The Irish experience

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*Background:* Following the Irish National Audit of Stroke Care 2008 and the development of the National Stroke Programme, the recruitment of specialized staff including Stroke Clinical Nurse Specialists (CNS) was a key element in improving stroke care in Ireland. We surveyed the Stroke CNS to see how the role works in practical terms and what challenges are evident.

*Method:* A survey was administered to Stroke CNS attenders of a study day in late 2014. The survey was based on the framework of the original job description for the specialist nursing role. The survey was self-administered.

*Results:* Of the 22 respondents, which represented 82% of the CNS currently in position in Ireland, the average time in position was 3.8 years, with a combined total of 84 years' experience in Stroke Medicine.

The majority of their time (>50%) was spent on ward based clinical role including patient assessment and education, and 95% of respondents were involved in at least monthly staff education.

Protected time for their training was available to 23% of respondents. 8/22 (36%) were involved in non-Stroke related commitments in their working week.

They identified low staffing rates in the stroke service and a lack of clarity in the CNS role as the greatest challenges they face.

*Discussion:* The responses show that the specialist nurses are providing essential services to stroke patients, that there are significant challenges the role, but that there is a knowledgeable and experienced group of people to draw from when developing the role into the future.

## ESOC-1475

### 21. Nursing and Carers

#### Understanding the burden of care during early supported discharge on spouses of people with stroke

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*Background and aims:* Despite the clearly documented benefits of Early Supported Discharge (ESD) there is limited research about the impact on caregivers. This research aimed to quantify the perceived workload and impact on well-being of caregiving during ESD.

*Objectives:* To determine i) the type and perceived duration of ESD care and rehabilitation tasks undertaken by informal caregivers ii) the impact of ESD work on caregiver wellbeing and iii) the relationship between the perceived duration and impact of ESD work and patient disability and quality of life and carer strain.

*Methods:* A structured interview was carried out with 18 caregivers after the first week of ESD. Using a researcher administered questionnaire we collected data measuring the time spent per day performing care tasks and the perceived impact of each task. Data were correlated with routinely collected measures; Barthel Index, EQ5D and Carer Strain index.

*Findings:* Tasks associated with health and safety, emotional management, exercise/ mobility, and new domestic responsibilities generated greatest workload. Tasks associated with health/safety, emotional management and new domestic responsibilities also generated the greatest impact on well-being. Duration of workload and impact on carers were strongly correlated for many of the tasks addressed by the questionnaire ( $r = 0.6-0.9$ ). A strong positive correlation was found between the carer strain index and data collected during ESD ( $r = 0.8$ ).

*Conclusion:* Carers report a substantial workload during the second week after a patient is discharged home which has a negative impact on well-being and associated high levels of carer strain.

## ESOC-1462

### 21. Nursing and Carers

#### A qualitative investigation into the burden of care during early supported discharge on spouses of people with stroke

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*Background and aims:* The benefits to patients of Early Supported Discharge (ESD) following stroke are well-documented but research investigating the impact of ESD pathways on care-givers is limited. This study aimed to describe the experience of caregiving during ESD, the consequences on carer well-being and to identify solutions to reduce the impact of caring.

*Objectives:* To explore caregivers experiences of managing the work of caring and identify how ESD pathways could better support people to care.

*Methods:* 14 purposively selected primary carers were recruited from one ESD service. In-depth semi-structured interviews with caregivers were conducted 3-8 weeks after ESD services ended. Data were audio-recorded and transcribed verbatim. A framework analysis approach was used.

*Findings:* Carers valued the support of the ESD team. However, all carers reported emotional strain (anxiety, sadness, anger, guilt and isolation); some reported physical symptoms (difficulty sleeping, fatigue and lack of appetite); some sought medical support for their own mental health. The intensity and causes of emotional strain varied as did the timing of greatest strain. Strain was associated with inadequately planned discharges, insufficient equipment or care provision, limited consideration of carer's



other commitments, worries about patient safety, and coping with patients' cognitive, language and mood impairments.

**Conclusion:** There is a need to routinely assess carer's needs including their willingness and ability to provide support. ESD services could reduce caregiver strain by reviewing discharge systems, providing tailored information and addressing the emotional needs and safety concerns of patients and caregivers.

## ESOC-1012

### 21. Nursing and Carers Implications of stroke for caregiver outcomes: Findings from the ASPIRE-S study

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**Background:** Informal caregivers are vital to long-term care and rehabilitation of stroke survivors worldwide. However, caregiving has been associated with negative psychological outcomes such as anxiety and depression, leading to concerns about caregiver in addition to stroke survivor well-being. Furthermore, caregivers may not receive the support and service provision they require from the hospitals and community.

**Aims:** This study examines caregiver psychological well-being and satisfaction with service provision in the context of stroke.

**Methods:** Caregiver data was collected as part of the ASPIRE-S study, a prospective study of secondary prevention and rehabilitation which assessed stroke patients and their carers at 6-months post stroke. Carer assessment included measurement of demographics, satisfaction with care (UK Healthcare Commission National Patient Survey of Stroke Care), psychological distress (Hospital Anxiety and Depression Scale), and vulnerability (Vulnerable Elders Scale). Logistic regression analyses were performed using STATA Version 12.

**Results:** Analyses from 162 carers showed substantial levels of dissatisfaction (37.9%) with community and hospital services, as well as notable levels of anxiety (31.3%) and depressive symptoms (18.8%) amongst caregivers. Caregiver anxiety was predicted by stroke survivor anxiety (OR = 3.47, 95% CI 1.35–8.93), depression (OR = 5.17, 95% CI 1.83–14.58) and stroke survivor cognitive impairment (OR 2.35, 95% CI 1.00–5.31). Caregiver depression was predicted by stroke survivor anxiety (OR = 4.41, 95% CI 1.53–12.72), and stroke survivor depression (OR = 6.91, 95% CI 2.26–21.17).

**Conclusion:** Findings indicate that caregiver and stroke survivor well-being are interdependent. Early interventions, including increased training and support programs that include caregivers are likely to reduce risk of negative emotional outcomes.

## ESOC-1093

### 21. Nursing and Carers Reducing door to needle time: Impact of the "fastroke" protocol implementation on intra hospital delay and functional outcome of patients treated with intravenous RTPA

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**Background:** Reduction of door-to-needle (DTN) time is an indicator of the quality of healthcare systems, being <45 min recommended in ESO guidelines. Our aim is to analyze DTN time and functional outcome of acute ischemic stroke patients treated with iv rtPA within 4.5 hours in our center after the implementation of a new in hospital protocol

**Methods:** The FASTROKE protocol was implemented in March 2014; main organizational changes were checkout medical history prior to arrival, point-of-care systems to determine the INR and starting iv rtPA at emergency room instead of transferring patients to the stroke unit. We studied patients treated 9 months before and after the FASTROKE implementation. Functional outcome was prospectively evaluated using the Barthel Index at discharge and Rankin Score at 90 days

**Results:** 70 patients in the pre-FASTROKE phase (68 years, median NIHSS 10) and 72 patients in the post-FASTROKE phase (67 years, median NIHSS 7) were included. A reduction of 30% was observed in the DTN (median 50 min [40–70] vs. 35 min [30–54],  $p < 0.001$ ). The European quality standard was achieved in 41% and 72% ( $p < 0.001$ ) of patients in the pre and post-FASTROKE phase. The Barthel Index at discharge was 50 vs. 65 ( $p = 0.28$ ) and good outcome at 3 months (mRS 0–2) was achieved in 59% vs. 60% patients ( $p = 0.92$ )

**Conclusion:** The implementation of a fast intervention protocol for the acute stroke patients has allowed a reduction of 30% in the door-to-needle time; nevertheless, an impact on clinical outcome was not observed in our limited sample

## ESOC-1267

### 21. Nursing and Carers Stroke team members' experiences of strategies to handle ethical problems in unexpected sudden death – Obstacles and possibilities

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In end-of-life ethical problems often come to the fore. Little research is performed on strategies for handling ethical problems and on obstacles and possibilities for using such strategies. A previous study illuminated stroke team members' experiences of ethical problems and how the teams managed the situation when caring for patients faced with sudden and unexpected death from stroke. The aim of the study of this study was to illuminate obstacles and possibilities perceived by stroke team members in using strategies for handling of ethical problems when caring for patients afflicted by sudden and unexpected death caused by stroke. A qualitative method with combined deductive and inductive content analysis was utilized. Data were collected through individual interviews with 15 stroke team members working in stroke units of two associated county hospitals in western Sweden. All the studied strategies for handling of ethical prob-

lems were found to have both obstacles and possibilities. Uncertainty is shown as a major obstacle and unanimity as a possibility in the use of the strategies. The findings also illuminate the value “the patient’s best” as a starting-point for the carers’ ethical reasoning. The concept “the patient’s best interests” used as a starting point for ethical reasoning among the carers is not explicitly defined yet, and its possible different cultural aspects are likewise not explored. These make this value difficult to use both as a universal concept and an argument for decisions. Carers need reflect on and use ethically-grounded arguments and defined ethical values in their clinical work.

## ESOC-1094

### 21. Nursing and Carers

#### Does quality of stroke nursing care improve in Catalonia after four audit editions?

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**Background:** After publishing/making available Catalan stroke guidelines in 2006, four biennial clinical audits have been carried out to assess the compliance of evidence-based recommendations. Need of improvement of some indicators led the Stroke Program to propose specific actions related to nursing care. The aim is to analyze the evolution of adherence to specific nursing care recommendations across four stroke audits conducted between 2005 and 2013.

**Method:** We assessed compliance with four quality indicators focusing at stroke nursing care across consecutive stroke audits for comparison purposes. Stroke Audits studied consecutive patients admitted to 46 of the 49 public hospitals in Catalonia for acute stroke. Data were obtained from a retrospective medical record review in the first three audits and prospectively in the 4th edition.

**Results:** 1.791 cases were evaluated in 2005, 1.767 in 2007, 2.190 in 2010 and 1.916 in 2013 representing 17%, 16%, 21.3% and 17.5%, respectively, of the annual stroke admissions in Catalonia. ‘Dysphagia screening’ improved gradually and significantly through the four Audits (from 30% to 68.2%). ‘Early mobilization’, stabilized between 2nd and 3rd audit improved in the 4th (from 78.6 in the 3rd to 85.1% in the 4th). Compliance with ‘mood assessment’ worsened between the 2nd (51.8%) and 3rd editions (46.1%) but improved in the 4th (67.6%) even though persisted sub-optimal. ‘Patient/family education’ showed a high increase (from 34.2% to 74.1%).

**Discussion:** Quality of nursing stroke care improves gradually in Catalonia. While, the improvement of some recommendations is possible, usefulness of specific interventions carried out it is demonstrated.

## ESOC-0128

### 21. Nursing and Carers

#### Incidence, risk factors and nursing of poststroke bladder and bowel dysfunction: A prospective, multicenter study of 310 patients in Western China

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**Objectives:** To describe the clinical features of the four types of bladder and bowel dysfunction (BBD) after stroke in West China and to compare nursing methods between West China and other countries.

**Methods:** Patients with stroke hospitalized from September 2010 to February 2012 were prospectively observed. Data were analyzed using descriptive statistics, chi-square test and Logistic regression.

**Results:** 310 patients were recruited. 190 patients suffered from BBD. The prevalence of urinary incontinence (UI) + fecal incontinence (FI), urinary retention (UR) + FI, UR + constipation, and UI + constipation were 4.52%, 2.26%, 6.13% and 4.52%, respectively. The risk factors for UI were disturbance of consciousness, a history of heart diseases and higher NIHSS scores. Hemorrhagic stroke and higher NIHSS scores were related to UR. Higher NIHSS scores was the risk factor for FI. The disturbance of consciousness and higher NIHSS scores were the risk factors for UI + FI. A history of heart diseases was the risk factors for UR + FI. Hemorrhagic stroke was related to UR + constipation. Some nursing methods of BBD in West China were inconsistent with the guidelines in developed countries.

**Conclusion:** Co-existed types of BBD after stroke are also common in stroke patients. There is a large gap of nursing methods for BBD between West China and other countries. We should also pay attention to patients who suffer from co-existed types of BBD after stroke. Some nursing methods of BBD should be improved in West China.

## Service Organisation

ESOC-0487

### 22. Service Organisation

#### Prolonged stay in emergency room results in more complications in acute stroke patients

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**Background and aim:** Complications in acute stroke (AS) affects patient outcome, but the settings causing these complications are not well understood. We aim to identify whether prolonged staying in emergency department (ED) has any effect on risk of increased complications in patients with AS.

**Methods:** We analyzed data from our stroke registry of patients admitted with AS during 2014. Data regarding demographics, stroke types, ED stay duration (in hours), length of stay (LOS) in hospital, number and types of complications and prognosis were collected. Stay in ED divided into three groups - , <8 hours, 8–24 hours, and >24 hours.

**Results:** Mean age was 55 years, and 79% were males (total n = 894). Twenty three percent (n = 202) remained in ED for <8 hours, 49% (n = 416) b/w 8–24 hours, and 27% (n = 233) >24 hours. Moderate to severe strokes (NIHSS > 4) were found in 46% in 1st, 47% in 2nd and 65% in 3rd group (p = 0.02). Patients staying <8 hours in ED (24%) were associated with reduced LOS in hospital (<4 days, p = 0.001), and better prognosis at discharge (62% had mRS of ≤2, p = 0.004). Prolonged stay was associated with increased risk of complications (15% vs 21%, p = 0.001), and increased aspiration pneumonia (9.3% vs 15.8%, p = 0.002).

**Conclusion:** Delay in transferring AS patients from ED results in more complications, which affects prognosis and increases LOS, causing burden on available resources. Priority transfer of these patients to stroke ward will improve their outcome, and reduction in health costs.

ESOC-0489

### 22. Service Organisation

#### The outcome following acute stroke is significantly better in patients admitted to a stroke ward compare to medical wards

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**Background and aim:** A number of studies have shown that patients admitted to multidisciplinary stroke ward (SW) have better outcome compared to general medical wards. The objective of this study is to compare outcome between patients admitted to stroke ward versus general medical wards (MW).

**Methods:** An 8 bed SW was established at the Hamad General Hospital, Qatar in April 2014, with multidisciplinary team & care pathways & protocols. This small unit was not sufficient to admit all stroke patients allowing an opportunity to compare outcome in admission to SW versus MW. Outcomes measured were mortality, discharge disposition, length of stay, and complications.

**Results:** 894 patients admitted in 2014, with 55.3% (n = 495) in SW, 29.5% (n = 264) in MW and 12.5% (n = 111) in intensive care (ICU). Investigations were completed faster in SW vs MW; neuroimaging (80% vs 67%), carotid Dopplers (89% vs 82%), echo (93% vs 72%), and Holter monitoring (37% vs 23%), p = 0.001. Patients managed in SW showed reduced deaths (2.8% vs 4.5%, p = 0.001), & fewer long-term care transfers (1.2% vs 2.2%). Medical complications were 3.8% in SW vs 16.2% in MW; aspiration pneumonia (2.3% vs 9.7%, p = 0.001), UTI (1.5% vs 6.8%), and bed sores (1.06% vs 8.4%, p = 0.001). Length of stay (≤4 days) was found in 63% in SW vs 54% in MW (p = 0.001). At 3 months mRS ≤ 2 was 93.4% in SW vs 76% in MW (p = 0.001).

**Conclusion:** Establishment of a SW significantly decreased complications, improved survival and increased home discharges.

ESOC-0060

### 22. Service Organisation

#### A comparison of remote and bedside assessment of the NIH stroke scale in acute stroke patients

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**Background:** Telestroke videoconference for conducting the National Institute of Health Stroke Scale (NIHSS) is recommended when direct bedside evaluation by a stroke specialist is not immediately available for hyperacute stroke assessment. However, some NIHSS-telestroke studies inherit systematic bias due to subjectivity of NIHSS administration. We aimed to evaluate NIHSS telestroke assessment, while implementing measures to minimize subjectivity bias.

**Methods:** Ninety acute stroke patients within 48 hours of onset were assessed by 6 stroke neurologists grouped in 15 pairs. Each pair of physicians assessed 6 patients. Patients were allocated through block randomization to a physician pair and order of bedside or remote assessment. Every patient was assessed once at the bedside and once remotely. Remote examination was performed by a neurologist through high-quality videoconferencing, assisted by a nurse at the patient's bedside. The Institutional Review Board waived the need for informed consent.

**Results:** Cumulative difference of ≤3 NIHSS points was observed in 85.6% (95% CI 76.6%; 92.1%) cases. Therefore, every fifth remote examination may have been inaccurate. Quadratically weighted kappa (k) for total NIHSS score was 0.91 (95% CI 0.87; 0.95). Fair agreements were for commands (k = 0.40), facial palsy (k = 0.27), and ataxia (k = 0.30). Remote assessments were longer than bedside: 8 minutes (IQR 7; 9) versus 6 (IQR 5; 8), p < 0.001.

**Conclusions:** NIHSS-telestroke assessment using high-quality videoconferencing in the acute stroke settings is closely matched with NIHSS-bedside assessment but its credibility for clinical use needs further evaluation.

ESOC-0059

### 22. Service Organisation

#### Distinctive features of the prevalence of risk factors of stroke among urban and rural residents

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One of the most pressing problems of the modern neurology is a stroke. **Aim:** The purpose of the research was to study the prevalence of risk factors of stroke among urban and rural residents of the north-east of Azerbaijan.

**Materials and methods:** The object of the study was 40–49 year old population. With the special survey form the prevalence of risk factors of stroke has been investigated (2008–2010).

**Results:** 1821 people have been involved in the study, 657 (348 females, 309 males) urban and 1164 (575 females, 589 males) rural residents.

The most frequent risk factor was physical inactivity  $37.3 \pm 1.1\%$ . Among rural population who have physically active lifestyle ( $76.4 \pm 1.3\%$ ) was in majority compared to urban residents ( $38.5 \pm 1.9\%$ ).

Although no sexual difference has been found in hypertension among rural residents (males  $14.4 \pm 1.5\%$  and females  $15.1 \pm 1.5\%$ ), in urban

population among males hypertension was higher ( $22.3 \pm 2.4\%$  and  $15.8 \pm 2.0\%$ ). Ischemic heart disease (IHD) among urban ( $10.5 \pm 1.2\%$ ) and rural residents ( $10.4 \pm 0.9\%$ ) had the same share. Obesity was more common in rural females ( $11.5 \pm 1.4\%$ ) than in rural males ( $7.6 \pm 1.1\%$ ). Prevalence of transient ischemic attack/stroke and diabetes among urban ( $0.5 \pm 0.1\%/1.5 \pm 0.5\%$  and  $6.4 \pm 1.0\%$ ) and rural ( $0.4 \pm 0.2\%/0.8 \pm 0.3$  and  $4.8 \pm 0.6\%$ ) residents was without significant difference. The share of smokers among urban population ( $19.9 \pm 1.6\%$ ) was higher than rural population ( $13.3 \pm 1.0\%$ ).

**Discussion:** Prevalence of some risk factors is the case depending on rural and urban settlements. The results show the importance of launching new studies in region, expanding the scope of preventive measures and awareness-raising among population about risk factors and their correction.

## ESOC-0908

### 22. Service Organisation

#### Does the quality of discharge planning following acute stroke influence long-term quality of life and unmet needs?

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**Background:** Comprehensive discharge planning is important for successful community integration following stroke. How this influences outcomes has not been previously reported.

**Aim:** To investigate the association between the quality of discharge planning following acute stroke and reported Health Related Quality of Life (HRQoL) at 90–180 days and unmet needs at 6–9 months post-stroke.

**Method:** Patients discharged to the community and registered in the Australian Stroke Clinical Registry (AuSCR) participated. Discharge quality was retrospectively measured using validated questionnaires (PREPARED, Grimmer et al 2001). Domain scores for information exchange, medication management, coping preparation, and discharge control were calculated. Unmet needs were measured using the LUNS questionnaire (LoTS care 2011). AuSCR data, including HRQoL information, were merged with survey responses. Quantile regression adjusting for demographics, stroke variables and patient clustering were used. Dependent variables were HRQoL (EQ-5D Visual Analogue Scale (VAS) 0–100) and number of unmet needs.

**Results:** 207/446 eligible registrants responded (median age 72 years, 69% male; 63% ischemic stroke). Responders and non-responders were similar. PREPARED scores were lowest for: discharge control (65%); and medications (71%). Approximately half (59%) reported feeling well prepared. Better information exchange (coefficient: 0.1, 95% CI: 0.03, 0.2  $p = 0.008$ ) and coping scores (coefficient: 0.1, 95% CI: 0.04, 0.2,  $p = 0.003$ ) were associated with higher VAS scores. Lower medication (coefficient:  $-0.009$ , 95% CI:  $-0.02$ ,  $-0.002$ ,  $p = 0.02$ ) and information exchange scores (coefficient:  $-0.02$ , 95% CI:  $-0.03$ ,  $-0.005$ ,  $p = 0.009$ ) were associated with increased unmet needs.

**Conclusion:** We provide new information demonstrating that the quality of discharge planning received by stroke patients is sub-optimal, with long-term implications.

## ESOC-0369

### 22. Service Organisation

#### Lone transient ischemic attack – Analysis of the application of the tissue-based diagnosis in the Budapest Districts 8–12 Project

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**Background:** although the current diagnosis of TIA involves the reversibility of focal neurological signs without tissue damage since 2002, in routine practice TIA is frequently diagnosed without neuroimaging based only on clinical features. We analyzed the rate of neurological evaluation and imaging of patients diagnosed with TIA.

**Methods:** the database of the National Health Insurance Fund was analyzed for patients living in 2 districts (about 130,000 inhabitants) of the Hungarian capital Budapest city with an exclusive ICD-10 diagnosis of G45 assigned by any specialists both in the inpatient and outpatient settings in the period of 2002–2007, i.e. the first years after the introduction of the tissue-based TIA definition.

**Results:** overall 4667 patients were diagnosed with TIA in the study period, of these 1960 (42%) had TIA as an exclusive diagnosis. The diagnosis was given in the outpatient setting in 93% of the cases. Of the 1960 patients the diagnosis of TIA was established by neurologists in 1562 cases, and the rest were not seen by a neurologist in the 6 years of the study. Cranial CT or MRI was performed in only 11.3% of the cases and 90% of the cases were not hospitalized during the 6 years.

**Conclusions:** in the Hungarian healthcare system TIA as a lone diagnosis is given by non-neurologists in 20%, and is not confirmed by neuroimaging in the majority of the cases. The current diagnostic standard of TIA requiring preferably MR imaging is not feasible in the outpatient setting in middle income countries.

## ESOC-1542

### 22. Service Organisation

#### Triage of TIA clinic referrals using clinical features identifies true vascular events

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**Introduction:** Rapid specialist assessment of patients with TIA is essential in preventing further stroke. However an increasing number of referrals to a fixed capacity service requires safe triaging to prioritize those at highest risk. We use clinical symptoms and time from event to triage patients into high, medium and low-risk categories. We hypothesized that we would identify more true vascular events in higher risk categories.

**Method:** We reviewed new clinic attendances over 12 months, triaged using the algorithm below. “A” referrals were targeted to be seen within 2 days, “B” within 7 days and “C” routine. Analysis looked at final diagnoses made by the treating neurologist.

Clinical features	Symptom onset to referral timing	Triage
Motor weakness or speech deficit	Within 7 days	A
≥5 mins	8–14 days	B
Amaurosis fugax	Within 14 days	B
Central retinal artery occlusion		
All other referrals – e.g. numbness, ataxia, late presentation motor or speech, etc.		C

**Results:** Amongst 1600 new patients, 652 (40.8%) had a final diagnosis of TIA (27.4%) or stroke (13.4%). Over 80% of TIA/stroke patients were seen urgently using this system. More patients were diagnosed with TIA/stroke in higher risk categories ( $p < 0.0001$ , 52.5% as 'A', 31.0% as 'B' and 16.7% as 'C'. There was no difference in vascular risk factors between triage groups. Recurrent stroke rates and hospitalization numbers will be available at the conference.

**Discussion:** TIA/stroke rates vary within triage categories. We saw more TIA/stroke patients urgently or semi-urgently.

## ESOC-1253

### 22. Service Organisation

#### Cost-effectiveness of telestroke in five organizational scenarios in Franche-Comté (France)

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Medical and economical evaluation of five different organizational scenarios for telestroke in the Franche-Comté region: the current model, comprised of three stroke units and eight emergency services, all equipped with telemedicine tools; the model with alternating hubs; the stroke ward model (local units dedicated to stroke care and equipped with telemedicine tools); the model without telemedicine; and the model with eight stroke units.

Establishment of a model that takes into account the patient management costs during the initial phase (from the onset of clinical signs to the discharge from hospital) according to the different financial sectors (transport, hospital personnel time, telemedicine tools, etc.).

Comparison of the different models according to three criteria: economical, thrombolysis rates, and hospitalization in a dedicated unit.

In conclusion, the scenarios with telemedicine, in particular those with the stroke ward model, reduce management costs whilst promoting care quality for all patients, including non-thrombolysed patients.

## ESOC-0231

### 22. Service Organisation

#### The quality of acute stroke care received by renal replacement therapy recipients in England: A National linkage study

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**Background:** The requirement for renal replacement therapy (RRT) may make it harder to provide good quality acute stroke care for patients. We aimed to identify if inequalities existed in the quality of acute stroke care provided to RRT recipients in England.

**Methods:** Retrospective linked cohort study using data from the UK Renal Registry and SINAP (a national quality register of stroke care), of patients admitted with stroke to hospitals in England from April 2010 to December 2012. Pseudonymized person level data linkage was carried out.

**Results:** 84,330 patients with acute stroke were admitted to 96 hospitals in England. 439 of these were RRT recipients: 292 (67%) hemodialysis, 41 (9%) peritoneal dialysis and 105 (24%) transplant. There were no significant differences in the proportion of patients admitted to a stroke unit within 4 hours between RRT and other patients (54% vs 56%;  $p = 0.23$ ), in having a brain scan within 24 hours (89% vs 92%;  $p = 0.05$ ), antiplatelet therapy if applicable within 24 hours (89% vs 86%;  $p = 0.14$ ) or in having a swallow assessment within 24 hours (85% vs 87%;  $p = 0.22$ ). RRT patients were less likely to have thrombolysis (7% vs 10% of ischemic stroke;  $p = 0.04$ ) or access to occupational therapy (80% vs 85%,  $p = 0.02$ ), physiotherapy (89% vs 93%;  $p = 0.005$ ) and speech and language therapy (59% vs 69%;  $p = 0.001$ ).

**Conclusion:** In patients reported to the national quality register for stroke in England, inequalities in stroke care quality in RRT patients largely relate to access to post stroke rehabilitation, which may reduce the chance of recovery.

## ESOC-0698

### 22. Service Organisation

#### Beliefs and opinions regarding telemedicine: A survey of the broad public and professional caregivers

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**Introduction:** Telemedicine can be a reliable alternative for face-to-face patient care, yet its adoption remains slow and fragmented. Many barriers for broad application of this technology have been suggested, among which patient and caregiver acceptance.

**Methods:** We designed a survey to evaluate the opinions and beliefs of the broad public regarding telemedicine for emergency and chronic care. In-ambulance telemedicine for stroke was presented as a live showcase for emergency telemedicine. The survey was obtained via face-to-face interviews of visitors at the Universitair Ziekenhuis Brussel (UZB) on World Stroke Day 2014. The online questionnaire was distributed among professional caregivers the UZB and among the broad public using social media.

**Results:** 642 respondents accessed the survey, of which 607 were aged  $\geq 18$  years and provided at least one answer. 20.3% of respondents were professional caregivers, 38.6% were visitors of the UZB at World Stroke Day and 41.2% were responders via social media. The questions and results are presented in the Table.

**Conclusion:** The results of this survey indicate that the broad public is ready to adopt telemedicine for emergency treatment (i.e. in-ambulance telestroke) and for chronic care at home. Possible issues with privacy are not perceived as a major objection and the majority of respondents is willing to participate in future teleconsultations.

Question	Result
Language preference:	
Dutch	536 (88.3%)
French	71 (11.7%)
What is your age?	
Median age in years (interquartile range)	47 (29-57)
What is your gender?	
Female	388 (63.9%)
Male	219 (36.1%)
Did you suffer from a stroke in the past?	
Yes	19 (3.1%)
No	580 (95.6%)
I don't know	8 (1.3%)
Do you use computer systems for telecommunication (e.g. Skype®)?	
Yes	353 (62.4%)
No	209 (36.9)
I don't know	4 (0.7%)
In case of a stroke, I would like to receive support via telemedicine during my transportation by ambulance to the hospital:	
Strongly disagree	5 (0.9%)
Disagree	29 (5.1%)
Neutral	114 (20.1%)
Agree	204 (36.0%)
Strongly agree	214 (37.8%)
I think telemedicine would be useful to support patients at home:	
Strongly disagree	4 (0.7%)
Disagree	21 (3.7%)
Neutral	64 (11.3%)
Agree	286 (50.7%)
Strongly agree	189 (33.5%)
I confide that my privacy and identity would be protected during telemedicine consultations:	
Strongly disagree	6 (1.1%)
Disagree	30 (5.3%)
Neutral	68 (12.1%)
Agree	250 (44.3%)
Strongly agree	210 (37.2%)
I would like to participate in telemedicine consultations in the future:	
Strongly disagree	30 (5.3%)
Disagree	92 (16.4%)
Neutral	106 (18.9%)
Agree	234 (41.6%)
Strongly agree	100 (17.8%)
Composite score of the 4 likert scale questions (range: 0-20)	
Median score (interquartile range)	16 (14-18)

## ESOC-0457

## 22. Service Organisation

## Alcohol habits and awareness in stroke patients attending a nurse-led stroke clinic for outpatients

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**Background:** Excessive alcohol intake is a risk factor for stroke. Guidelines in the United Kingdom recommend that stroke patients are advised on maximum alcohol intake per day. The aim of this study is to understand alcohol habits and awareness of patients attending a new nurse-led stroke clinic in hospital.

**Methods:** Patients that attended an outpatient nurse-led stroke clinic at 1 month following discharge from a Hyper-acute stroke unit were included. Patients were seen by a Clinical nurse specialist in stroke during the month of December 2014 and the first week of January 2015. An audit tool was developed to facilitate a retrospective audit of the clinic's proforma.

**Results:** Fourteen patients were included. Six of 14 patients (42,9%) denied alcohol consumption before and after the stroke, while only 1 of 14 patients (7,1%) reported alcohol consumption prior to the stroke. Seven of 14 patients (50%) were identified with having drinking habits and wine was mentioned by 5 of 7 patients (71,3%) as their preferred drink. All patients drinking alcohol were unaware of maximum unit consumption, nor their usual unit intake. Four of 7 patients (57,1%) consumed alcohol above the recommended prior to their stroke.

**Conclusion:** Alcohol consumption was present in 50% of patients that attended an outpatient nurse-led stroke clinic. Stroke patients are unaware of their maximum recommended intake of alcohol per day and usual intake of alcohol (in units). Information tailored to patient's gender and preferred drink should be provided. An outpatient nurse-led stroke clinic enhanced secondary stroke prevention.

## ESOC-0788

## 22. Service Organisation

## Time is brain: The Sheffield straight to scan audit

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**Introduction:** UK Stroke teams have had to develop thrombolysis services in an environment not originally set up to deal with an acute service. To try and reduce the door to needle time (DNT) in Sheffield we developed a 'straight to CT' approach. Analysis of our thrombolysis pathway showed delays in obtaining a CT scan prolonged DNT.

**Methods:** The 'straight to CT' approach involves patients going directly to CT scan on hospital arrival. Previously, patients went to the ward and then CT scan. Between 9am–5pm paramedics pre-alert the stroke team (who then meet the paramedics in CT) of a potential thrombolysis case.

**Data collection:** 3 months before and after this change.

**Results:** 21 patients were thrombolysed prior to the start of 'straight to CT'; DNT was 64 minutes, median Door to CT scan time was 14 minutes (IQR 8–18.5).

Seven patients were thrombolysed after the start of 'straight to CT'. DNT was 30 minutes (IQR 28–37), median door to CT scan time was 3 minutes (IQR 2–5).

Sixteen patients were taken straight to CT, but not thrombolysed due to contraindications. Median Door to CT time was 4 minutes (IQR 0–5.5) for 13 of the 16 (1 refused CT, 2 currently missing data). No serious complications occurred by going straight to scan.

**Conclusion:** Straight to scan can substantially reduce DNT times; in our case by 34 minutes. Many UK stroke centers may face similar logistical problems. With adaptation of the thrombolysis pathway, substantial reductions can be safely made to the DNT.

## ESOC-1189

## 22. Service Organisation

## Integration of dedicated mri into acute stroke services is cost-effective in reducing length of hospital admission and expediting clinical decision-making for atypical stroke presentations

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**Introduction:** Atypical stroke presentations constitute a large proportion of stroke unit workloads. Magnetic resonance imaging (MRI) may differentiate stroke and non-stroke presentations and guide management. However, MRI availability is often limited and delays waiting for scans result in increased lengths of hospital stay (LOS). We assessed how increased availability of MRI affected LOS and its cost implications.

**Methods:** The expedited MRI protocol involved a dedicated daily MRI slot for stroke unit use. Patients requiring MRI for diagnosis or to determine management were identified from all acute stroke admissions to Cambridge University Hospitals between November 2013 and May 2014. MRI sequences included T1, T2, diffusion-weighted imaging (DWI), gradient echo, and angiography.

**Results:** 93 individuals underwent expedited MRI scanning. 36 (38.7%) were discharged within 24 hours of admission. Median time from admission to MRI was 1 (IQR 1.5) day. Median MRI to discharge was 3.5 (IQR 9) days for confirmed stroke and 0 (IQR 2.5) days for stroke mimics ( $p < 0.01$ ). 50 had DWI lesions, 31 had normal MRI scans, 12 had abnormal but DWI negative findings (such as tumors).

**Discussion:** Before expedited MRI scanning, four to five bed days were taken up every week by individuals awaiting MRI. Timely MRI

investigation facilitates early stroke mimic discharge and improves clinical decision-making in the acute setting. For patients discharged within 24 hours, there is an estimated cost saving of £546 per patient, representing potential savings of £88,450 per annum. These results have important implications for hospital capacity, service costs, patient satisfaction and clinical care.

## ESOC-0344

### 22. Service Organisation

#### Developing a state-wide acute stroke protocol for public hospitals

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**Objectives:** The Stroke Clinical Network (Network) used a participatory process to develop state-wide procedures and protocols for acute stroke care in South Australia (SA).

**Setting:** SA has a small population of 1.7 million, but large land area (983,000 km<sup>2</sup>), with four metropolitan stroke units (52 beds), three rural services and around 3,000 acute stroke admissions per year.

**Background:** Despite having Australian guidelines for acute stroke management since 1999, a 2013 national audit reported: access to stroke unit care in SA is low (43%); 13% of patients with ischemic stroke received thrombolysis; 64% of eligible patients were swallow screened or assessed before food or drink; and 56% were seen by a physiotherapist within 48 hours.

**Methods:** A number of work groups, comprising in total 98 people, from different disciplines (doctors, nurses, allied health) and consumers, were tasked with developing different sections of the procedures and protocols. Two clinical leads provided leadership in the development and writing of the document. Iterative feedback/consultation sessions were held, culminating in a forum attended by around 80 people. The process was inclusive and consensus based with choices provided, such as where more than one evidence based assessment/screening tool was identified, final selections were by consensus. The 94 page document operationalizes Australian guidelines and provides a pathway to ensure our stroke units provide best practice, safe, effective and efficient care.

**Next steps:** The Network will lead an implementation process in conjunction with the state Safety & Quality Unit and includes targeted data collection, consumer and clinician feedback.

## ESOC-0737

### 22. Service Organisation

#### Differences in standardized thrombolysis rates according to stroke service level are mainly explained by restriction of thrombolysis to patients >80 years and with preexisting disabilities

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**Background:** Intravenous thrombolysis (IVT) is a well-reviewed treatment of proven benefit for selected patients with acute ischemic stroke, but in everyday clinical practice thrombolysis remains underused. We analyzed the proportion of patients receiving IVT in a state with 10.4 million inhabitants using uniform reporting and interpretation instruc-

tion to describe differences between stroke service levels and to explore reasons for possible underuse of IVT.

**Methods:** Data from 2008 to 2012 of the Baden-Württemberg stroke registry was analyzed for the proportion of patients admitted within the 4.5 h time-window receiving IVT. We used a Poisson-model to identify predictors of IVT and reasons for differences between stroke service levels. Potential IVT rates were estimated using stroke centers as reference. We adjusted for comorbidities stroke severity.

**Results:** 10,499 of 36,901 patients were treated with IVT; the rate was 28.5% and decreased with service levels from 44.0% (stroke centers) to 13.1% (hospitals without a stroke unit). For patients >80 years and with preexisting disabilities IVT rates decreased from 43.5% to 2.8%. Potential thrombolysis rates differed between 41.9% (regional stroke units) and 44.4% (hospitals without a stroke unit) leading to a potential relative increase of 52.7% of the IVT rate.

**Conclusion:** Standardized IVT rate may improve comparability of IVT rates between stroke service providers. Differences in IVT rates between stroke service levels were mainly explained by differences in use of IVT in patients >80 years and with preexisting disabilities. The potential relative increase of 52.7% of the IVT rate underlines the importance of optimizing stroke service organization.

## ESOC-0245

### 22. Service Organisation

#### Differences in vascular investigations in the setting of transient ischemic attacks

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**Background:** Recent studies suggest that rapid evaluation of patients with transient ischemic attack (TIA) is critical. Quality of in-hospital care strongly depends on a complex package of vascular investigations. Rates of diagnostic tests may vary between wards. We used data from the National Acute Stroke Israeli (NASIS 2004, 2007 and 2010) prospective hospital-based registry for comparing vascular investigation in TIA patients admitted at different departments.

**Methods:** Odds Ratios (ORs, 95% CI) by admission ward (neurological departments with stroke units – NDSU, neurological departments without stroke units – ND and other departments-Other) were produced using logistic regression models for brain computed tomography or magnetic resonance imaging (CT/MRI), CT/MRI angiography, carotid duplex, transcranial Doppler (TCD), transthoracic or transesophageal echocardiography (TTE/TEE) and Holter electrocardiography in TIA patients adjusting for age, gender, prior stroke, prior disability, cancer and dementia.

**Results:** Overall, 1245 patients were admitted (NDSU: 137 patients; ND: 309; Other: 799). OR (95% CI) for NDSU and ND compared to other wards were: 20.03 (2.76–145.21) and 3.42 (1.83–6.41) respectively for CT/MRI angiography; 2.60 (1.77–3.82) and 5.43 (4.00–7.39) for carotid duplex; 3.53 (1.81–6.88) and 2.21 (1.21–4.03) for TCD; 1.57 (0.99–2.51) and 1.55 (1.08–2.22) for TTE; 0.34 (0.04–2.66) and 3.13 (1.52–6.46) for TEE; 2.94 (1.36–6.33) and 4.78 (2.69–8.49) respectively for Holter electrocardiography. Findings were generally consistent in all NASIS periods. **Conclusions:** Our data suggest that TIA patients are best evaluated in NDSUs. Findings may partially be related to availability and awareness of tests in the various wards, as well as differences in patients characteristics not accounted for in this study.

## ESOC-1350

## 22. Service Organisation

## The Irish National Stroke Programme 2010–2014: Evaluation of results

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The National Audit of Stroke Care (INASC) published in 2007 showed that stroke services in Ireland were underdeveloped with only one stroke unit in the country and a thrombolysis rate of 1%. In response a clinician led, National Stroke Programme was established in 2009 to improve stroke care and develop multiple areas of stroke care from prevention to rehabilitation. In the interim, Ireland suffered a banking collapse and consequent economic crisis that severely restricted resources available for the program.

**Methods:** The program undertook several initiatives, notably the reorganization of stroke services including redirection of acute patients to organized stroke services, the opening of 7 new stroke units and the appointment of 49 new specialist nursing and therapy staff to units across the country. We appointed a number of new stroke trained physicians (neurologists and geriatricians) and established a training program for thrombolysis. We established early supported discharge teams in three urban areas and a national electronic stroke register. Most recently, a national telemedicine network has been established to support stroke and other specialties.

**Results:** Between 2009 and 2013 there was a 2.9% reduction in stroke admissions but a 10.5% reduction in stroke deaths ( $p = 0.06$ ). Discharge direct to nursing homes reduced by 22.9% ( $p < 0.001$ ). Average length of stay for dropped by 2.1 days (10.2%), median length of stay by 1 day. National thrombolysis rate increased from 3.5% in 2009 to 10.5% in 2013.

**Conclusions:** With limited resources, reorganization of stroke services has significantly improved care of stroke in Ireland.

## ESOC-1272

## 22. Service Organisation

## Quality of stroke unit care in Germany 2010–2012: The German Stroke Registers Study Group (ADSR)

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**Background:** Evaluations of the quality of stroke unit (SU) care in Germany are scarce. We investigated characteristics of patients admitted to a SU as well as adherence to evidence-based quality indicators among hospitals providing SU care between 2010 and 2012.

**Methods:** Data were derived from the German Stroke Registers Study Group (ADSR), a network of 9 regional registers for monitoring quality of acute stroke care in Germany. Analyses were restricted to hospitals with a certified SU according to the criteria of the German Stroke Society, the German Stroke Foundation or to regional criteria with available information on SU admission. Adherence of these hospitals to a set of 11 evidence-based quality indicators (QIs) including aspects of early prevention, management, rehabilitation and diagnosis with predefined target ranges for good quality of acute stroke care was calculated. Multivariate logistic regression analyses were performed.

**Results:** Between 2010 and 2012 more than 490,000 patients were treated in 259 hospitals providing SU care; of those 76.8% were admitted on a SU. Patients younger than 85 y ( $p < 0.0001$ ), with a symptom admission time of less than 24 hours ( $p < 0.0001$ ), without disturbances of consciousness ( $p < 0.0001$ ), and with an ischemic stroke or TIA ( $p < 0.0001$ ) were more likely to be admitted directly to a SU. Overall, in hospitals providing SU care a median of 8 (inter-quartile range 7–10) out of a maximum of 11 QIs was found to be within or above the defined target ranges.

**Conclusions:** Data indicate high quality of acute SU care in Germany.



## ESOC-1329

## 22. Service Organisation

## Delays in pre-hospital and in-hospital acute ischemic stroke management

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**Background:** Delays during acute ischemic stroke (AIS) management may be identified at population, emergency services and hospital level. The purpose of this study is to evaluate the duration of “stroke-onset to hospital-arrival” time and of “hospital-arrival to computerized tomography (CT) initiation” time, in three University Hospitals of Northern and Central Greece.

**Methods:** We used data derived from the multicenter observational PREWISE study (11/2013–11/2014) concerning the prognostic value of blood pressure variability in AIS. Age, gender, NIHSS on admission and the exact time of stroke onset, arrival at hospital and CT initiation were recorded.

**Results:** A total of 163 AIS patients with mean NIHSS 9.9, mean age 80.6 years, male 43.8%, consisted the material of our study. The mean “onset-to-door” time was 5 hours and 36 minutes and the mean “door-to-CT initiation” time was 2 hours and 15 minutes. The observed frequency of intravenous thrombolytic therapy was only 2.5%, but the potential frequency according to age, NIHSS and time was 8.6% for thrombolysis at 3 hours and 14.7% at 4.5 hours, and by excluding the delayed time of arrival the frequency of potential candidates for thrombolysis increased to 29.4%.

**Discussion:** The long mean “onset-to-door” time may reflect the unawareness concerning the recognition of stroke by population or delay of transportation to hospital. The long mean “door-to-CT initiation” time constituted another barrier to timely intravenous thrombolytic therapy which was not implemented widely compared to the threefold potential frequency of its application at 3 hours or fivefold potential frequency at 4.5 hours.

## ESOC-0847

## 22. Service Organisation

## Stroke awareness campaign in Western Norway

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**Purpose:** Stroke is one of the leading causes for morbidity and mortality worldwide. Yet, ischemic stroke can effectively be treated within the first hours after symptom onset. Despite of this effective treatment available, most patients arrive too late in hospital and thus cannot be treated. Many patients wait too long before calling the medical emergency phone. Thus, in order to increase the number of acute stroke patients coming early to hospital, we conducted a multi media stroke campaign in Western Norway. We present the effect of this campaign.

**Material and methods:** A multimedia stroke campaign was run for one month (May 2014). Stroke awareness in the population was assessed before and after the campaign. The number of thrombolysed patients was

registered in all participating hospitals before and after the campaign. Additionally, in one health region the number of calls to the medical emergency phone suspecting a stroke was registered.

**Results:** Stroke awareness in the general population increased from 66% to 75%. The number of patients thrombolysed increased in all participating hospitals varying from 5% to 43%. The number of calls to the medical emergency phone suspecting a stroke increased by 37.4%. The effect of the stroke awareness campaign persisted for more than five month.

**Conclusion:** The stroke awareness campaign in Western Norway increased both stroke awareness in the population and the number of thrombolysed patients. The results of this campaign encourage the planning of new and nationwide awareness campaigns.

## ESOC-1000

## 22. Service Organisation

## Centrally Observed Home Telemetric Monitoring of Blood Pressure to Manage Intensive Treatment (COMMIT) Study: Acceptability to patients

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**Background:** Hypertension is a major modifiable risk factor for recurrent stroke, but is often under-diagnosed by occasional clinic BP readings. Home BP-monitoring could improve accuracy of diagnosis of hypertension and BP-variability and allow more appropriately-informed titration of treatment. We determined the opinion of patients on centralized telemetric home monitoring of BP to diagnose and treat hypertension after TIA or stroke.

**Methods:** Consecutive consenting patients with a recent TIA or non-disabling stroke in a population-based study (Oxford Vascular Study) were taught to use a Bluetooth-equipped BP-monitor (t + Medical, Abingdon, UK). BP was measured 3 times over 10 minutes on 3 occasions each day at home for at least 1-month, depending on control. Measurements transmitted automatically using mobile phone technology were checked daily on a secure web-page. If BP was consistently above 130/80 mmHg or below 100/60 antihypertensive therapy was adjusted. Patients' views were assessed by anonymized questionnaire at 1-month.

**Results:** Of 1000 patients recruited, 576 (57.6%) returned the questionnaire. 533 (90.8%) approved of the intensive monitoring, 522 (89%) felt reassured by the central surveillance, and 500 (85.2%) thought it helpful to be able to discuss their BP readings over the phone. However, 72 (12.3%) patients reported that monitoring their BP made them anxious and 83 (14.1%) felt it was time consuming. Mean/SD overall satisfaction (0% extremely dissatisfied to 100% extremely satisfied) was 89/15.58%.

**Conclusion:** Centrally-observed telemetric home BP-monitoring was well received by the majority of patients as a method of diagnosing residual hypertension and titrating treatment after TIA and stroke.

**ESOC-1017**

**22. Service Organisation**

**Thirty-day case fatality for stroke in Scotland is falling: Data from the Scottish Stroke Care Audit**

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*Introduction:* It is hoped that as stroke care improves case fatality will fall, but there are few reliable data confirming this.

*Aims:* To investigate the impact of case mix, hospital of admission and stroke unit care on changing 30 day and one year case fatality after stroke.

*Methods:* Routinely collected Scottish Stroke Care Audit data (2005–2011) were linked to national mortality data. Using 2011 as the index year, odds ratios (OR) for death within 30 days were calculated, and adjusted for case mix [six simple variables (SSV)] in three models which included variations of: admitting hospital, stroke subtype (infarct/hemorrhage) and stroke unit admission.

30-day mortality according to year of admission (Adjusted OR (95% CI))

Year of admission	Model 11	Model 22	Model 33
2011	1.00	1.00	1.00
2010	1.15 (1.01–1.32)	1.14 (0.98–1.32)	1.10 (0.95–1.28)
2009	1.17 (1.02–1.35)	1.18 (1.01–1.37)	1.12 (0.96–1.32)
2008	1.38 (1.21–1.58)	1.41 (1.21–1.64)	1.31 (1.13–1.53)
2007	1.25 (1.08–1.43)	1.32 (1.13–1.53)	1.24 (1.06–1.45)
2006	1.22 (1.06–1.41)	1.23 (1.05–1.44)	1.12 (0.95–1.31)
2005	1.25 (1.09–1.44)	1.29 (1.11–1.51)	1.11 (0.95–1.30)

1 Adjusted for SSV and hospital; 2 Adjusted for SSV, hospital, stroke type; 3 Adjusted for SSV, hospital, stroke type, stroke unit.

*Results:* Thirty day mortality adjusted for SSV and hospital (model 1) showed that the likelihood of dying after stroke fell after 2008. Including stroke type (model 2) showed a similar pattern. Adding stroke unit care (model 3) attenuated the risk of death for all years except 2007 and 2008. Findings were broadly similar at one year.

*Conclusions:* Case mix, stroke type, admitting hospital and more strikingly stroke unit admission may partly explain changes in case fatality over time

**ESOC-0890**

**22. Service Organisation**

**An intra-arterial thrombolysis and thrombectomy pathway for patients with acute ischemic stroke at a district general hospital**

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*Background:* Endovascular therapy for the management of acute ischemic stroke due to large vessel occlusion is offered to select groups of patients at some tertiary centers. A pathway has been introduced at our district general hospital to transfer patients, who may benefit from intervention, to a tertiary center. Results of patients entering the pathway over the first 9 months are presented here.

*Methods:* Patients entering the pathway were entered into a prospective register, recording baseline demographic, clinical data, National Institutes for Health Stroke Scale (NIHSS) and imaging results. Mortality and modified Rankin score (mRS) were assessed at 3 months for those receiving intervention (intra-arterial thrombolysis, mechanical thrombectomy or both).

*Results:* From February to October 2014, 19 patients entered the pathway and 11 patients (58%) were transferred to the tertiary center. Of the group transferred 10 (91%) received intravenous bridging thrombolysis and 9 (82%) underwent endovascular therapy. The median NIHSS was 21 (11–25) and mean age 62 years (31–79). The median time from stroke onset to groin puncture was 225 minutes (155–335). At 3 months, 5 patients (55%) had a mRS ≤ 3, 3 patients (33%) achieved functional independence (mRS ≤ 2) and 2 patients died (mortality 22%). For all patients, median time from admission to intravenous thrombolysis was 31 minutes (20–120) and 38 minutes (11–160) for CT angiogram acquisition.

*Conclusions:* Patients at District General Hospitals can potentially benefit from Endovascular Therapy. A multidisciplinary agreed pathway should be in place in centers providing hyperacute care for the transfer of select patients to a tertiary unit.

**ESOC-0878**

**22. Service Organisation**

**Outpatient TIA care bundle – An exploration of potential utility to clinical services**

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*Introduction:* Inpatient acute stroke care in Scotland is audited against evidenced based standards using a “stroke bundle.” Improving adherence to the care bundle is associated with improved outcome. Outpatient standards concentrate on rapid access to assessment, but without appropriate investigations and treatment this will not meet patients’ needs. We investigated the potential utility of a “TIA bundle” to improve outpatient care. *Methods:* We collected data for new patient appointments during one month in a teaching hospital with six TIA clinics/week. Limited dedicated imaging slots are available for each clinic but no direct access to cardiac investigations. Standards set were: clinic review within 4 days of receipt of referral; same day brain imaging; carotid imaging within 48 hours; cardiac investigations within one month; treatment advice on the day of clinic attendance.

*Results:* 59 urgent TIA referrals were received. 61% (n = 36) were offered an appointment within the target of 4 days. In 15 the diagnosis after clinic review was not TIA. Of those with a diagnosis of possible or definite

TIA (n = 44) none achieved all five elements of the bundle. 7% (n = 3) achieved four elements; 34% (n = 15) three elements; 54% (n = 24) two elements and 5% (n = 2) one element. Treatment advice was offered in 98% (n = 43). Poorest performance was in cardiac investigation, where there is no dedicated service; only 16% (n = 7) met the bundle standard.

*Discussion:* Presentation of the data in bundle format made assessment of service deficiencies clearer. A national "outpatient bundle" for TIA clinics could highlight areas of deficiency and improve access to rapid specialist assessment and also timely investigation and treatment.

## ESOC-0684

### 22. Service Organisation

#### Lay involvement in stroke service reorganization: Practices and queries

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*Background:* NHS organizations have are required to involve patients and the public when redesigning healthcare services. Little is known about what such involvement contributes to service improvement. Recent reconfiguration of acute stroke services in London and Manchester sought to involve patients, carers and the public.

*Aim:* To understand how lay people were involved in stroke service reconfigurations and the perceived impact of this.

*Methods:* Thematic analysis of qualitative interviews with 41 stakeholders working on the reconfigurations.

*Results:* Lay people were informed about but did not actively contribute to reconfiguration planning. Lay people were asked to help to prepare information delivery strategies, including how to frame 'scripts' about the planned changes. Considerable efforts, using a range of methods, went into seeking lay views on the reconfiguration plans. Stakeholder consultations collected evidence that lay people largely supported the planned changes to acute services. In one area, total consultation costs were estimated at £1.2 million. Interviewees raised concerns about the representativeness of lay people who were 'involved'. They considered that consulting the public was a necessary political exercise but felt it had little or no influence on reconfiguration plans. Lay people were reported to use consultation to express their greater concern about a need to improve rehabilitation services.

*Conclusion:* In these cases, lay involvement served a symbolic function, asserting the centrality of the patient, and demonstrating that political legitimacy had been sought and obtained. Both reconfigurations improved patient outcomes, raising questions about what kinds of involvement are required for specific circumstances.

## ESOC-1219

### 22. Service Organisation

#### A service evaluation of stroke knowledge amongst hospital staff

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*Background:* In-hospital strokes are associated with slower referral than those which occur outside the hospital, which results in contraindication for thrombolysis treatment. It may be that knowledge deficits in stroke response amongst hospital staff may contribute to delays in referral, assessment and treatment of in-hospital stroke.

*Method:* A hospital survey was conducted with all hospital staff members operating at ward level including doctors, nurses, allied health professionals, support staff, porters and students. The Stroke Awareness Questionnaire was adapted for use with hospital staff to assess knowledge of stroke symptoms, stroke impairments, acute treatments, and hospital protocol for treatment of stroke.

*Results:* Ninety-six staff members were interviewed, 81% of whom were clinical staff (medical, nursing, allied health professionals). Ninety-two percent were found to have adequate knowledge of stroke symptoms (i.e. name three or more symptoms), however only 49% of staff were aware of thrombolysis treatment and only 48% could identify the treatment window for thrombolysis administration. Staff on neurology wards were found to be more likely to name more symptoms than staff on general medical and surgical wards (5.1 vs. 3.7 [p < 0.001]). Post-stroke depression was poorly recognized as a long-term impairment of stroke (6.3%, n = 6). *Conclusion:* Hospital staff were found to have adequate stroke knowledge. Of concern was the low awareness of thrombolysis therapy amongst hospital. Only half of the sample could identify the time restrictions for thrombolysis administration. If inpatient staff do not activate stroke protocols immediately when in-hospital stroke occurs, opportunities for treatment with thrombolysis may be missed.

## ESOC-0948

### 22. Service Organisation

#### Convincing quality of acute stroke care in telestroke units

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*Background and purpose:* Implementation of TeleStroke Units is one way to organize acute stroke care in underserved, mostly rural, areas. The Telemedical Project for Integrative Stroke Care (TEMPiS) is a TeleStroke Unit network in Bavaria, Germany. We aimed to determine quality of acute stroke care in TEMPiS TeleStroke Units.

*Methods:* All TEMPiS TeleStroke Units report quality data to the Bavarian Stroke Registry. Predefined national quality indicators are analyzed. Results for the year 2013 are reported. Results of quality indicators of TEMPiS TeleStroke Units were looked at regarding fulfillment of predefined national targets and compared to statewide and national results.

*Results:* In 2013, 15 TEMPiS TeleStroke Units treated 7,386 patients with stroke and TIA (hospital range 240 to 892; mean 492; median 452).

Documentation rate was 99.3%. In 12 of 13 indicators predefined targets were fulfilled. In comparison to all 154 hospitals participating in the Bavarian Stroke Registry, TeleStroke Units had higher percentage points in 14, lower in 3 and equal percentage level in one quality indicator.

**Conclusion:** Registry data of the TeleStroke network TEMPiS suggest a convincing acute care quality in TeleStroke Units.

## ESOC-0488

### 22. Service Organisation

#### Variation in organization of TIA care in The Netherlands: A nationwide survey study

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**Background:** Previous research has shown the importance of urgent initiation of secondary prevention after transient ischemic attack (TIA) to reduce the risk of recurrent stroke. Many hospitals in the Netherlands have therefore implemented rapid care pathways for TIA patients, hereafter TIA screening. Dutch stroke guidelines lack clear directives for organization of the TIA screening and thus allow for variation.

**Aim:** The aim of this study was to investigate variation in organization of TIA care in Dutch hospitals.

**Methods:** In 88 Dutch hospitals a neurologist was invited to participate in a web-based survey. The survey primarily focused on the organization and content of TIA care. Timeliness of TIA care was also addressed.

**Results:** A total of 70 (80%) neurologists completed the survey, all of whom reported having a TIA screening in their hospital. There was considerable variation in the method of application and the location where the screening is conducted. In 10,2% of the hospitals TIA patients are admitted to the ward. The content of the screenings is similar, although hospitals vary in the extent of cardiological assessment and young stroke protocol. Almost all hospitals aim for timeliness as directed by guidelines, however registration of timeliness is often lacking. 85,7% of respondents reported that secondary prevention is initiated prior to screening.

**Conclusions:** As was hypothesized, this study found variation in organization of rapid TIA care in Dutch hospitals, especially regarding location, method of application and cardiological assessment. Further research is needed to investigate implications of this variation for quality of care.

## ESOC-0547

### 22. Service Organisation

#### Streamlining a carotid ultrasound service to expedite imaging for high-risk patients

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**Aims:** National guidance promotes early identification of carotid stenosis in patients with TIA and non-disabling stroke so that surgery can be contemplated early. We aim to image vessels within 24 hours and refer for endarterectomy by 48 hours. Ultrasound provides quick and safe diagnosis. Limited vascular ultrasound expertise in our Trust leads to reliance on other modalities. We aimed to assess whether clearer pathways for carotid ultrasound across the Trust could facilitate rapid access scans for TIA.

**Method:** We analyzed all carotid ultrasounds performed over 6 months, waiting times, requesting speciality, indications and results.

**Results:** 104 scans were performed between May and November 2014. Mean waiting time was 6.49 days. Scans were requested from 14 specialities – mainly stroke physicians (52.9%), general practitioners (13.5%) and cardiologists (6.7%). In 22 (21.2%) no clear indication was given. Bar one, these were from non-stroke specialists. 33 (32%) scans were for suspected stroke or TIA, mean waiting time 4.24 days. 7 of these were from

non-stroke specialists. Flow limiting stenosis (>50%) was identified on 15 (14.4%) scans, of which 8 had seen the stroke team beforehand. By excluding requests with insufficient detail or non-standard indications we estimate mean waiting time reduces to 5.12 days.

**Conclusion:** A significant proportion (68%) of carotid ultrasound requests do not aim to assess high-risk carotid stenosis which might benefit from early surgery. Closer evaluation of request form information or policing of referrals might improve identification of these patients and allow more rapid assessment for this group.

## ESOC-1138

### 22. Service Organisation

#### Casemix-adjusted comparison of resource use first year following a stroke in Sweden – Results from Sveus

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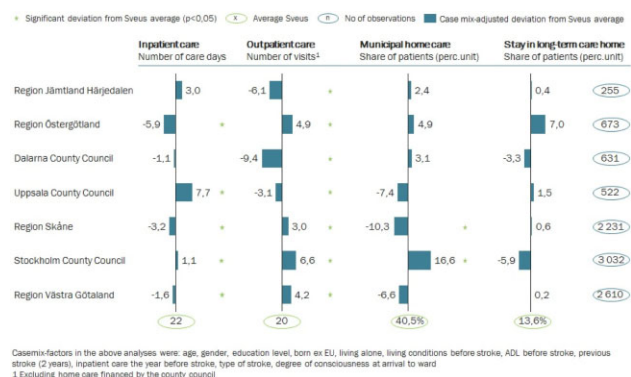
**Background:** Since 2013, seven Swedish county councils collaborate within the project Sveus to develop value-based monitoring and reimbursement systems for eight patient groups including stroke. Research topics (approved by Ethical Review Board):

- Are there differences in the value of health care between care givers/counties?
- How can a value-based monitoring system and reimbursement system be designed?

**Aim of substudy:** To compare resource use during one year following a stroke between county councils, adjusted for patient characteristics.

**Method:** Identification of key resources and factors influencing outcome (casemix-variables) were based on available literature and clinical expertise of the research group, representing county councils, patient organization, specialists, quality registries and Ivbar (RnD company). The research database consists of data from patients suffering a stroke 2007–2012 retrieved from several registries; county councils' administrative systems, national quality registries for stroke (Riks-Stroke) and rehabilitation (WebRehab), the National Board of Health and Welfare, Swedish Social Insurance Agency, and Statistics Sweden. Data were linked on patient level, anonymized, and statistical analyses were performed, primarily using mixed-effects models, to allow for casemix-adjusted comparisons.

## Results:



Generally, county councils averaging longer inpatient stay have less outpatient visits.

**Conclusions:** In this sub-study within Sveus we show that there were, after case-mix-adjustments, significant differences in resource use between counties in the care of stroke patients. How this is associated with outcome will be explored.

## ESOC-0578

## 22. Service Organisation

## Factors associated with stroke patients experiencing severe complications in acute hospitals in New South Wales (Australia)

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**Background:** Severe complications following an acute stroke adversely impacts outcomes. Little is known about the factors that contribute to, or ameliorate, the risk of severe complications in hospital after stroke.

**Aims:** To describe the factors associated with the occurrence of severe complications following acute stroke in public hospital patients in New South Wales, Australia.

**Methods:** A medical record audit of eligible acute stroke admissions from 2000–2014, was carried out using a standardized and validated data collection tool. Severe complication was defined as a new condition that was incapacitating, life threatening and prolonged hospital admission. Factors, including gender, admission stroke severity/type, and stroke unit (SU) care were included in a multilevel logistic regression model if  $p < 0.15$ , with hospital defined as the level.

**Results:** Among 5,413 patients from 43 hospitals (22 metropolitan, 21 rural), 448 (8%) experienced a severe complication (53% female, median age 81, 85% ischemic stroke). Multilevel model factors included: independence prior to stroke, hemorrhagic stroke, more severe stroke, use of care plans (all  $p < 0.001$ ), SU care ( $p = 0.03$ ), and team meetings ( $p < 0.01$ ). Patients with a clinical care plan during their admission were less likely to experience a severe complication (aOR: 0.64 95% CI 0.46, 0.90). Patients who experienced a severe complication were more likely to have a team meeting within 7 days (aOR: 1.6 95% CI 1.2, 2.2).

**Conclusion:** In a large sample of acute stroke patients, those with a clinical care plan during their admission had fewer severe in-hospital complications and therefore, potentially improved patient outcomes.

## ESOC-0902

## 22. Service Organisation

## Investigation and management of transient ischemic attacks and minor strokes presenting in general practice compared to emergency departments – INSIST cohort study findings

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**Background:** Transient ischemic attacks and minor strokes (TIAMS) require urgent diagnosis and management.

While a proportion of people with TIAMS in Australia present to an emergency department (ED), many are managed in general practice (GP). We aimed to establish and compare the demographics and presentation patterns of ED-presenting and GP-presenting TIAMS.

**Methods:** Ethics approval was obtained. InSiST – an inception cohort study of patients of 17 general practices in the Hunter and Manning Valley regions of Australia. Possible TIAMS were ascertained by multiple overlapping methods including searching of GP and hospital databases. Data is extracted from participants' GP and hospital medical records and from structured interviews conducted at baseline, 3-months and 12-months. A three-clinician panel adjudicates cases as TIAMS or TIAMS-mimic based on this data plus vascular- and neuro-imaging.

Differences in ED-presenting and GP-presenting TIAMS were tested with logistic regression, adjusting for age and sex (and ABCD2-score for processes of care and management parameters) within Generalized Estimating Equations to account for clustering within practices.

**Results:** Of 171 panel-adjudicated TIAMS, 97 were GP-presenting. GP-presenters had a significantly lower (ABCD2-determined) stroke risk, lower systolic BP, consumed less alcohol and higher educational attainment than ED-presenters. Following the TIAMS, GP-presenters delayed contacting medical help longer, and waited longer to see a doctor, compared with ED-presenters. GP-presenters were less likely to have an ECG performed or have appropriate pharmacotherapy (anti-platelet or anticoagulant) initiated or increased.

**Conclusions:** Many TIAMS are GP-presenting, but may receive less appropriate investigation and management compared to ED-presenting TIAMS.

## ESOC-0903

## 22. Service Organisation

**A comparison of rural and urban health-seeking behaviour and processes of care in patients with transient ischemic attack and minor stroke**

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**Background:** Transient ischemic attacks and minor strokes (TIAMS) require urgent diagnosis and management. Distance is a barrier to health-care access in rural Australia. We sought to determine if community-based TIAMS patients were disadvantaged by rurality. We aimed to compare help-seeking and process-of-care between rural and urban TIAMS patients

**Methods:** An inception cohort study of patients of 17 general practices in the Hunter and Manning Valley regions of Australia. Ethics approval and patient consent were obtained. Possible TIAMS are ascertained by overlapping methods including searching of GP and hospital databases. Data is extracted from participants' GP and hospital medical records and from structured interviews conducted at baseline, 3-months and 12-months. A three-clinician panel adjudicates cases as TIAMS or TIAMS-mimic based on this data plus vascular and neuro-imaging.

'Major city' was classified 'urban', and 'inner and outer regional' as 'rural'. Differences in rural and urban help-seeking behaviour and process-of-care were tested with logistic regression, adjusting for age and sex within Generalized Estimating Equations to account for clustering within practices.

**Results:** Of 171 adjudicated TIAMS, 83 were rural, 88 were urban. There were no significant demographic differences between rural and urban patients (including ABCD2-determined stroke-risk).

Time from seeking to receiving medical care was slightly, but significantly, longer for rural patients. There was a non-significant trend for longer time to receiving brain-imaging. Otherwise there were no significant differences.

**Conclusions:** Accessing initial healthcare and neuro-imaging post-TIAMS was not greatly compromised for rural patients. But results may not generalize to 'remote' and 'very remote' areas.

## ESOC-0904

## 22. Service Organisation

**Presentation patterns of patients with transient ischemic attack (TIA) and minor stroke, compared with those of stroke/TIA mimics**

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**Background:** In many health systems a majority of TIAs and minor strokes (TIAMS) present to general practice and often managed without onward referral. Distinguishing from TIAMS from TIAMS-mimics is often challenging for the general practitioner (GP) or Emergency Department physician (EDP). We aimed to establish and compare the demographics and presentation patterns of TIAMS and TIAMS-mimics.

**Methods:** Ethics approval and patient consent were obtained. An inception cohort study of patients of 17 general practices in the Hunter and Manning Valley regions of Australia. Possible TIAMS were ascertained by multiple overlapping methods including searching of general practice and hospital databases. Data is extracted from participants' GP and hospital medical records and from structured interviews conducted at baseline, 3-months and 12-months. A three-clinician panel adjudicates cases as TIAMS or TIAMS-mimic based on this data plus vascular- and neuro-imaging.

Differences in characteristics of TIAMS and TIAMS-mimics were tested with logistic regression, adjusting for age and sex and within Generalized Estimating Equations to account for clustering within practices.

**Results:** Of the first 311 adjudicated cases, 171 (55.0%) were TIAMS. Most common TIAMS-mimics were migraine, vestibular disturbance and syncope/pre-syncope.

TIAMS adjudication was significantly associated with male sex, age, BMI, hypertension, smoking-history, lower educational attainment, living alone and a higher ABCD2 score. TIAMS were significantly more likely to have motor, speech or ataxic (but not visual or sensory) symptoms.

**Conclusions:** Presentations of TIAMS and TIAMS-mimics differ on multiple parameters. This will inform decision-support tools for GP diagnosis of TIA and minor stroke.

## ESOC-1143

## 22. Service Organisation

## Effectiveness and safety of endovascular treatment in acute stroke by a mobile neurointerventional team

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Stroke endovascular treatment (EVT) off-hours in our health area is performed by staff on call that may attend patients in their own

comprehensive stroke center (CSC) or in a different CSC. Our aim was to compare effectiveness and safety of EVT between the two models of intervention, local and visiting team.

We studied all patients treated off-hours with EVT from Oct-2012 to Aug-2014 in three CSC, prospectively recorded in the Catalan Stroke Code and Reperfusion Consortium Registry. 216 consecutive patients received off-hours EVT, 154 by local and 65 by visiting teams. Age, NIHSS, vascular risk factors, stroke subtype, ASPECTS, vessel occlusion site and IV tPA use were comparable between the two groups. Safety data, outcome variables at 90 days and time from door to groin puncture and end of procedure are shown in table.

Our findings suggest that treating patients in CSC by visiting staff is not associated with poorer outcome, regardless of longer door-to-groin times.

		Local team n = 154	Visiting team n = 62	P value
Outcome	Revascularization (mTICI 2b,3)	117 (76%)	50 (81%)	0.45
	Dramatic recovery at 24 hours (improvement $\geq 8$ or NIHSS $\leq 2$ )	67 (43%)	25 (40%)	0.78
	Good outcome (mRS 0–2)*	65 (42%)	25 (40%)	0.87
Safety	Symptomatic ICH (SITS-MOST definition)	4 (2.6%)	0	0.50
	Procedural complications	23 (15%)	10 (16%)	0.78
	Mortality*	36 (23%)	12 (19%)	0.59
Quality	Door-to-groin, median[IQR]	125 [85,168] min	141 [111,193] min	0.015
	Groin-to-end, median[IQR]	86 [60,127] min	70 [50,120] min	0.22

\*Available in 147 patients of local and 57 of visiting groups; missing values are considered as failures and deaths

## ESOC-0906

## 22. Service Organisation

## Northwick park hospital inter-disciplinary task-based learning in stroke medicine

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**Background:** The Northwick Park Hospital Stroke unit in London is one of the busiest in the United Kingdom. It was crucial for further healthcare quality improvement and professional development to develop a comprehensive educational program focused on stroke medicine. The program had to be implemented into the busy hectic hyper acute stroke service. For successful implementation it was important it is comprehensive, inter-disciplinary, highly relevant to day-to-day clinical practice and not time-consuming.

**Methods:** Between July 2013 and January 2015 has been developed, implemented and evaluated an inter-disciplinary educational program focused on stroke medicine.

**Results:** The program development started in 2013 with needs assessment, and set up the goals and learning outcomes. As the educational strategies, inter-disciplinary education and task-based learning were

decided. The program is designed for ten months in total and consists of basic and advanced modules. The 60-minute plenary sessions of study groups, tutors and super-tutors are held once weekly. After piloting in summer 2014, the program was fully implemented in September 2014. The members of four study groups are junior and senior doctors, stroke nurses, pharmacists, research nurses, and stroke unit managers. Multiple systematic evaluation strategies have been used.

**Conclusions:** The educational program has been developed, piloted and implemented in 2013. It was design as a continuing medical education inter-disciplinary program in stroke medicine as well as very powerful managerial tool. The program is generic and is transferable to different healthcare settings and specialties. It can be used both in undergraduate and postgraduate continuing medical education.

## ESOC-1278

## 22. Service Organisation

## The effect of pre-hospital alert and out of hours services on stroke thrombolysis timing

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**Introduction:** Intravenous thrombolysis given within 4.5 hours of symptom onset increases independent survival rates in ischemic stroke patients. Pre-hospital notification (PHN) by ambulance services (AS) can improve timing and increase the proportion of patients eligible for thrombolysis within 4.5 hours. We aimed to determine whether PHN and treating out of hours (OOH) impact on thrombolysis timings.

**Methods:** The stroke thrombolysis proforma collects information on timing of CT scan, thrombolysis and whether there was PHN or patient presented OOH. Data were collected between May 2012 and June 2014. This study was approved by our local ethics committee.

**Results:** 182 patients were identified (88 females; mean age of 74; median NIHSS score of 12). PHN patients were significantly ( $p < 0.0001$ ) more likely to have a CT head scan within 25 minutes (60% vs. 24%), be assessed earlier by stroke physician (mean time of 10 vs. 33 min) and to receive thrombolysis within 60 minutes (89% vs. 49%). PHN did not affect pre-hospital timing. Being treated OOH did not significantly influence timing of AS response, stroke physician assessment, CT imaging or thrombolysis. Introduction of a near sited CT scanner to the emergency department improved the proportion of patients receiving a CT scan within 25 minutes (15% vs. 35%;  $p = 0.042$ ), but did not significantly alter thrombolysis timing.

**Conclusion:** PHN improves timely delivery of thrombolysis and reassuringly there was no difference in timing OOH. Increased usage of PHN and continuing audit amongst other measures will likely further improve timing.

## ESOC-0058

## 22. Service Organisation

## Using the Sentinel Stroke National Audit Programme benchmarks to improve hyper-acute stroke care at a district general hospital

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**Background:** The Sentinel Stroke National Audit Programme (SSNAP) in the United Kingdom is a platform for collecting data regarding stroke care and auditing stroke services against nationally set benchmarks. SSNAP collects various data sets for every stroke patient, including acute care, rehabilitation, 6-month follow-up, and outcome measures in England, Wales and Northern Ireland. On a local level it allows stroke services a real time process mapping opportunity to improve their services to provide the quality of care set by the benchmark.

**Method:** SSNAP being a prospective audit allows us to continuously make improvements in problem areas aiming to meeting the benchmark targets. SSNAP includes ten domains; process mapping each domain as a multi-disciplinary team allows us to concentrate resources in more innovative ways.

**Results:** We present data over four consecutive audit cycles July 2013 to June 2014. Performances against the benchmarks have consistently improved.

	July– September 2013	October– December 2013	January– March 2014	April– June
Scanning	A	A	A	A
Stroke unit	B	B	B	B
Thrombolysis	C	D	D	B
Specialist assessment	B	B	B	A
Occupational therapy	D	B	A	A
Physiotherapy	D	B	A	A
Speech and language	E	E	C	C
MDT working	D	C	B	B
Standards by discharge	C	B	B	A

**Conclusion:** Our service has consistently improved. Targeted approaches, continuous process mapping and innovative multi-disciplinary working have all helped in improving our stroke service. Our efforts were rewarded with the stroke service winning a national award for patient care in 2014. This poster will explore the individual strategies we have employed for other European hyper-acute stroke units to learn from and replicate.

## ESOC-1505

## 22. Service Organisation

## UNWELL S

## Troke mimics in the HASU – Who are they, what are their diagnoses and what happens to them?

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**Introduction:** The introduction of the Hyperacute Stroke Unit (HASU) model has meant that many stroke mimics present to the stroke team. Some of these patients cannot be immediately discharged, and need referral to another speciality.

**Methods:** Using the ward lists generated from collecting Stroke Sentinel National Audit Programme data we identified patients over a 7 month period (February–August 2014) who had been transferred to the care of another medical speciality. We recorded diagnosis at discharge, length of stay, and mortality. We reviewed the case notes of 19 patients and recorded discharge destination, time spent on HASU, time to referral and the number of therapy sessions they received.

**Results:** 42 patients transferred to another team. The average age was 81. Their average length of stay was 20.6 days. Mortality was high – 6 died in hospital. At least 5 more died by the time of audit (November 2014) with an overall mortality of 26%. Diagnoses were varied, the top three being seizures, metastatic disease and community acquired pneumonia. Of the 19 patients with case note review the average time on HASU was 7 days, 11/19 were discharged home, 6/19 to rehab or nursing home, and 2 died. Their average number of therapy sessions required pre discharge was 9.

**Conclusion:** These patients are elderly, require a long length of stay and large therapy input. They stay on HASU longer than the expected stay of 3 days. Mortality is high. Their care is a significant challenge for the HASU team.



## ESOC-1256

## 22. Service Organisation

## Care needs and functional impairment after stroke in England and Wales

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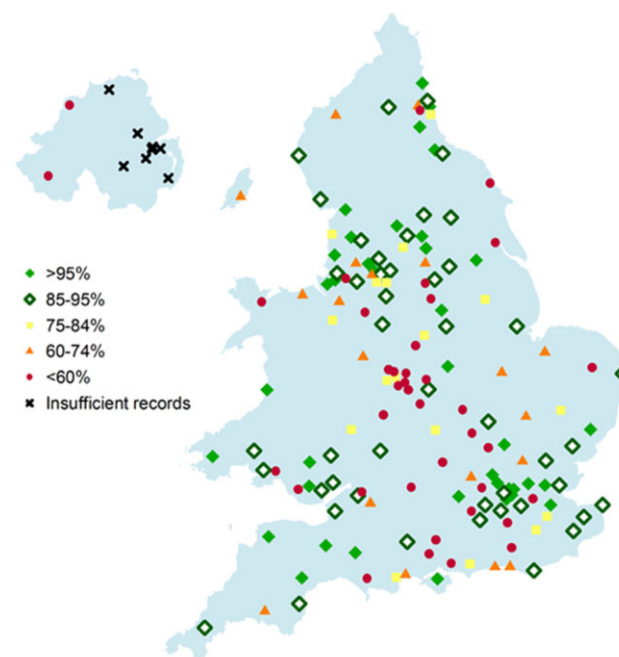
**Background:** While acute care in hospital has improved significantly over the last decade, the transition from hospital to the community remains problematic. The failure to provide joined-up services after discharge is a principal area of concern raised by patients.

**Methods:** Data were extracted from the Sentinel Stroke National Audit Programme, the national register of stroke care in England and Wales. The sample included 66,798 patients with acute stroke, aged over 18, discharged from 266 stroke services from April 2013 to March 2014. Data were collected by clinical teams and entered into the database using an online web tool.

**Results:** 54.6% of patients (36,490/66,798) were discharged home, 26.1% of these (9,515/36,490) to a place where they lived alone. 10.9% of patients (7,262/66,798) were discharged to a care home, 63.7% (4,627/7,262) of these for the first time. 32.8% (21,890/66,798) left hospital with moderate to severe disability (modified Rankin scale score 3–5). 51.6% (11,307/21,890) of patients leaving hospital with moderate to severe disability were over 80 years old at the time of stroke.

36.7% of patients (20,747/56,605) discharged from hospital required help with activities of daily living. Of these, 19.4% (4,025/20,747) did not have paid carers.

**Conclusion:** Despite improvements in acute stroke care, many stroke survivors are discharged home with significant functional impairments and care needs. Health services need to ensure that stroke survivors and carers have effective long-term support.



## ESOC-1266

## 22. Service Organisation

## Inequalities in the management of the psychological symptoms of stroke

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**Background:** Many patients will have significant psychological symptoms following stroke. We describe access to and provision of psychological screening and support in a national sample of stroke patients during their inpatient stay.

**Methods:** Data for 66,798 stroke patients treated in 266 stroke services between April 2013 and March 2014 were extracted from the Sentinel Stroke National Audit Programme, the national register of stroke care in England and Wales. Data on organizational characteristics of 183 acute hospitals (100%) were collected via survey. Data were collected by clinical teams and entered into the database using an online web tool.

**Results:** Of 34,390 patients with a stay of longer than 7 days, 85.6% were reported as being applicable for mood screening and 84% for cognition screening. Of these, 27.1% were not screened for mood prior to discharge from inpatient care. 16.2% were not screened for cognition. 39% of hospitals do not have access to a clinical psychologist and 19% of hospitals with access have waiting times longer than 5 days. Psychological support is provided on a median of 5.9% of inpatient days. Fig. 1 shows wide variation of access.

**Conclusion:** Not all stroke patients in England and Wales have adequate access to psychology services in hospital. Early diagnosis of mood and memory problems is vital to identify and meet psychological support needs.

## ESOC-1271

## 22. Service Organisation

## Provision and use of domiciliary stroke services in a national cohort of contemporary stroke patients

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**Background:** After inpatient care, many stroke patients need further rehabilitation in the community, ideally in their own homes. Previous studies have shown that early supported discharge (ESD) for stroke reduced length of stay and improved patient outcomes.

**Methods:** Data for 66,798 stroke patients discharged from 266 stroke units between April 2013 and March 2014 were extracted from the Sentinel Stroke Audit Programme, the national register of stroke care in England and Wales. Data on the organization of services in 183 acute hospitals (100%) were collected via a snapshot organizational audit in July 2014. Data were collected by clinical teams and entered into the database using an online web tool.

**Results:** Of 56,605 patients discharged alive from inpatient care 24.7% were discharged with plans for on-going rehabilitation from a specialist ESD team and 22.8% from a specialist community rehabilitation team (CRT). 74% of acute hospitals (135/183) have access to specialist ESD services and 72% (131/183) to specialist CRT, an increase from 44% and 55% respectively in 2010.

**Conclusion:** While there is greater access to domiciliary stroke services, there is an inequality of access across England and Wales. As length of stay in hospital decreases access to specialist domiciliary care is increasingly important to good outcome after stroke.

## ESOC-1294

## 22. Service Organisation

## Time trends in quality of acute stroke care in Germany 2003–2012: The German Stroke Registers Study Group (ADSR)

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<sup>8</sup>Quality Assurance in Stroke Management in North Rhine–Westphalia, Medical Association North Rhine, Düsseldorf, Germany

<sup>9</sup>SQMed, Institute of Quality Assurance Rhineland-Palatinate, Mainz, Germany

<sup>10</sup>Quality Association for Acute Stroke Treatment Schleswig-Holstein (QugSS) Institute of Social Medicine and Epidemiology, University of Lübeck, Lübeck, Germany

<sup>11</sup>BAQ, Bavarian Permanent Working Party for Quality Assurance, Munich, Germany

**Background:** Analyses of variations in appropriate stroke care over time are scarce. We analyzed adherence to evidence-based quality indicators over a time period from 2003–2012 in Germany

**Methods:** Data were derived from 9 regional acute stroke care registers collaborating within the German Registers Study Group (ADSR). Temporal changes in evidence-based quality indicators in appropriate patients (antithrombotic therapy, vascular imaging, anticoagulant therapy, brain imaging, early physiotherapy therapy, speech and language therapy, thrombolytic therapy) for which comparable information was available over a 10-year time period were assessed. Logistic regression models were performed to estimate time trends.

**Results:** Between 2003 and 2012 (without 2006), individual data from more than 780,000 patients treated in more than 300 hospitals with continuous documentation of quality indicators since the start of the individual registers were documented. A continuous increase in adherence to predefined quality indicators was seen for all indicators. In some indicators a constant increase across the whole study period was observed: anticoagulant therapy ( $p < 0.0001$ ), vascular imaging ( $p < 0.0001$ ), and speech and language therapy ( $p < 0.0001$ ). In other indicators, an initial increase was followed by a stable plateau of high-level adherence (thrombolytic therapy [ $p < 0.0001$ ], antithrombotic therapy [ $p < 0.0001$ ], brain imaging [ $p < 0.0001$ ], physiotherapy [ $p < 0.0001$ ]).

**Conclusion:** An increasing quality of stroke care defined by standardized quality indicators was observed over time in Germany. In some indicators, high level of adherence might indicate that best practice is already reached.

## Small Vessel Disease

### ESOC-0861

#### 23. Small Vessel Disease

##### Influence of intravenous low-intensity laser irradiation of blood on the level of circulating endothelial progenitor cells in acute lacunar stroke

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**Background and purpose:** The purpose of our study was to determine influence of low-intensity intravenous laser irradiation of blood ILIB on the levels of circulating endothelial progenitor cells (EPCs) and adult vascular endothelial stem cells (ESCs) CD117+ (c-kit+) in patients with acute lacunar stroke (LS) resulting from CSVD.

**Methods:** The level of circulating EPCs (CD34+, CD133+, KDR+, CD31+, CD144+, CD146+, vWF+) and CD117 + (c-Kit+) were examined in patients at 48 hours of LS (n = 20, a mean age of 59 ± 4,3 years) and after 7 days of standard therapy and ILIB by the semi-conductor laser at wave length 0,67 μm, and radiation power at the end of the light guide – 2,0–3,0 mW and time of application 20 minutes, 7 procedures per course using flow cytometry; once in 10 healthy volunteers.

**Results:** Significant increased CD133+CD34– (from 0,51 ± 0,07% to 0,92 ± 0,13%, p < 0,01), CD133–CD34+ (from 0,38 ± 0,05% to 1,34 ± 0,18%, p < 0,001), CD117+CD34– (from 0,83 ± 0,06% to 1,54 ± 0,24%, p < 0,01), CD117–CD34+ (from 0,52 ± 0,09% to 1,16 ± 0,16%, p < 0,01) levels after 7 days of treatment were revealed. The increase in the proportion of CD133+CD34+, CD45+CD117+ and CD45+CD34+, p < 0,05, after ILIB application may indicate an increase in the degree of functional activity of the EPCs. A significant increase in CD31+CD144+ and CD31+CD71+ level (p < 0,05) after treatment reflected blood–brain barrier (BBB) stabilization.

**Conclusions:** Our data suggest that application of ILIB from the first days LS allows significantly increase the functional and proliferative activity and the level of circulating EPCs; CD117 + ESCs and pluripotent CD34+CD45+, CD45+CD117+ cells and stabilize BBB.

### ESOC-0606

#### 23. Small Vessel Disease

##### Small vessel disease after stroke at young age: The future study

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**Objective:** To investigate the prevalence of small vessel disease (SVD) in patients with an ischemic stroke or TIA at young age.

**Methods:** Prospective cohort study among 337 patients with a first-ever TIA or ischemic stroke, aged 18–50 years and 90 healthy, age and sex matched controls. At follow-up blood pressure, diabetes and smoking were assessed and all participants underwent a cerebral MRI. White matter hyperintensity (WMH) volume was assessed and lacunes and microbleeds were rated. Linear regression was used to quantify the relation between risk factors and SVD.

**Results:** There were 110 patients with a TIA and 227 patients with an ischemic stroke, 45.4% of the patients were male and 45.6% of the con-

trols. After mean follow-up of 9.9 (SD 8.1) years, mean age for patients was 49.7 (SD 10.3) years and 48.7 (SD 11.8) for controls. At follow-up, 81 (24.0%) patients and 4 (4.5%) controls had at least 1 lacune (p < 0.001). There was no difference in prevalence of microbleeds (13.6% versus 6.7%). Median WMH-volume was 1.9 ml (IQR 0.6–4.6) for patients and 0.34 ml (IQR 0.03–1.2) for controls, which differed significantly after adjustment for hypertension, DM, age and sex (p < 0.001). In the young TIA and stroke group, age (β = 0.19, p = 0.001), smoking (β = 0.19, p < 0.001), DM (β = 0.13, p = 0.023) and systolic blood pressure (β = 0.18 per mmHG, p = 0.002) were independently associated with WMH-volume, adjusted for sex.

**Conclusion:** Patients with a young stroke have a higher prevalence of SVD than control subjects. This might give us more insight in pathophysiological mechanisms of the development of SVD.

### ESOC-1450

#### 23. Small Vessel Disease

##### Absence of cortical superficial siderosis in CADASIL

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Cortical superficial siderosis (cSS) recently emerged as a novel neuroimaging marker for cerebral amyloid angiopathy (CAA). CAA patients with cSS are at much higher risk of intracranial hemorrhage, indicating a high clinical relevance. However, there are other known causes of cSS such as reversible cerebral vasoconstriction syndrome or vasculitis, and therefore the specificity of cSS as a marker for CAA remains unclear. In particular, it is not known whether severe non-amyloidogenic small vessel disease (SVD) can also present with cSS.

We therefore investigated the prevalence of cSS in cerebral autosomal-dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL), a hereditary non-amyloidogenic SVD with early-onset and severe clinical manifestation. 367 CADASIL patients were drawn from a two-center cohort study. As a control group, we included elderly subjects from population-based study (Austrian Stroke Prevention Study, n = 372). Ethics committees approved the study and written informed consent was obtained from every subject. We studied the pattern of SVD-related lesions, in particular hemorrhagic manifestations: cSS and cerebral microbleeds on T2-star-weighted gradient echo images.

The amount of white matter hyperintensities and lacunes confirmed the presence of severe SVD in the CADASIL group. Similar to CAA, we found a significant number of lobar cerebral microbleeds in CADASIL patients. Importantly, cSS was absent in CADASIL, indicating a prevalence below 0.3% (population-based sample: 0.8%).

Our results suggest that cSS is not part of the neuroimaging spectrum of severe non-amyloidogenic SVD. The presence of cSS together with other signs of SVD should therefore be regarded as highly suspicious for CAA.

## ESOC-0404

## 23. Small Vessel Disease

## Use of blood oxygen level dependent MRI to assess cerebrovascular reactivity in cerebral small vessel disease: A systematic review

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**Introduction:** The pathophysiology of cerebral small vessel disease (SVD) is poorly understood. Cerebrovascular reactivity (CVR) impairment may play a role, but evidence for this is indirect. Blood oxygen level dependent (BOLD) MRI can investigate CVR directly in tissues affected by SVD. We performed a systematic review to assess data on its use in SVD.

**Method:** We searched MEDLINE and EMBASE for articles assessing CVR using BOLD MRI in humans with SVD published between 1990 and September 2014. We extracted data from relevant articles on patient and control demographics, study quality, methods, technical factors and results using standardized forms.

**Results:** Of 263 potentially relevant articles, 3 provided data on CVR using BOLD MRI in patients with SVD (total n=71). Reporting of patient and control demographics was incomplete, the MR protocol varied significantly, each study used different stimuli and method of calculating CVR, only one study reported safety and tolerability and did so only partially. CVR decreased with age in two studies, was lower in females than males and with increasing diastolic blood pressure in another study. Each study reported CVR impairment associated with at least one imaging feature of SVD, but not with others and did not mention adjustment for other factors known to affect CVR.

**Conclusion:** Despite the perception that CVR declines in SVD, little objective evidence exists to support or quantify SVD-specific changes in CVR, there is considerable variation in methodology, and inadequate controlling for potentially confounding factors. CVR changes in SVD requires considerable clarification in larger, well-controlled studies.

## ESOC-1443

## 23. Small Vessel Disease

## Cerebral hemodynamics in patients with large vessel disease stroke and lacunar stroke

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**Background:** Large vessel disease stroke(LVDS) and lacunar stroke(LS) are two different subtypes of ischemic stroke. They have a different risk factor profile, outcome and etiopathological cause with atherosclerosis being more important in LVDS and hypertension in LS. It is not clear whether cerebral blood flow dynamics are different in both subtypes. We studied the cerebral blood flow patterns in patients with LVDS and LS.

**Methods:** Transcranial Doppler(TCD) was performed on 47 patients with LVDS(33 males, age 67 ± 10 yrs) and 43 patients with LS (33 males, age68 ± 9 yrs) within 3 months of diagnosis. All patients underwent CT/MRI head to confirm the stroke subtype. Cerebral blood flow parameters (Peak systolic(PSV), End diastolic(EDV) and Mean flow velocities (MSF)) and cerebral vascular resistance parameters(Pulsatility index(PI), Resistive index(RI) and Adjusted Cerebral Resistance Index-(ACRI = MAP/MFV)) of the middle cerebral arteries were obtained.

**Results:** Patients with LS had a higher prevalence of hypertension, drank more alcohol and had a larger waist compared to LVD stroke. There was no difference in MFV (49(95% CI 45–50) vs. 49(46–52), p = 0.38) and no

difference in cerebral PI and RI between LVDS and LS patients (p = 0.6). ACRI was higher in LS patients compared to LVDS patients (2.1 (95% CI 2–2.2) vs. 1.9 (95% CI 1.8–2), p = 0.02).

**Discussion:** We demonstrated a higher ACRI in patients with LS compared to LVDS. Given this increased resistance one would expect a higher cerebral blood flow in LS in order to maintain cerebral perfusion; however cerebral flow velocities were similar in LVDS and LS. This may support the notion of a state of chronic cerebral hypoperfusion in patients with LS.

## ESOC-1191

## 23. Small Vessel Disease

## APOE ε2 increases white matter hyperintensity burden in pure small vessel disease

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Cerebral small vessel disease (SVD) is the most common cause of vascular cognitive impairment, with white matter hyperintensities (WMH) being one of its neuroimaging hallmarks. A strong genetic contribution to WMH has been demonstrated, and an association between *APOE* and increased WMH volumes (WMHV) was established. However, this association was found mostly in the elderly population and might be explained by the co-occurrence of other *APOE* related diseases, like Alzheimer's disease (AD) and cerebral amyloid angiopathy (CAA).

In order to decrease the likelihood of concomitant age-related diseases, we studied Cerebral Autosomal Dominant Arteriopathy with Subcortical Infarcts and Leukoencephalopathy (CADASIL), an inherited, early-onset SVD. We recruited 488 CADASIL patients through an international, multicenter consortium. Median age was 51 years (inter-quartile range 44 to 60 years). Institutional Review Boards approved the study. Subjects signed written informed consent. WMH were segmented and corrected centrally by two raters (intraclass-correlation coefficient of 0.996). Regression analysis was used to determine the effect of *APOE* status on WMHV. Age, sex and hypertension were entered as covariates. In a second analysis, we also controlled for genetic background using principal components derived from a genome-wide set of 466 single nucleotide polymorphism markers.

Carriers of *APOE* ε2 ( $\beta = 0.031$ ,  $t = 2.4$ ,  $p = 0.0186$ ) but not *APOE* ε4 ( $\beta = 0.017$ ,  $t = 1.7$ ,  $p = 0.0902$ ) showed increased WMHV, compared to the reference genotype ε3/ε3. When further controlling for genetic background variation, the results remained largely unchanged. Our findings suggest a modifying influence of *APOE* ε2 on WMHV in pure SVD and motivate future studies investigating the underlying mechanisms.

## ESOC-0032

## 23. Small Vessel Disease

## Recurrent intracerebral hemorrhage in a young adult caused by COL4A2 mutation

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**Background:** Type IV collagen  $\alpha 1$  and  $\alpha 2$  chains form heterotrimers that constitute an essential component of basement membranes. Mutations in COL4A1, encoding the  $\alpha 1$  chain, cause porencephaly, bleeding prone cerebral small vessel disease (cSVD), intracranial aneurysms and variable abnormalities of the eyes, kidneys and muscles. Mutations in COL4A2 have recently been reported in a few porencephaly families, members of whom also harbored white matter abnormalities and intracranial aneurysms.

**Objective:** Herein, we report on a young adult patient with recurrent intracerebral hemorrhage, leukoencephalopathy, intracranial aneurysms, nephropathy and myopathy associated with a *de novo* COL4A2 mutation. **Methods:** We examined a 29-year-old male patient with recurrent intracerebral hemorrhages. Brain MRI, abdominal ultrasound, ophthalmological examination, laboratory tests (including biochemical, hematological, clotting, autoimmune and inflammatory studies, urine analysis) and molecular genetic analysis of COL4A1, COL4A2, PKD1 and PKD2 genes were performed. Several family members have also been investigated.

**Results:** MRI showed deep ICHs of different age, multiple cerebral microbleeds, diffuse leukoencephalopathy and small carotid siphon aneurysms. Laboratory workup revealed microscopic hematuria and elevated CK. Autoimmune, inflammatory and hemostasis studies were normal. Genetic testing found a novel glycine mutation within the COL4A2 triple helical domain (c.2821G > A, p.G941R) not present in parents and other family members without this phenotype.

**Conclusions:** This study reports the first COL4A2 mutated adult patient with a phenotype very close to the spectrum of manifestations in COL4A1 mutations, and emphasizes the importance of screening both COL4A1 and COL4A2 in patients showing recurrent ICH of unknown etiology particularly if associated with leukoencephalopathy.

## ESOC-1048

## 23. Small Vessel Disease

## Amyloid spells related to cortical siderosis misdiagnosed as TIA

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**Background:** Cortical superficial siderosis (CSS) is related to cerebral amyloid angiopathy (CAA), and increases the risk of symptomatic intracerebral hemorrhage (ICH). The clinical presentation as amyloid spells can be confused with transient ischemic attacks (TIA) and antithrombotic agents are not indicated. We analyzed the frequency of CSS in patients with suspected TIA.

**Methods:** We conducted a retrospective review of consecutive patients diagnosed with TIA at our center. All patients underwent MRI study, including T2\*gradient-recalled echo sequences. We collected the following variables: demographics (age, sex), relevant medical history (head trauma, brain surgery, etc), clinical features of the episodes (positive/negative symptoms, duration, recurrence) and MRI data (CSS, micro-

leeds, acute/chronic ischemic lesions). We used bivariate analyses to compare patients with CSS (CSS+) and without CSS (CSS-).

**Results:** We included 160 patients (age  $71.5 \pm 11.7$  years), 48% were men. Thirty-eight (23.8%) patients had prior stroke/TIA, 4 (2.5%) previous ICH, 3 (1.9%) severe head trauma, and 2 (1.3%) brain surgery. 81 patients (51%) were on antithrombotic therapy at TIA onset. CSS was detected in 10 (6.3%) patients, that was focal in 9 and disseminated in 1. Also, acute ischemic stroke in DWI sequences were found in 9 (5.6%) patients, while old vascular lesions were observed in 29 (18.1%).

We did not observe differences between groups (CSS+ vs CSS-) regarding demographics, medical history, antithrombotic therapy, presence of acute/chronic ischemic lesions, or clinical features of episodes.

**Conclusions:** In our cohort, CSS is present in 6.3% of patients initially diagnosed as TIA. Further studies are needed to better define the clinical characteristics of these patients that will help to select which patient needs antithrombotic therapy for secondary prevention.

## ESOC-0703

## 23. Small Vessel Disease

## Arterial spin labeling MRI in CADASIL: Impaired cerebrovascular reactivity is associated with an increased number of lacunes

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**Objectives:** Radiological manifestations of CADASIL such as white matter hyperintensities (WMH) are well defined, but offer limited insight into natural history and progression. We aimed to examine cerebral blood flow (CBF) and cerebrovascular reactivity (CVR) in CADASIL using arterial spin labeling (ASL) MRI and a hypercapnic challenge, as a first step in investigating them as potential biomarkers of disease progression.

**Methods:** Subjects underwent standard brain MRI plus normocapnic and hypercapnic ASL. Region of interest and segmented tissue analysis of CBF and CVR was performed. The normalized volume of lacunes and WMH were calculated. Subjects were categorized into those with 0–4 or  $\geq 5$  lacunes. Neuropsychological testing was performed in all subjects with test results normalized and grouped into cognitive domains.

**Results:** We investigated 22 CADASIL patients (median age 53). CBF in grey matter ( $58 \text{ ml}/100\text{g}/\text{min} \pm 12$ ), normal appearing white matter ( $26 \pm 5$ ) and WMH ( $19 \pm 4$ ) were significantly different. Age did not correlate with CBF, CVR or neuropsychological tests. Subjects with  $\geq 5$  lacunes had lower CVR in NAWM ( $14\% \pm 9 \text{ v } 3\% \pm 4$ ) and WMH ( $13\% \pm 8 \text{ v } 3\% \pm 3$ ). Lacune count and volume correlated with executive function and processing speed but not other neuropsychological indices.

**Conclusions:** ASL offers non-invasive insight into cerebral hemodynamics in CADASIL. Impaired CVR is associated with increased lacunes, which are in turn associated with impaired executive function. If impairment of CVR precedes the development of lacunes, it has potential as a biomarker for disease progression which warrants investigation in longitudinal studies.

## ESOC-0826

## 23. Small Vessel Disease

## Dimensions of lacunar infarcts associated with the lenticular artery territory in CADASIL

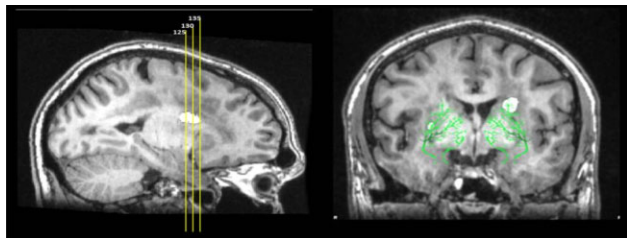
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**Objectives:** Axial diameter is proposed to define lacunar infarcts and suggest etiology, but the size of artery involved is more relevant when investigating disease mechanisms. CADASIL, an inherited vasculopathy, is proposed as a model for sporadic small vessel disease. We studied basal ganglia infarcts in CADASIL using MRI with overlaid microangiographic templates, to determine their relationship to arterial branching order.

**Methods:** Infarcts identified by seed-based thresholding on T1-weighted scans were registered to a standard brain template. Microangiographic templates of the lenticulostriate arteries (LSA) were overlaid onto coronal slices and 4 raters estimated the branching order of arteries related to the infarct (Fig.). Lacunar infarct dimensions and volume were measured.

**Results:** 22 CADASIL patients (median age 53) underwent MRI. None had hypertension, AF, carotid disease or diabetes. Ten had one or more infarcts in LSA territory, with 13 infarcts suitable for analysis. Three were associated with secondary branches (coronal height 14 mm  $\pm$  3, volume 0.48 ml  $\pm$  0.16), and 10 with tertiary branches (height 5 mm  $\pm$  2, volume 0.04 ml  $\pm$  0.04). The groups were significantly different in all dimensions.

**Conclusions:** Basal ganglia lacunar infarcts in CADASIL were predominantly small and associated with tertiary branch lenticulostriate arteries. This observation is consistent with lacunar infarct dimensions providing insight into stroke etiology. Replication in non-CADASIL sporadic small vessel disease would further strengthen the findings.



## ESOC-1201

## 23. Small Vessel Disease

## Depressive symptoms in cerebral small vessel disease are associated with white matter microstructural damage: The VMCI-TUSCANY Study

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**Background and purpose:** It has been suggested that disruption of cortical-subcortical circuits related to small vessel disease (SVD) may predispose to depression. Our objective was to determine the independent association between white matter (WM) microstructural damage, evaluated with diffusion tensor imaging (DTI), and depressive symptoms in a cohort of elderly subjects with mild cognitive impairment (MCI) and SVD.

**Methods:** The VMCI Tuscany study is an observational multicentric longitudinal ongoing study that enrolled patients with MCI (Winblad *et al.* criteria) and moderate to severe degrees of WM hyperintensities on MRI. Lacunar infarcts, cortical atrophy, medial temporal lobe atrophy, microbleeds and DTI derived-indices (mean diffusivity, MD and fractional anisotropy, FA) were evaluated on baseline MRI. Geriatric depression scale (GDS) (score 0–15) was used to assess depressive symptoms. An extensive neuropsychological battery, instrumental activities of daily living scale, and short physical performance battery were used for cognitive, functional and motor assessments, respectively.

**Results:** Seventy-six patients (mean age: 75.1  $\pm$  6.8) were included. Univariate analyses showed a significant association between GDS score and both DTI derived-indices (MD:  $r = 0.366$ ,  $p = 0.002$ ; FA:  $r = -0.258$ ;  $p = 0.031$ ). The significant association remained after adjustment for age, WM hyperintensities severity, global cognitive, functional and motor performances, and antidepressant therapy (MD:  $r = 0.307$ ,  $p = 0.007$ ; FA:  $r = -0.245$ ;  $p = 0.033$ ).

**Conclusions:** These results confirm the presence of an association between WM microstructural damage and depressive symptoms in our cohort of MCI patients with SVD. This relationship does not seem to be mediated by disability, cognitive, and motor impairment, thus supporting the vascular depression hypothesis.

## ESOC-0532

## 23. Small Vessel Disease

**White matter hyperintensities may be related to brain swelling in early cerebral small vessel disease**R Peres<sup>1</sup>, R Schmidt<sup>2</sup>, S Ropele<sup>2</sup>, L Pirpamer<sup>2</sup>, E Hofer<sup>2</sup>, F De Guio<sup>1</sup>, E Duchesnay<sup>3</sup>, M Duering<sup>4</sup>, M Dichgans<sup>4</sup>, H Chabriat<sup>1</sup>, E Jouvent<sup>1</sup><sup>1</sup>INSERM 1161, Paris Diderot University, Paris, France<sup>2</sup>Department of Neurology, Medical University of Graz, Graz, Austria<sup>3</sup>LNAO, Neurospin CEA, Saclay, France<sup>4</sup>Institute for Stroke and Dementia Research, Ludwig-Maximilians University, Munich, Germany

**Objectives:** Experimental data suggest that white matter edema without structural loss may be involved in the early development of white matter hyperintensities (WMH) in cerebral small vessel disease (SVD). To test this hypothesis in vivo with MRI, the relationships between brain volume and WMH volume (WMHV) were analyzed in a large cohort of healthy subjects.

**Methods:** 302 healthy individuals from the ASPS family study were included. Volumes of whole brain parenchyma, of white matter, of cortical gray matter, and of WMH were determined using validated methods. Sulcal depth and width were obtained as another independent marker of brain morphology. Associations between brain volumes or sulcal depth and width with WMHV were tested after adjustment for age, gender, presence of lacunar lesions and intracranial cavity volume.

**Results:** Mean age was  $64.3 \pm 10.6$  years. Whole brain volume was positively related to WMHV ( $\beta = 0.74$ , s.e. = 0.32,  $p = 0.02$ ). White matter volume was positively related to WMHV with a trend towards significance ( $\beta = 0.47$ , s.e. = 0.26,  $p = 0.06$ ). Sulcal depth was also positively related to WMHV ( $\beta = 1.5 \cdot 10^{-5}$ , s.e. =  $3.3 \cdot 10^{-6}$ ,  $p$

**Conclusion:** In middle-aged community dwelling subjects with moderate extent of WMH, WMHV are associated with larger brains and larger white matter volumes. Additionally, sulcal depth, by contrast to the effect of age, also increases with WMHV. Our results support the hypothesis that the early development of WMH in SVD is related to white matter edema without structural loss.

## ESOC-1279

## 23. Small Vessel Disease

**Peripheral vasoreactivity in CADASIL (cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy)**F Pescini<sup>1</sup>, V Rinnoci<sup>2</sup>, I Donnini<sup>2</sup>, R Valenti<sup>2</sup>, E Adriano<sup>3</sup>, B Bertaccini<sup>4</sup>, A Carluccio<sup>5</sup>, R Mazzei<sup>6</sup>, M T Dotti<sup>5</sup>, M Balestrino<sup>3</sup>, L Pantoni<sup>1</sup><sup>1</sup>Cardio-Thoracic and Vascular Department, Stroke and Neurology Unit Azienda Ospedaliero-Universitaria Careggi, Florence, Italy<sup>2</sup>NEUROFARBA Department Neurosciences Section, University of Florence, Florence, Italy<sup>3</sup>Department of Neuroscience Ophthalmology and Genetics, University of Genoa, Genoa, Italy<sup>4</sup>Department of Statistics "G. Parenti," University of Florence, Florence, Italy<sup>5</sup>Department of Neurological Neurosurgical and Behavioural Sciences, University of Siena, Siena, Italy<sup>6</sup>Institute of Neurological Sciences National Research Council Cosenza, Institute of Neurological Sciences National Research Council Cosenza, Cosenza, Italy

**Background:** CADASIL is an inherited small vessel disease pathologically characterized by degeneration of vascular smooth muscle cells (VSMC). Data are arising about a possible role of endothelial dysfunction in

modulating phenotype. Altered vasoreactivity has been proposed as a possible pathogenic mechanism.

**Methods:** We assessed vasoreactive response to hyperemia in CADASIL patients with respect to controls by non invasive pletismographic method of pulse arterial volume at the fingertips (EndoPAT2000, Itamar, Israel). The ratio between the average post-occlusion and baseline signal amplitude (PAT score) was assumed as RH index (RHI). A cut-off 1.67 was used to define abnormal RHI values. Normalized augmentation index (NAI), measuring arterial elasticity, and PAT score after administration of nitroglycerin (NVI), an endothelium-independent vasodilatation index, were also assessed.

**Results:** We enrolled 74 consecutive CADASIL pts and 55 age and sex-matched controls among patients' partners. Mean RHI was  $2.050 \pm 0.70$  in CADASIL pts and  $2.128 \pm 0.55$  in controls ( $p = 0.50$ ). RHI was more frequently abnormal in CADASIL pts than controls (37.3 vs 18.2%,  $p = 0.019$ ). Mean NAI was significantly higher in CADASIL pts ( $14.66 \pm 15.4$  vs  $6.25 \pm 15.3$ ;  $p = 0.003$ ), while mean NVI was almost the same ( $1.59 \pm 1.08$  vs  $1.45 \pm 0.59$ , respectively in CADASIL pts and controls;  $p = 0.415$ ). The differences remained significant in multivariate logistic regression models adjusting for age, hypercholesterolemia, hypertension, diabetes, statins and antiaggregants use.

**Conclusion:** Our findings support the presence of functional alterations in endothelium and other vascular components in CADASIL patients. These alterations could be a consequence of both the mutation and the co-existing vascular risk factors.

## ESOC-1129

## 23. Small Vessel Disease

**Impairment of ubiquitin-mediated proteolysis in cerebral small vessel disease**M F Ritz<sup>1</sup>, S Engelter<sup>2</sup>, M Tolnay<sup>3</sup>, P Lyrer<sup>2</sup>, N Peters<sup>2</sup><sup>1</sup>Department of Biomedicine, University of Basel, Basel, Switzerland<sup>2</sup>Neurology, University Hospital Basel, Basel, Switzerland<sup>3</sup>Pathology, University Hospital Basel, Basel, Switzerland

**Objective:** Both, sporadic and hereditary cerebral small vessel disease (SVD) lead to vascular cognitive impairment (VCI) and subcortical ischemic vascular dementia. To date, the mechanisms linking SVD and neuronal damage, eventually leading to VCI are incompletely understood.

**Methods:** Aim of this project was to further elucidate the molecular mechanisms underlying neuronal damage in SVD. We compared gene expression in snap-frozen post-mortem brain specimens from the frontal and occipital cortex and white matter of 5 sporadic SVD and 2 CADASIL patients with samples from 5 non-neurologically affected controls, using oligonucleotide-based microarray technology (Affymetrix® Genechips). Gene annotation and statistical analysis were performed using Partek® Genomics Suite. Genes with fold expression changes  $F > 1.2$  in both directions ( $P < 0.05$ ) were considered differently expressed between diseased and control groups. Biological functions enriched with these up- and down-regulated genes were identified using DAVID® bioinformatics resources.

**Results:** Functional classification revealed various cellular pathways affected in sporadic and hereditary SVD. One interesting common pathway involving many under-expressed genes in several brain regions was ubiquitin-mediated proteolysis. We confirmed these results by immunohistochemistry on brains sections, showing accumulation of mono- and poly-ubiquitinated proteins, such as p62 or P-Tau.

**Conclusions:** Our findings emphasize that, on a molecular level, besides ischemia, SVD follows patterns of neurodegeneration with deregulation of the ubiquitin-mediated proteolysis, inducing formation of protein aggregates. This suggests that the ubiquitin proteasome system plays a potential role in neuronal damage in SVD and may thus represent a possible therapeutic target in subjects with VCI related to SVD.

## ESOC-1306

## 23. Small Vessel Disease

## Cerebral microbleeds and late-life depressive symptoms in the Framingham Heart Study

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**Background:** The 'vascular depression' hypothesis dictates that disruption of cerebral circuits secondary to cerebrovascular lesions drives the occurrence/progression of late-life depressive symptoms (DS). We aimed to assess the relationship between cerebral microvascular lesions, in particular cerebral microbleeds (CMBs), and late-life DS in a community-dwelling population.

**Methods:** We evaluated stroke and dementia-free Framingham Offspring Cohort participants who underwent brain MRI allowing for CMB detection and assessment for DS with the Center for Epidemiological Studies Depression Scale (CES-D). MRI markers of interest were covert brain infarcts (CBIs), extensive white matter hyperintensity volume (eWMHV), and CMB presence, as well as CMB count ( $\geq 2$  vs. 1) and topography (strictly lobar, deep or mixed). Presence of DS was defined as a CES-D score  $\geq 16$  and/or antidepressant medication use.

**Results:** In 1598 participants (mean age: 65), 320 (20%) had DS. DS were more frequent in male participants ( $p < 0.001$ ), current smokers ( $p = 0.04$ ) and those with diabetes ( $p < 0.01$ ). In multivariable logistic regression adjusting for vascular risk factors (including sex, diabetes mellitus, and current smoking), mixed CMBs were associated with DS (OR 4.03, 95% CI 1.35–12.05). The association remained robust after additionally adjusting for CBIs and eWMHV. There was no notable association between DS and other CMB topographic patterns, CBIs or eWMHV.

**Conclusion:** In the community, late-life DS is associated with vascular risk factors and mixed CMBs. Our cross-sectional study cannot establish causality or direction of effect, but supports the 'vascular depression' hypothesis that diffuse disruption of cortico-subcortical networks by microvascular lesions may potentiate late-life DS.

## ESOC-0071

## 23. Small Vessel Disease

## Severe cerebral white matter lesions in ischemic stroke patients are associated with less time spent at home and early institutionalization

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**Background and purpose:** Cerebral white matter lesions (WMLs) are a surrogate for cerebral small-vessel disease. These WMLs are associated with increased morbidity and mortality in both the general population and ischemic stroke patients. We aimed to investigate whether severe WMLs in a cohort of ischemic stroke patients are associated with fewer days spent at home and earlier permanent institutionalization.

**Methods:** We included 391 consecutive patients aged 55 to 85 years with ischemic stroke admitted to the Helsinki University Central Hospital (The SAM cohort) with a 12-year follow-up. Hospitalization and nursing home admissions were reviewed from national registers.

WMLs were rated using MRI performed 3 months post-stroke, dichotomized as none-to-moderate and severe. Kaplan-Meier plots log-rank and binary logistic regression (odds ratio, OR) and Cox multivariable proportional hazards model were used to study the association of WMLs with days spent at home and the time of permanent institutionalization. HR and OR with their 95% confidence intervals (CI) are reported.

**Results:** Severe WMLs were associated with fewer days spent at home, more frequent, and earlier permanent institutionalization (1487 versus 2354 days; log-rank  $p < 0.001$ ).

After adjusting for significant covariates from univariable analyses, severe WMLs were associated with fewer days spent at home (OR 1.78; CI 1.13–2.80), permanent institutionalization within 5 years (OR 2.61; CI 1.54–4.42), and increased hazards ratio of permanent institutionalization during 12 years of follow-up (1.41; CI 1.10–1.81).

**Conclusions:** After ischemic stroke, patients with severe WMLs spend fewer days at home and become earlier permanently institutionalized, especially within the first 5 years.

## ESOC-0558

## 23. Small Vessel Disease

## A re-evaluation of the lacunar concept through perfusion imaging

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**Background:** Lacunar infarct is postulated to be the result of intrinsic small vessel disease based on early clinico-pathological works from the 1960s. Based on this mechanism, we hypothesized that hyperacute lacunar infarcts should not have perfusion deficits or vessel occlusions. The aim of this study is to compare the perfusion and vessel status between subcortical and cortical strokes in the hyperacute phase.

**Method:** Patients undergoing CT Perfusion/angiography within 6 hours of symptom onset and follow-up MRI for ischemic stroke were included (2009–2013). Perfusion deficit was defined from mean transit time map; and MRI for infarct topography and dimensions. Lacunar infarct on MRI was defined as single subcortical infarct  $< 20$  mm. Vascular risk factors and other patient characteristics were obtained from medical records.

**Results:** Two hundred and ninety-two patients were included (mean age  $66.4 \pm 15.3$  years, 66% male); follow-up MRI occurred at median 15 days post symptom onset (IQR 5.0–34.8 days). Lacunar infarct occurred in 31 (17%) of 182 patients. Approximately 40% ( $n = 12/31$ ) of patients with lacunar infarct had a perfusion deficit. The smallest lacunar infarct dimension with a perfusion deficit had diameter  $\leq 5$  mm. Large artery occlusion was present in 6 of these 12 patients.

**Conclusion:** A small subcortical stroke at outcome MRI may be associated with perfusion deficits and relevant vessel occlusion in the hyperacute phase. The assignment of 'lacunar' or intrinsic small vessel disease mechanism requires evaluation of the acute CTP to avoid misclassifying cases of embolic occlusion.



## ESOC-0782

## 23. Small Vessel Disease

## Associations between structural network connectivity, gait and cognition in small vessel disease

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Cerebral small vessel disease (SVD), including white matter hyperintensities (WMH) and lacunes of presumed vascular origin, affects gait by disrupting important white matter tracks. However, little is known about the relationship between the structural network connectivity and gait in subjects with cerebral SVD, and the interaction with cognitive function. We assessed gait characteristics (stride length, cadence and stride width, as well as Tinetti and Timed-Up-and-Go test) of 423 subjects with cerebral SVD. The structural network was constructed using diffusion tensor imaging and tractography. We applied graph-theory to calculate network efficiency from the undirected weighted network. Associations between network measures, conventional MRI markers for SVD, gait performances and cognitive index as global cognitive function were tested. Network measures were associated with conventional MRI markers for SVD (WMH and lacunes) and with gait performances. Stride length, Tinetti and Timed-Up-and-Go test were associated with network measures, independent of WMH or lacunes. However, after adjusting for cognitive index, these associations diminished and were not significant anymore. In the mediation analyses, cognitive index mediated the association between global efficiency and stride length, Tinetti and Timed-Up-and-go test. Regional analysis showed widespread involvement of cortical regions in gait performance, including frontal motor, cingulate and visuospatial regions, which diminished after adjusting for cognitive index. These results suggest that measures for network disruption were associated with gait performance, possibly indirectly by disrupting brain network responsible for cognitive function and hereby impairing gait performance.

## ESOC-0363

## 23. Small Vessel Disease

## Predictors of mortality in cerebral small vessel disease patients: The RUN DMC Study

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**Background:** Information about life expectancy is very important in medical decision making. Recent attention has been drawn to gait speed, cognitive function and diverse cerebral imaging parameters as reliable and easily obtainable markers of mortality. However, prediction models com-

binning these different markers are currently lacking and these markers have never been investigated in specific groups of elderly, including older adults with cerebral small vessel disease (SVD).

**Objective:** to investigate the relationship between clinical and imaging parameters and all-cause mortality in elderly with SVD.

**Methods:** 503 independently living elderly participants with SVD on MRI were included (2006). Vital status and cause of death were collected through November, 2014. Cox regression analysis was used to identify baseline clinical and imaging predictors of all-cause mortality, adjusted for age, sex and vascular risk factors. Prediction models of all-cause mortality were constructed to study which parameters were most predictive.

**Results:** 80 participants died. Mean follow-up duration was 7.8 years and cumulative 7.5-year risk of mortality was 13.2%. In the prediction of all-cause mortality, gait speed (HR1.13 per 0.1 m/s slower gait, 95% CI:1.04–1.22), gray matter volume (HR0.75 per standard deviation (SD) increase, 95% CI:0.56–0.99) and structural integrity of the white matter, assessed by diffusion tensor imaging using mean diffusivity (HR1.53 per SD increase, 95% CI:1.19–1.96) had the best predictive ability, next to age, sex and vascular risk factors.

**Conclusion:** Gait speed, gray matter volume and structural integrity of the white matter are the main predictors of mortality at 7.5-years follow-up in elderly with SVD and could possibly be targets for preventive interventions.

## ESOC-0630

## 23. Small Vessel Disease

## Decreased kidney function is associated with progression of cerebral microbleeds in lacunar stroke patients

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**Introduction:** Cross-sectional studies found impaired kidney function to be associated with the presence of cerebral microbleeds in stroke patients. It is hypothesized that both impaired kidney function and cerebral microbleeds represent small vessel disease in different organs. Our aim was to determine whether kidney function is related to progression of cerebral microbleeds to further confirm the association in a longitudinal study design.

**Methods:** In 117 lacunar stroke patients, in whom baseline brain MRI (including gradient echo images) and estimated glomerular filtration rate (eGFR) were available, we obtained a follow-up brain MRI after 2 years. eGFR was calculated using the Cockcroft-Gault equation. Presence of cerebral microbleeds on baseline and follow-up MRI was scored visually and progression of microbleeds was defined as the presence of any new microbleed on follow-up MRI. The relationship between progression of cerebral microbleeds (dependent variable) and eGFR (independent variable) was assessed by logistic regression analysis adjusting for age, sex and 24-hour ambulatory mean arterial pressure (MAP).

**Results:** Progression of cerebral microbleeds was present in 21 patients (17.9%). In binary logistic regression analysis lower eGFR was associated with progression of cerebral microbleeds (OR 1.37 per 10 ml/min/1.73 m<sup>2</sup>, 95% CI 1.03–1.82, with correction for age, sex and MAP).

**Conclusion:** We found an association between lower eGFR and progression of cerebral microbleeds. Cerebral microbleeds and chronic kidney disease are both seen as manifestations of microvascular organ damage and our findings support the assumption that small vessel disease should be considered as a multi-system disorder.

## ESOC-0301

## 23. Small Vessel Disease

## Plasma markers of inflammation, endothelial function and hemostasis in cerebral small vessel disease

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**Background and purpose:** The cause of cerebral small vessel disease is unknown. Inflammation and endothelial dysfunction have been implicated. Plasma biomarkers could provide mechanistic insights but current data are conflicting. Imaging biomarkers such as white matter hyperintensities (WMH) are common. It is unknown if plasma biomarkers add predictive capacity beyond age and vascular risk factors in explaining WMH.

**Methods:** We prospectively recruited patients presenting with mild ischemic stroke, classifying them clinically and with magnetic resonance imaging as lacunar or cortical. We measured biomarkers of inflammation, endothelial dysfunction and hemostasis and compared biomarker levels between stroke subtypes. We quantitatively calculated WMH. We used multiple linear regression to model WMH as a function of age, sex, hypertension and smoking (the baseline model). We fitted exploratory models using plasma biomarkers as predictor variables to assess model improvement over baseline.

**Results:** We recruited 125 patients. The lacunar group (n = 65) had lower t-PA levels in unadjusted (7.39 v 8.59 ng/mL, p = 0.029) and adjusted (p = 0.031) analyses compared with the cortical group (n = 60). There were no significant differences in the other plasma biomarkers. The baseline regression model explained 29% of the variance in quantitative WMH (R<sup>2</sup> 0.289). Inflammatory biomarkers showed minor improvement over baseline (R<sup>2</sup> 0.291) but the other plasma biomarkers did not improve the baseline model.

**Conclusion:** t-PA is lower in lacunar stroke compared with mild cortical stroke, independent of age, sex and risk factors. Inflammatory biomarkers explain WMH beyond age and risk factors, but model improvement is somewhat minor.

## ESOC-0385

## 23. Small Vessel Disease

## Intravoxel incoherent motion MR imaging reveals abnormal parenchyma and microvasculature in cerebral small vessel disease

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**Introduction:** Cerebral small vessel disease (cSVD) is an age and vascular risk factor related microvascular disease. The pathophysiology of cSVD remains to be elucidated. Previous MRI studies have showed that early changes in cSVD include microstructural alterations in the normal appearing white matter (NAWM) and a possible association with hypoperfusion. However, no distinction between the contributions of parenchymal or vascular microstructure could be made, leaving the more precise nature of the damage undetermined. To examine both the parenchymal microstructure and microvasculature, we performed intravoxel incoherent motion (IVIM) diffusion MRI.

**Methods:** Sixty-five cSVD patients (age 68 ± 11 y) and thirty-five healthy controls (age 69 ± 12 y) underwent IVIM imaging (3.0T MRI). The IVIM measures *f* (perfusion fraction), *D* (parenchymal diffusivity), *D*\* (intra-vascular diffusivity) and the perfusion-related measure *fD*\* were calculated using a diffusion model in the NAWM, deep gray matter (DGM), cortex and white matter hyperintensities (WMH).

**Results:** For patients a larger *f* and *D* were found than controls (p*D*\* and *fD*\* or other regions).

**Discussion and conclusion:** In contrast to previous studies, no signs of hypoperfusion were found for these patients. Instead, we found a larger blood volume (*f*), suggesting alterations in microvasculature, which may be due to vasodilative responses or increased tortuosity. The observed higher *D* may imply degeneration of parenchymal microstructure and can provide evidence of early parenchymal changes preceding WMH formation. We demonstrated that IVIM imaging can provide novel pathophysiological information of the normal appearing brain tissue in patients with cSVD.

## ESOC-0474

## 23. Small Vessel Disease

## The concept of "total small vessel disease score" in healthy adults: Validation in the Kashima Scan Study

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**Background:** Recently, the concept of total small vessel disease (SVD) score, composed of four major MRI makers of SVD, has been proposed as a comprehensive index of SVD severity in the brain. However, little is known about the construct validity of this score in healthy populations.

**Methods:** We analyzed baseline data of an ongoing Japanese population-based study. Lacunes, cerebral microbleeds, periventricular and white matter hyperintensities, and perivascular spaces in basal ganglia were rated independently on appropriate MRI sequences. The presence of each SVD feature was summed in an ordinal "total SVD score" (range 0–4). The associations with vascular risk factors, %cerebral parenchyma (an index of cerebral atrophy = [cerebral parenchyma area / intracranial space] x 100), and global cognitive function (MMSE) were investigated.

**Results:** We included 1451 neurologically healthy adults (mean age ± standard deviation [SD] 57.1 ± 9.7, 47% male). In multivariable ordinal regression analyses, age (per 10 years increase) (OR 1.56, 95% CI 1.32–1.85), hypertension (OR 2.44, 95% CI 1.91–3.12), diabetes mellitus (OR 1.56, 95% CI 1.09–2.24) and %cerebral parenchyma (OR 0.86, 95% CI 0.74–0.98) were significantly associated with the total SVD score. MMSE < 27 (OR 1.67, 95% CI 1.05–2.65) and MMSE < age-education related mean-1.5SD (OR 1.50, 95% CI 1.00–2.25) were associated with SVD score.

**Conclusions:** In a neurologically healthy cohort, the SVD score showed good correlation with vascular risk factors. Associations of SVD score with cerebral atrophy and global cognitive function provide additional construct validity. The total SVD score might be useful for future observational or interventional clinical studies of stroke or dementia prevention in SVD.

ESOC-0147

**23. Small Vessel Disease****Lower cerebral microvascular perfusion is associated with lower cognitive function in patients with cerebral small vessel disease**

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*Background:* Cerebral small vessel disease (cSVD) may cause vascular cognitive impairment. Earlier studies have shown that a decreased microvascular perfusion is associated with cSVD. It is unknown whether decreased microvascular perfusion is also associated with decreased cognitive function. Intravoxel Incoherent Motion (IVIM) imaging is a diffusion-based MRI technique designed to determine microstructural integrity and microvascular perfusion. The aim of the present study was to determine the relationship between microvascular perfusion and cognitive function in cSVD patients using IVIM.

*Methods:* Thirty-nine cSVD patients underwent IVIM imaging. The IVIM parameters  $D$  (parenchymal diffusivity),  $f$  (perfusion fraction),  $D^*$  (intravascular diffusivity) and the perfusion-related parameter  $fD^*$  were calculated using a two-compartment diffusion model. This was performed for the normal appearing white matter (NAWM), white matter hyperintensities (WMH), cortex and deep grey matter. All patients had an extensive neuropsychological assessment. The relationship between the IVIM parameters and cognition was examined, corrected for patient characteristics and WMH volumes.

*Results:* A lower  $fD^*$  in the NAWM and cortex is significantly associated with a lower score in overall cognitive function ( $p = 0.011$  resp  $p = 0.007$ ), executive function ( $p = 0.044$  resp  $p = 0.048$ ) and information processing speed ( $p = 0.045$  resp  $p = 0.027$ ), but not with memory. There were no significant associations between cognition and the other IVIM parameters.

*Conclusion:* Our findings suggest that a lower cognitive function is associated with a lower microvascular perfusion in the NAWM and cortex in patients with cSVD. Longitudinal studies are needed to examine the nature of this relationship and whether microvascular perfusion can be used to predict future cognitive decline.

## Vascular Cognitive Impairment

### ESOC-0758

#### 24. Vascular Cognitive Impairment

##### Baseline stroke symptoms as predictors of cognitive impairment after stroke

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**Background:** Post stroke cognitive impairment (PSCI) is a frequent complication of stroke, and is linked with development of dementia. We investigated the relationship between baseline stroke symptoms and presence of PSCI at 1 and 3 years after ischemic stroke.

**Methods:** Anonymized data were accessed from the Virtual International Stroke Trial Archive (VISTA). PSCI was defined as a Mini Mental State Examination (MMSE) score of  $\leq 26$  at 1 and 3 years after stroke. We conducted univariate analyses, assessing the relationship between baseline stroke symptoms, medical history and MMSE at 1 and 3 years following stroke, retaining the significant and relevant clinical factors as covariates in a final adjusted logistic regression model.

**Results:** Data were available for 2172 (Median age = 65, median OHS = 1) and 1324 patients (Median age = 65, median OHS = 1) at 1 and 3 years respectively, after stroke. At one year, presence of aphasia ( $p = 0.005$ , OR = 1.43; 95% CI = 1.12–2.83), and leg paralysis ( $p = 0.003$ , OR = 1.60; 95% CI = 1.17–2.17) at baseline were associated with MMSE  $\leq 26$ . At three years, presence of aphasia ( $p = 0.014$ , OR = 1.55; 95% CI = 1.09–2.21), and leg paralysis ( $p = 0.003$ ; OR = 1.69, 95% CI = 1.20–2.39) at baseline were associated with MMSE  $\leq 26$ .

**Conclusions:** Aphasia and leg weakness are known to affect up to 30% and 72% of stroke survivors respectively; our results suggest that these impairments are associated with the development of PSCI up to 3 years after stroke, as described by MMSE  $\leq 26$ . Further validation work is required using a robust PSCI measure; findings may help to identify those at risk to develop post-stroke cognitive impairment.

### ESOC-1537

#### 24. Vascular Cognitive Impairment

##### Overnight memory, attention, speech disruption: Disconnection syndromes

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**Introduction:** Small, single infarcts in thalamus can cause a clinical picture which is characterized by abrupt onset of confusion, impairment of attention and memory. The above may often be misdiagnosed as CNS inflammation.

**Case report:** A 63-year old woman with medical history of POEMS syndrome and autologous marrow transplant, hypertension, hyperlipidemia and mastectomy presented with sudden onset of higher mental functions disturbance less than 2 weeks prior to her admission.

The neurological examination revealed disorientation in space and time, profound memory and attention deficits (MMSE = 11/30 and MoCA = 6/30), speech disorder with difficulty in naming objects and no motor or sensory pathology.

Routine blood, immunology, viral and CSF testing were normal.

Brain MRI depicted T2 and FLAIR-hyperintense lesion in the anatomic area of left anterior thalamus that was not enhanced with contrast administration, congruous with a subacute ischemic vascular event.

On her follow-up a month later she re-appeared slightly improved (MMSE = 15/30 and MoCA = 6/30) and 3 months later her MMSE score was 22/30 and the patient was functional for basic activities of daily living. **Conclusion:** Frontotemporal cortices have extensive connections with ipsilateral anterior thalamic nuclei via the anterior and inferior thalamic peduncles which are formed by corticothalamic and thalamocortical fibres. Previous studies have confirmed that in the case of an infarct in the thalamus, the disruption of the thalamic projection fibers determines a functional deactivation of the ipsilateral frontal cortex (thalamocortical disconnection syndrome).

### ESOC-0380

#### 24. Vascular Cognitive Impairment

##### Hippocampal and entorhinal cortex atrophy in post-stroke patients with cognitive impairments

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The occurrence of a cognitive impairment after a stroke is a well known phenomenon that can affect about 30% of the patients. The aim of this work was to explore the potential cerebral alterations behind these impairments, by focusing on the hippocampus and entorhinal cortex according to the cognitive profile of patients after a stroke.

92 subjects free of dementia were scanned on 3T MR scanner (Achieva, Philips) 6 months after a stroke. Two groups were defined: 52 subjects with cognitive impairments at 6 months and 40 without. Hippocampus and entorhinal cortex were automatically segmented from 3D T1-weighted images using Freesurfer. Hippocampal volumes and entorhinal cortex surfaces were compared between groups. Furthermore, a shape analysis using SPHARM-PDM was done to assess potential focal alterations of the hippocampus. Statistical comparisons between groups were assessed using two-sample t-test corrected by age and gender. In shape analysis, p-values were adjusted by the FDR p-value adjustment procedure.

Shape analysis revealed a significant shrink of the left hippocampus ( $p < 0.05$ ), mainly in posterior part in subjects with cognitive impairments. However, this was not corroborated with a reduction of the left and right hippocampal volume ( $p = 0.19$ ). Furthermore, this alteration of the hippocampus integrity was associated with a significant reduction of the entorhinal cortex surface (left:  $p < 0.001$ , right:  $p < 0.05$ ).

Cognitive impairments following the stroke seem to be associated with alterations of the hippocampus and entorhinal cortex surface. Then, the next step is to follow these alterations and corroborate with a potential dementia that could further appear.

## ESOC-0644

## 24. Vascular Cognitive Impairment

## Acute confusional state and recovery in aged patient with vascular risk factors in neurology unit – A challenging etiology

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**Background:** The aim of this study was to evaluate the prevalence of ACS in neurological service, to describe the etiology, risk factors, investigation, possible recovery and ACS outcome.

**Method:** we reviewed the clinical data of 86 aged (>65, median age, 70 years) patients hospitalized in our neurological service (2 years long) for sudden confusional state, vascular risk factors (>2) and no preexisting cognitive decline history. Patients were diagnosed for ACS using DSM-IV criteria, “Confusion assessment method” and the Delirium Rating Scale with a cut off of 12. Also by clinical examination, brain computed tomography, vascular related blood tests, EEG, angio IRM in selected cases.

**Results:** we find 28(33%), hyperactive 40 (46%), hypoactive, and 18 (21%) mixed types of delirium and no correlation with the etiology. The final causes of ACS were: subarachnoid hemorrhage 8 cases (9%), non-dominant temporal lobe stroke 26 cases (30%), silent viral encephalitis 4 cases (5%), frontal lobe lacunars stroke 12 cases (14%), occipital ischemic stroke 18 cases (21%), dementia onset 6 cases (6%), metabolic disorders 4 cases (5%), bilateral thalamic small hemorrhage 4 cases (5%), silent urinary tract infection in women 4 cases (5%). 18 (21%) patients with no stroke etiology.

After 2 weeks the psychological outcome was good for 56 (65%), patients poor for 22 (25%) patients and partial recovery for 8 (10%) patients. In stroke etiology patients, thalamic and non dominant temporal lesions were poor recovery.

**Conclusions:** Acute confusional state etiology is always a challenging diagnosis in elderly even vascular risk factors is present.

## ESOC-0928

## 24. Vascular Cognitive Impairment

## Hippocampal volume early after stroke lower than controls

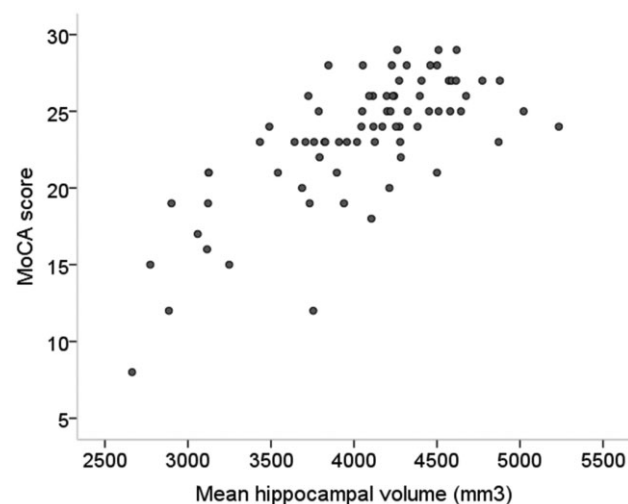
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**Background:** Structural brain volume is an important marker of neurodegeneration. Quantifying regional brain volume early after stroke allows us to establish a baseline for longitudinal change measurement.

**Methods:** The Cognition And Neocortical Volume After Stroke (CANVAS) study is an ongoing longitudinal investigation. Ischemic stroke patients without dementia are recruited and assessed within a month of stroke, and are compared to healthy age-matched controls. All participants undergo high-resolution 3T MPRAGE MRI to evaluate regional brain volume. Cognitive assessments include the Montreal Cognitive Assessment (MoCA), the Hopkins Verbal Learning Test-Revised (HVLT-R) and a test of working memory (CogState one-back task).

**Results:** We recruited 80 stroke patients (57 male, age  $67.3 \pm 12.9$  years, education  $13.0 \pm 3.8$  years; days post-stroke  $25.4 \pm 10.2$ ) and 30 controls (17 male, age  $68.8 \pm 7.6$  years, education  $15.0 \pm 5.0$  years). Adjusting for age and intracranial volume, regional analysis indicated smaller hippocampi ( $p = 0.025$ ) and amygdalae ( $p = 0.005$ ) in stroke patients than controls, but no difference in the thalami or caudate nuclei. In stroke patients, hippocampal volume was significantly correlated with MoCA

( $r = 0.72$ ,  $p < 0.001$ ; Fig. 1), HVLT-R immediate recall ( $r = 0.39$ ,  $p = 0.001$ ) and working memory ( $r = 0.36$ ,  $p = 0.002$ ).



**Fig. 1** Correlation between stroke patients' hippocampal volume and MoCA score.

**Conclusions:** Stroke patients have smaller-than-expected hippocampi and amygdalae early after stroke, and these differences have important implications for cognitive function.

## ESOC-0851

## 24. Vascular Cognitive Impairment

## The relationship between premorbid IQ, education level and post-stroke cognitive functioning in patients with mild stroke

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**Background:** Those with better cognitive functioning in childhood appear to be more likely to achieve a higher level of education and experience and fewer cognitive difficulties in older adulthood. More recent research has suggested that these early life variables may act as protective factors against cognitive dysfunction following neurological incidents including stroke. The purpose of this study was to examine the relationship between premorbid IQ, educational level and post-stroke cognitive functioning in patients with mild stroke.

**Methods:** Participants from the Mild Stroke Study completed measures of current cognitive functioning, including Addenbrooke's Cognitive Examination (ACE-R) and Montreal Cognitive Assessment (MoCA), at three to four years after ischemic stroke. Premorbid IQ was assessed using the National Adult Reading Test (NART) and socio-economic data were also collected.

**Results:** Amongst 89 participants (mean age 70.4, range 51–94), performance on the NART positively correlated with scores on both the ACE-R ( $r = 0.49$ ) and MoCA ( $r = 0.50$ , both at  $p < 0.001$ ). In addition, a logistic regression showed that those with further education beyond completion of secondary school were significantly less likely to have mild (ACE-R = 82–87) or severe (ACE-R < 82) cognitive impairment at three to four years post stroke than those with less education ( $b = -0.02$ ,  $p < 0.001$  and  $b = -0.17$ ,  $p < 0.001$  respectively). Similar trends were found on performance on the MoCA, however this did not reach statistical significance.

*Conclusions:* Higher performance on the NART late after stroke is related to both a higher education level and better post stroke cognitive functioning in patients with mild stroke.

## ESOC-0893

### 24. Vascular Cognitive Impairment Specific patterns of subcortical volume reduction in vascular cognitive impairment no dementia and vascular dementia

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*Introduction:* Subcortical volume reduction is conventionally considered a sensitive marker of neurodegeneration. However, its association with cerebrovascular disease, particularly in vascular cognitive impairment no dementia (VCIND) and vascular dementia (VaD) has not been explored previously.

*Methods:* A case-control study was performed, with cases (VCIND and VaD) recruited from memory clinics and controls from memory clinics and the community. All subjects underwent detailed neuropsychological assessment and 3T MRI. Subcortical volumes of the accumbens, amygdala, caudate, pallidum, putamen and thalamus were measured using FreeSurfer. VCIND was defined as impairment in at least one cognitive domain associated with a history of ischemic stroke and neuroimaging evidence of infarct. VaD was diagnosed using the NINDS-AIREN criteria. Logistic regression models were constructed for age2 initially and subsequently for gender and hypertension.

*Results:* A total of 90 controls (mean age:67.6 years), 64 VCIND (mean age:68.2 years) and 22 VaD (mean age:72.1 years) were included. In multivariate adjusted models, smaller volumes of accumbens, amygdala, pallidum, putamen and thalamus were significantly associated with VCIND compared to controls. In VaD, significant reduction was observed in the volumes of accumbens [OR:3.67; 95% CI (1.68–7.99)], pallidum [OR:4.29; 95% CI (1.78–10.33)] and putamen [OR:2.26; 95% CI (1.27–3.99)].

*Conclusion:* These findings suggest that the amygdala and thalamus have reduced volume in the early stages of vascular cognitive impairment whereas the accumbens, pallidum and putamen are more severely affected by volume reductions in the later stages of vascular cognitive impairment. The mechanisms underlying this specific pattern of subcortical volume reductions requires further elucidation.

## ESOC-0972

### 24. Vascular Cognitive Impairment Asymptomatic carotid artery stenosis and cognitive function: A systematic review

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*Scope:* Symptomatic carotid artery stenosis (CAS) is associated with cognitive impairment, but it is unclear whether asymptomatic CAS is asso-

ciated with cognitive function. We performed a systematic review to assess whether asymptomatic CAS was an independent risk factor for cognitive decline.

*Search methods:* Two independent researchers searched Medline, Embase and PsychINFO using terms for (i) CAS and (ii) cognition. The inclusion criteria were: published full-text primary research in English, adult subjects over 18 years old with asymptomatic CAS and use of validated neuropsychological tests. Data including study design, participant characteristics, exclusion criteria, method of assessing CAS, neuropsychological tests, statistical analysis, result summary and conclusions were extracted for analysis.

*Results:* We included 11 studies consisting 5 case-control, 4 prospective and 2 cross-sectional studies. These included a total of 15805 participants (range 12 to 4371) with mean age of 62.5 years studied in 10 centers within 6 countries. 38 different neuropsychological tests were used. 10 studies concluded that cognitive impairment is present in people with asymptomatic CAS. The strength of the association and whether increasing degree of CAS causes increasing cognitive impairment is undetermined.

*Conclusion:* Asymptomatic CAS is associated with cognitive impairment. However, more analysis is needed to be done to gauge the degree of stenosis at which cognitive impairment becomes significant. Furthermore, studies are needed to explore the options and benefits of treatment and whether population screening would be appropriate.

## ESOC-1349

### 24. Vascular Cognitive Impairment White matter hyperintensities and cognition in MCI and dementia: A domain-specific analysis

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*Background:* White matter hyperintensities (WMHs) are related to cognition in the general population. WMHs and cognition are also linked in patients with dementia, but the clinical relevance is not well-defined. We aimed to quantify the effects of WMHs on specific cognitive functions in patients with MCI and dementia.

*Methods:* PubMed (January 1990–May 2014) was searched for studies that used MRI to quantify WMHs, and measured cognitive functioning ( $\geq 1$  predefined cognitive domains with  $\geq 1$  test) in a well-defined population of persons with cognitive dysfunctioning. Correlation coefficients (transformed to Fischer's Z) were extracted/calculated and used as the common metric for effect size.

*Results:* Twenty-one cross-sectional studies on dementia (total n = 2974, median age 75 y) and 9 studies on MCI (8 cross-sectional, 1 longitudinal; total n = 2258, median age 73 y) were included. Presence of WMHs was associated with overall cognition (Fischer's Z: -0.14, 95% CI -0.19 to -0.09). This effect was significantly larger for MCI (-0.23, -0.36 to -0.09) than for dementia (-0.11, -0.16 to -0.06; QM 4.7, p < 0.05). WMHs were specifically associated with attention & executive functions (-0.26, -0.40 to -0.12), processing speed (-0.20, -0.37 to -0.02) and visuoconstruction (trend: -0.21, -0.48, -0.48 to 0.08), but were unrelated to memory (-0.05, -0.14 to 0.04) and language (-0.03, -0.28 to 0.22).

*Conclusion:* WMHs have a small but consistent effect on cognition in persons with MCI and dementia, particularly with regard to attention &

executive functioning and processing speed. These results underscore the important role of vascular brain damage in the clinical presentation of dementia.

## ESOC-0284

### 24. Vascular Cognitive Impairment Methodological factors in determining rates of dementia in TIA and stroke: Impact of baseline selection bias

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**Introduction:** Many previous studies on dementia in stroke have restrictive inclusion criteria which may result in under-estimation of dementia rates. We undertook a large prospective population-based study of all TIA and stroke to determine the impact of study entry criteria on measured rates of pre- and post-event dementia.

**Methods:** All patients with acute TIA or stroke from a defined population of 92 728 are referred from primary care or at hospital admission to the Oxford Vascular Study (2002–2007) and have baseline clinical and cognitive assessment and follow-up. We examined the impact of early death, other non-availability, and commonly-used selection criteria, on measured rates of dementia.

**Results:** Among 1236 patients (mean age/SD 75.2/12.1 years, 582 male, 403 TIA), 139 died or were otherwise unavailable for baseline assessment, 224 were dysphasic, 319 had prior dependency, 425 had co-morbidity, 512 were aged  $\geq 80$  years and 502 were hospitalized. Pre-event dementia was threefold higher in patients dying pre-ascertainment (10/47, 21%) and twice as high in other non-assessed (14/92, 15%) vs assessed patients (69/1097, 6%;  $p = 0.0006$ ,  $p = 0.002$ ) and was several-fold higher in those with prior functional impairment (24% vs 3%,  $p < 0.0001$ ), age  $> 80$  years (13% vs 3%,  $p < 0.0001$ ), dysphasia (11% vs 7%,  $p < 0.0001$ ) and co-morbidity (10% vs 6%,  $p = 0.04$ ). Findings for post-event dementia were similar: prior functional impairment (40% vs 13%,  $p < 0.0001$ ), age  $> 80$  years (28% vs 10%,  $p < 0.0001$ ), dysphasia (22% vs 15%,  $p = 0.02$ ) and co-morbidity (25% vs 15%,  $p = 0.005$ ).

**Conclusions:** Exclusion of patients unavailable for assessment, and other widely used selection criteria, results in underestimation of the measured rate of dementia associated with TIA and stroke.

## ESOC-0857

### 24. Vascular Cognitive Impairment Methodological factors in determining rates of dementia after TIA and stroke: Impact of loss to face-to-face study clinic follow-up

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**Introduction:** Cognitive assessment in cohorts and trials is often based only on face-to-face clinic testing. However, cognitive impairment is strongly associated with increased morbidity and mortality potentially leading to substantial loss to face-to-face follow-up assessment. In the absence of previous population-based data, we determined the impact of such attrition on measured rates of dementia after TIA and stroke.

**Methods:** Patients with TIA or stroke prospectively recruited (2002–2007) into the Oxford Vascular Study (OXVASC) had baseline clinical and cognitive assessment and follow-up to 2014. Dementia was diagnosed through face-to-face clinic interview, supplemented by home-visits and

telephone-assessment in patients unable to attend clinic and by hand-searching of primary care records in uncontactable patients.

**Results:** Of 1236 patients (mean/SD age 75.2/12.1 years, 582 male), 527 (43%) died by 5-year follow-up. Follow-up assessment rates (study clinic, home visit or telephone) of survivors were high at 947/1026 (92%), 857/958 (89%), 792/915 (87%), and 567/673 (84%) at 1, 6, 12 months and 5 years. Dementia developed in 260 patients, of whom 87 (33%) had not been available for face-to-face study clinic follow-up. The 5-year cumulative incidence of post-event dementia was 19.0% (95% CI 17–22) in study clinic assessed patients but 29% (26–32%) overall ( $p$ -difference = 0.012).

**Conclusions:** Exclusion of patients unavailable for clinic follow-up substantially reduces the measured rate of post-event dementia. Use of multiple other follow-up methods including home visits, telephone assessments and consent to access primary care records increases ascertainment of dementia outcomes by about a third.

## ESOC-1110

### 24. Vascular Cognitive Impairment Executive function in stroke patients with ipsilateral internal carotid artery stenosis: The impact of clinical variables

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**Purpose:** The association between stroke, vascular risk factors and cognitive impairment is well documented. However, few studies report the cognitive performance of ischemic stroke patients with ipsilateral internal carotid artery stenosis (ICAS), before being subjected to revascularization treatments, and considering clinical variables like hemispheric lateralization, degree of stenosis or presence of collateral circulation. The aim of the present study is to understand the impact of these variables on executive function.

**Methods:** 74 participants were eligible for inclusion and were divided in three groups, matched by gender, age and scholar grade: 14 ischemic stroke with ICAS and 30 ischemic stroke without stenosis, and 30 participants without either neurological or cognitive disorders. A neuropsychological evaluation was performed, during the first two weeks after the vascular event, before being subjected to carotid revascularization treatment.

**Results:** ischemic stroke patients with ICAS showed lower results when compared to the other groups, in most of the executive function tests applied. Higher education is considered good predictors for executive function performance. However, having a right stroke and stenosis, hypertriglyceridemia and anxiety, were considered predictors for poorer performance in executive function.

**Conclusions:** Poor performance in specific executive domains was associated to stroke patients and ICAS, when compared to stroke patients without stenosis. Having a higher education grade seems to have a positive impact in executive function. The presence of a right hemispheric stroke, hypertriglyceridemia and anxiety seems to have a negative impact. There for more research is needed to clarify the mechanisms implied in this process.

## ESOC-0485

### 24. Vascular Cognitive Impairment

#### Basal ganglia enlarged perivascular spaces and other MRI markers are associated with mild cognitive impairment in hypertensives

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**Background:** The relation of mild cognitive impairment (MCI) with enlarged perivascular spaces (EPVS) is not completely established. Our objectives are to describe the presence of EPVS at basal ganglia (BG) and centrum semiovale (CSO) in a hypertensive cohort and determine how their presence (either individually or combined with other imaging markers) and location relate to cognitive status (–MCI- or normal cognitive aging –NCA-).

**Methods:** Cross-sectional study on 798 non-demented and stroke-free hypertensives, diagnosed of MCI or NCA. EPVS and other MRI (magnetic resonance imaging) markers (brain infarcts, white matter hyperintensities and microbleeds) were rated in brain MRI. Multivariate analysis were performed to relate the presence of extensive (>11 lesions) EPVS (alone or combined with other MRI markers) with MCI, after adjustment by potential confounders (age, sex, education and vascular risk factors).

**Results:** 76 participants were diagnosed of MCI and 658 of NCA. 40.2% of the participants had extensive CSO EPVS and 23.3% had extensive BG EPVS. MCI was associated with extensive BG EPVS, particularly when they were jointly found with either brain infarcts (OR 2.99, CI 95% 1.25;7.15), extensive subcortical (OR 5.86, CI 95% 2.15;15.95) or periventricular (OR 7.95, CI 95% 1.69;37.11) white matter hyperintensities after correcting for confounders. However, extensive CSO EPVS were not associated with cognitive status.

**Conclusions:** Extensive BG EPVS and particularly their combined effect with other brain MRI markers might contribute to MCI. Besides, our results support the need to relate cognition to the burden of MRI markers, rather than focus on individual lesions.

## ESOC-1315

### 24. Vascular Cognitive Impairment

#### Cardiovascular health and subsequent cognitive decline in patients with pre-existing coronary heart disease

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**Background:** Cardiovascular (CV) health factors are associated with lower risk of CV disease and stroke. We used a CV health metric to examine association with subsequent cognitive decline in coronary heart disease (CHD) patients.

**Methods:** A subset of 203 surviving patients (95.9% males; age at baseline 57 ± 6.0 yrs.) with chronic CHD who had previously participated in a clinical trial (BIP;1990–1997) underwent cognitive evaluations after median follow-ups of 14 yrs and 20 yrs. Cognitive performance was assessed using the NeuroTrax Computerized Cognitive Battery. A CV health metric at baseline was calculated including 3 health factors (glucose, LDL-cholesterol, blood-pressure), 4 health behaviors (physical-activity, adherence to Mediterranean diet, smoking, BMI), and body-height assessing, in-part, early life environment, categorizing each into ideal (0-points), intermediate (1-point), and poor levels (2-points). To examine the association between CV health metric and rate of cognitive decline, we used linear mixed effects models.

**Results:** Controlling for potential confounders, increment in the overall CV health score (per 1-point) was associated with an increased rate of cognitive decline in a global cognitive score (Standardized  $\beta$  coefficient ( $\beta$ ) =  $-0.04 \pm SE 0.02$ ;  $P = 0.008$ ) and in specific cognitive domains: executive function ( $\beta$  =  $-0.05 \pm 0.02$ ;  $P = 0.036$ ) and visual spatial ( $\beta$  =  $-0.09 \pm 0.03$ ;  $P = 0.002$ ). Increment (per 1-point) in the health behavior component was associated with a decline in the global cognitive score ( $\beta$  =  $-0.04 \pm 0.02$ ;  $P = 0.057$ ) and in the visual spatial domain ( $\beta$  =  $-0.11 \pm 0.04$ ;  $P = 0.007$ ). Lower height score was associated with a decline in the global cognitive score ( $\beta$  =  $-0.18 \pm 0.08$ ;  $P = 0.037$ ). The health factors component was not associated with subsequent cognitive scores.

**Conclusion:** Among patients with pre-existing CHD, worse CV health is associated with subsequent cognitive decline.

## ESOC-0187

### 24. Vascular Cognitive Impairment

#### Cerebral microbleeds and cognitive function in ischemic stroke or transient ischemic attack patients

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**Background:** We explored the association between cerebral microbleeds (CMBs) and cognitive impairment in patients with ischemic stroke/transient ischemic attack (TIA).

**Methods:** A total of 218 acute ischemic stroke/TIA subjects received magnetic resonance imaging with sensitivity weighted imaging sequence.



Montreal Cognitive Assessment (MoCA) was used to evaluate global cognitive function and cognitive domains. The association of CMBs quantity with cognitive function and the impact of CMBs locations (“strictly lobar” region; “strictly deep” region; “mixed” region) on cognitive impairment were examined in regression models after adjusting for confounders, including brain atrophy, white matter hyperintensities, lacunes and volume of acute infarction. This study was approved by New-Territories clinical research committee.

**Results:** A total of 71 subjects (32.6%) had  $\geq 1$  CMB, with 28 having 1 CMB, 22 having 2–4 CMBs, 21 having  $\geq 5$  CMBs. Strictly lobar, strictly deep and mixed CMBs were identified in 23, 22 and 26 patients, respectively. Presence of  $\geq 5$  CMBs in the whole brain or strictly deep CMBs was associated with MoCA total score ( $\beta = 0.279$ , 95% CI 0.008–0.551,  $P = 0.044$ ;  $\beta = 0.234$ , 95% CI 0.012–0.456,  $P = 0.039$ , respectively. Table). Of all the MoCA domains tested, lower score in attention domain was related to presence of  $\geq 5$  CMBs (OR = 10.632, 95% CI 1.638–68.998,  $P = 0.013$ ) and strictly deep CMBs (OR = 3.359, 95% CI 0.924–12.212,  $P = 0.066$ ).

**Conclusion:** CMBs was associated with cognitive dysfunction especially in attention domain in stroke/TIA patients. This association was mainly driven by CMBs in the “deep” region, underlining the role of hypertensive microangiopathy in stroke-related cognitive impairment in Chinese.

	Crude $\beta$ (95% CI)	P	Adjusted $\beta$ (95% CI)	P
<b>CMBs number</b>				
<b>total number (log transformed)</b>	0.218 (0.098–0.338)	<0.001	0.104 (0.006–0.201)	<b>0.038</b>
<b>1 vs none</b>	0.087 (–0.203–0.376)	0.555	0.047 (–0.171–0.265)	0.670
<b>2–4 vs none</b>	0.280 (–0.044–0.603)	0.090	0.126 (–0.131–0.384)	0.333
<b><math>\geq 5</math> vs none</b>	0.603 (0.262–0.945)	0.001	0.279 (0.008–0.551)	<b>0.044</b>
<b>CMBs location</b>				
<b>No CMBs</b>	reference		reference	
<b>Strictly lobar</b>	0.187 (–0.151–0.524)	0.276	0.053 (–0.196–0.301)	0.677
<b>Strictly Deep</b>	0.336 (0.023–0.650)	0.036	0.234 (0.012–0.456)	<b>0.039</b>
<b>Mixed</b>	0.334 (0.020–0.647)	0.037	0.112 (–0.136–0.360)	0.374

**Table** Association of CMBs with MoCA total score (reflect and log transformed. linear regression)

## ESOC-1208

### 24. Vascular Cognitive Impairment

#### Association between macroscopic and microstructural white matter damage and cognition in vascular cognitive impairment

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**Background:** White matter hyperintensities (WMH) detectable on MRI provide a measure of macroscopic white matter damage and have been associated with increased risk of cognitive impairment. Diffusion MRI provides more sensitive, fine-grained measures of the microstructural integrity of white matter. We investigated the association between degree and localization of macro- and micro-structural white matter damage and cognitive performance in patients with recent TIA or non-disabling stroke.

**Methods:** We studied 306 consecutive eligible patients with TIA or non-disabling-stroke (Oxford Vascular Study) who underwent MRI and cognitive assessment with MMSE and MoCA. WMH were automatically segmented on FLAIR images. Voxel-based correlational analyses were performed with FSL tools to evaluate associations with MoCA and MMSE scores. Diffusion-weighted images were acquired on a subsample of 242 subjects and the same voxel-based correlational analyses were performed on fractional anisotropy (FA) images using TBSS.

**Results:** After correction for age, lower MoCA scores were associated with higher likelihood of having WMH in the left frontal periventricular white

matter and in the genu and splenium of corpus callosum (voxel-corrected  $p < 0.05$ , tpeak-voxel = 5.6). Less involvement of WMH in the left frontal white matter was found for MMSE. After correction for age, lower MoCA and MMSE scores were associated with lower FA values in almost all the white matter tracts (TFCE-corrected  $p < 0.01$ , tpeak-voxel = 5.6).

**Conclusion:** Vascular cognitive impairment is associated with diffuse microstructural white matter damage and more focal frontal and callosal WMH, suggesting that silent microstructural injury occurs early and is already widespread by the time WMH and cognitive impairment are manifest.

## Vascular Neurosurgery

### ESOC-0105

#### 25. Vascular Neurosurgery

##### 4'-O-β-D-Glucosyl-5-O-methylvisamminol, an active ingredient of *Saposhnikovia divaricata*, attenuates high-mobility group box 1 and subarachnoid hemorrhage-induced vasospasm in a rat model

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**Abstract:** High-mobility group box 1 (HMGB1) was observed to be an important extracellular mediator involved in vascular inflammation associated with subarachnoid hemorrhage (SAH). This study is of interest to examine the efficacy of 4'-O-β-D-glucosyl-5-O-methylvisamminol, C22H28O10, on the alternation of cytokines and HMGB1 in a animal model.

**Methods:** A rodent double hemorrhage SAH model was employed. Administration with 4'-O-β-D-glucosyl-5-O-methylvisamminol was initiated 1 hr after animals subject to SAH. Basilar arteries (BAs) were harvested and cortex to examine HMGB1 mRNA, protein expression (Western blot) and monocyte chemoattractant protein-1 (MCP-1) immunostaining. CSF samples were collected to examine IL-1β, IL-6, IL-8 and MCP-1 (rt-PCR).

**Results:** Morphological findings reveal endothelial cell deformity, intravascular elastic lamina torture, and smooth muscle necrosis in the vessels of SAH groups. Correspondently, IL-1β, IL-6 and MCP-1 in the SAH only and SAH plus vehicle groups was also elevated. 4'-O-β-D-glucosyl-5-O-methylvisamminol dose-dependently reduced HMGB1 protein expression when compared with the SAH groups. ( $p < 0.01$ ) Likewise, 400 ug/kg 4'-O-β-D-glucosyl-5-O-methylvisamminol reduced IL-1β, MCP-1 and HMGB1 mRNA levels as well as MCP-1(+) monocytes when compared with the SAH groups.

**Conclusion:** 4'-O-β-D-glucosyl-5-O-methylvisamminol exerts its neuro-inflammation effect through the dual effect of inhibiting IL-6 and MCP-1 activation and also reduced HMGB1 protein, mRNA and MCP-1(+) leukocytes translocation. This study lends credence to support 4'-O-β-D-glucosyl-5-O-methylvisamminol could attenuate pro-inflammatory cytokine mRNA, late-onset inflammasome and cellular basis in SAH-induced vasospasm.

### ESOC-1041

#### 25. Vascular Neurosurgery

##### The influence of neurovascular multidisciplinary team on the carotid management in ischemic stroke patients with carotid artery stenosis

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**Introduction:** Discussion of patients with carotid stenosis at a neurovascular multidisciplinary team (MDT) meeting allows consensus decisions to take account of cerebrovascular imaging, medical management, and the impact of comorbidities with ageing; but might delay surgery beyond the guideline of a maximum of two weeks from symptoms. We therefore studied the impact of an MDT on carotid management.

**Methods:** A prospective observational study was performed over a five month period. All patients with stroke or TIA underwent extracranial CT angiography or contrast enhanced MRA. Patients with carotid stenosis

>50% were discussed at a joint neurovascular MDT attended by a neurologist, neuroradiologist and vascular surgeon twice weekly. Patient demographics and results of carotid imaging techniques were collected. Proposed management plans were recorded before and after the MDT discussion. The impact of the MDT was documented as a change in plan or request for further imaging.

**Results:** 78 patients had significant carotid stenosis of >50%. The MDT meeting discussed 35 of the 78 patients; 25 had symptomatic and 10 asymptomatic stenosis or occlusion. MDT discussion resulted in no change in 7 patients, 7 had a change in diagnosis on imaging review, 9 a change in management and 5 both; a further 7 underwent further review. Carotid endarterectomy was performed in 16 patients and 1 was included in the medical arm of ESCAT-2, all within 14 days of symptoms.

**Conclusion:** A neurovascular MDT impacts on clinical management without unduly delaying surgery and is necessary for clinical governance in patients with carotid artery disease.

### ESOC-0137

#### 25. Vascular Neurosurgery

##### Clipping versus coiling in the management of posterior communicating artery aneurysms with third nerve palsy: A Systematic review and meta-analysis

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**Object:** To compare surgical clipping to endovascular coiling in terms of recovery from oculomotor nerve palsy (ONP) in the management of posterior communicating artery (PCoA) aneurysms causing third nerve palsy.

**Methods:** The authors conducted a systematic review of the literature and meta-analysis.

**Results:** 10 relevant studies involving a total of 205 patients with third nerve palsy due to PCoA aneurysms at baseline, of which 123 (60.0%) were treated by clipping and 82 by coiling (40.0%), were included in a meta-analysis. Pooled Odds Ratios of the impact of clipping or coiling on complete ONP recovery, lack of ONP recovery and procedure-related death were calculated. The overall complete ONP recovery rate was 47.6% in the coiling group compared to 73.1% in the clipping group, corresponding to an overall pooled Peto odds ratio of 2.97 (95% CI 1.54–5.71). Subgroup analysis revealed a clear benefit of clipping over coiling in patients with ruptured aneurysms, but not in unruptured aneurysms. None of the ten studies reported any procedure-related death.

**Conclusions:** Surgical clipping of PCoA aneurysms causing third nerve palsy achieves better outcome than endovascular coiling. This result could be particularly true in the case of ruptured aneurysms. In view of the small number of cases and purely observational data, statements about this effect should be made with great caution. A randomized trial would better respond to the therapeutic dilemma raised, but while awaiting the results of such a trial, we recommend managing PCoA artery aneurysms causing ONP with surgery.

## ESOC-0574

## 25. Vascular Neurosurgery

## The role of vasa vasorum activities in carotid atherosclerosis are associated with plaque development and vulnerability

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**Background:** The aim of this study was to investigate the correlation between the activities of carotid vasa vasorum and carotid plaque vulnerability by indocyanine green (ICG) angiography during CEA, focusing on how the vasa vasorum of carotid artery is depicted.

**Methods:** Sixty-five patients (mean age:  $68.8 \pm 2.5$ , mean degree of stenosis  $78.9 \pm 3.8$ ) who underwent a CEA were enrolled prospectively. ICG was injected intravenously as a bolus before and after the arterectomy during CEA. We also performed an immunohistochemistry study using CD68 (macrophage), CD117 (mast cell), CD4 (T-cell), and CD8 (B-cell) antibody for resected plaque specimens.

**Results:** In the ICG angiographic series ( $n = 65$ ), the active vasa vasorum density was observed in all patients. The vasa vasorum externa (VVE) and interna (VVI) were seen in 10 patients (15.4%) and 55 patient (84.6%), respectively. The types of VVE were strongly associated with preoperative angiographic instability (90.0%,  $p = 0.001$ ) and carotid plaque vulnerability (100%,  $P = 0.003$ ) microscopically. In contrast, the types of VVI were less associated with angiographic instability (36.1%) and plaque vulnerability (49.1%). Macrophages and mast cells stained by CD86 and CD117 were more frequently observed in unstable plaque, compared to stable plaque ( $P < 0.0001$ ,  $P = 0.002$ , respectively). However, there were no significant differences in T-cell and B-cell

**Conclusion:** The early appearance of VVE in ICG angiography is strongly associated with carotid unstable plaque. Macrophage and mast cell are involved in the formation of microvessel in the atherogenic plaque and accelerate plaque progression into an unstable phenotype.

## ESOC-0575

## 25. Vascular Neurosurgery

## The results and perioperative complications of revascularization surgery for the ischemic cerebrovascular disease

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**Background:** We evaluate the outcome of our patients of ischemic cerebrovascular disease who underwent revascularization surgery.

**Methods:** We retrospectively reviewed the medical records and results of follow up imaging studies on 80 cases in 63 patients with moyamoya disease and 144 patients with occlusive vascular disease who received bypass surgery at our institution over a 10-year period.

**Results:** In 80 cases of moyamoya disease, transient ischemic attack was presented on 11 cases (13.8%); focal infarction on 2 cases (2.5%); subdural hemorrhage (SDH) on 2 (2.5%); intracerebral hemorrhage (ICH) on 2 (2.5%) postoperatively. All cases of TIA were recovered without permanent deficit. In 6 patients with postoperative ICH or SDH or infarction, 2 patients had moderate or severe neurological deficit and one patients was expired (mortality 1.3%). Others were discharged without any neurological deficit after conservative treatment. In occlusive vascular disease, TIA was developed on 7 patients (4.8%); postoperative infarction was developed on 5 patients (3.4%); small sized ICH at previous infarction site on 2 (1.4%); SDH required revision on 1 (0.7%); wound infection on 1. Although 4 patients with postoperative infarction or ICH had neurological deficit, others were recovered without neurological deficit.

**Conclusion:** Cerebral revascularization procedures are effective for symptomatic patients with moyamoya or occlusive vascular disease. However, Half of the cause of poor outcome is postoperative complication. Therefore the prevention and adequate treatment of perioperative complications of revascularization surgery can be a one important factor that improve the outcome.

## ESOC-0777

## 25. Vascular Neurosurgery

## Have outcomes improved in patients with subarachnoid hemorrhage (sah) related delayed cerebral ischemia (DCI)? A single-center sequential cohort study

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**Introduction:** Delayed cerebral ischemia (DCI) is a well-accepted negative prognostic predictor of outcome in patients that have had a SAH. Overall outcomes following SAH have improved over time, but it is unclear if outcomes have improved in patients that have developed DCI.

**Methods:** We retrospectively compared outcomes (mortality, discharge destination, GOS (Glasgow outcome scale)) in patients documented to have DCI treated before (2004–2007 Epoch A) and after (2009–2011 Epoch B) the introduction of a specialized SAH service. Patients were identified from a departmental SAH database, the relevant notes and scans were scrutinized for confirmation of DCI. Multi-factorial logistic regression analysis was performed to determine the injury and age adjusted odds survival at discharge, discharge home, good recovery (GOS 5) and favorable outcome (GOS 4–5) at 3 months.

**Results:** Seventeen percent of patients were documented to have DCI (82/495 in Epoch A and 81/485 in epoch B). DCI was an independent predictor of unfavorable outcome (OR 0.468,  $p < 0.001$ , 95% CI 0.316–0.694). There was no significant difference in the odds of discharge home (48% vs. 48%,  $p = 0.251$ , OR 0.654, 95% CI 0.316–1.351), hospital mortality (16% vs. 14%,  $p = 0.207$ , OR 1.910 95% CI 0.699–5.218) good recovery (46% vs. 52%,  $p = 0.127$ , OR 1.740, 95% CI 0.852–3.552) or favorable recovery (71% vs. 73%,  $p = 0.323$ , OR 1.510, 95% CI 0.658–3.559) between the two epochs.

**Conclusions:** Our data suggests that outcomes in patients with DCI have not significantly improved over time in our experience, and strategies to address this clinical problem continue to be important.

## ESOC-0376

## 25. Vascular Neurosurgery

## Decompressive hemicraniectomy for malignant hemispheric infarction—a review of practice at a comprehensive stroke center (CSC)

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**Introduction:** Recent societal guidelines (UK) for stroke suggest that decompressive hemicraniectomy should be offered in selected patients for malignant hemispheric infarction. However intervention is often dependent on the referring stroke and treating neurosurgical teams. As a first step to creating a consensus based protocol and a prospective database for patients referred for hemicraniectomy, we audited our recent practice at Salford Royal NHS Foundation Trust.

*Methods:* This was a retrospective audit (5 year) involving data collection from electronic patient records, neurosurgical referral database, inpatient elective and emergency theatre lists (1 Jan 2009–31 Dec 2014).

*Results:* 15 patients were included in final analysis. Median age was 45 y (range 29 y–65 y); majority were male (75% M vs 25% F). Information on time to hemicraniectomy (median = 37 hrs) was available in 80% of patients with 33% of patients undergoing surgery after 48 hrs (range from 50% of MCA territory with mass effect at time of referral. 93% of patients were alive at 1 year with limited morbidity data.

*Conclusions:* There appeared to be substantial variation in documentation of essential criteria when deciding on hemicraniectomy. A large number of patients underwent hemicraniectomy outside of national guidance, although with good survival rates at 1 year. A robust local hemicraniectomy protocol with a prospective database is thus likely to have utility in both clinical research and practice.

## ESOC-0888

### 25. Vascular Neurosurgery

#### **Efficacy of adenosine-induced transient cardiac arrest for cerebral aneurysm surgery**

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*Introduction:* Cerebral aneurysm surgery occasionally requires transient deflation of the aneurysm to prevent its rupture or to manage premature rupture. Temporary occlusion of the parent artery is an effective method to reduce the pressure of the aneurysm. However, in some case, blocking the parent artery may not be feasible. Transient cardiac arrest (TCA) induced by adenosine triphosphate (ATP) is an effective alternative in such cases. Adenosine is a purine nucleoside that suppresses atrioventricular conduction. A bolus dose of ATP provokes short duration of cardiac arrest. *Aims:* We present the efficiency of TCA to the clipping process.

*Methods:* 290 consecutive patients with aneurysms (ruptured aneurysm: 140, unruptured aneurysm: 150) were surgically treated between 2007 and 2014. Of these, 12 patients underwent TCA-inclusive surgery. Bolus intravenous injection of ATP was administered. Microsurgery was performed during the short period of cardiac arrest. *Results:* We observed 3–40 s of cardiac arrest and noted remarkable softening or collapse of the aneurysms in all cases. In every case, the aneurysms were successfully obliterated. TCA also served to control the bleeding in one case with premature rupture of the aneurysm. Complications associated with TCA were not observed in any of these patients.

*Conclusions:* TCA facilitated safe and quick dissection of the aneurysm and clip application during the clipping operation. This approach is useful when temporary occlusion of the parent artery is difficult. ATP-induced TCA is a quite useful and safe method, although the former requires close monitoring by an experienced anesthesiologist.

## Women and Stroke

ESOC-0667

### 26. Women and Stroke

#### Functional recovery after stroke: Does being a woman make the difference?

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*Study aim:* To investigate if women show different recovery rates, from men, after a first-ever stroke, across age groups.

*Study design:* Retrospective cohort study.

*Methods:* The data was extracted from a multicenter study on subjects, admitted to intensive rehabilitation after a first-ever stroke. Recovery rate was measured through the Effectiveness Index [(Barthel Index (BI) score at discharge – BI score at admission)/(100-BI at discharge) x100], and used as a dependent variable in the prognostic equation. The explanatory variables, collected at rehabilitation admission, were: age, sex, pre-stroke Rankin score, lesion side, interval from stroke to rehabilitation, comorbidities, CNS score, trunk control test, motricity index, functional ambulation category, aphasia, neglect, cognitive impairment (MMSE score), urinary incontinence, dysphagia.

*Results:* The studied sample consisted of 246 men and 174 women aged 66.6 ± 10.1 years and 67.8 ± 10.7 years, respectively. An inverse relationship between age and the Effectiveness Index was observed ( $p < 0.0001$ ), in both sexes, with a faster decline of observed/expected recovery in women, after 60 s ( $p < 0.04$ ). Bladder incontinence, severe trunk control and gait dysfunctions were more frequent in women, on admission, independent of age. Cognitive ability declined with age ( $p < 0.008$ ), though faster in women over 60 s ( $p < 0.0001$ ). The multivariate analysis indicated that both advanced age and cognitive impairment, though not sex, increased the risk of poor recovery ( $p < 0.001$ ).

*Conclusion:* Age and cognitive impairment predict functional recovery in stroke subjects admitted to intensive rehabilitation. Women may exhibit a worse prognosis, than men, only after 60 s, likely due to the impairment of their cognitive reserve.

ESOC-0803

### 26. Women and Stroke

#### Cerebral venous thrombosis with levonorgestrel-releasing intrauterine system in a low-risk patient with essential thrombocythemia

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*Introduction:* Essential thrombocythemia (ET) is a myeloproliferative syndrome and cerebral venous thrombosis (CVT) is a rare complication. Common cardiovascular risk factors contribute to the pathogenesis of arterial events, whereas circumstantial risk factors to that of venous events.

*History:* A 39 year old woman with a seven year history of ET with no vascular event until hospitalization (low-risk ET). Four weeks before admission she began to use a low dose levonorgestrel-releasing intrauterine system as a contraceptive. The brain MRI and the venous MRA showed a thrombosis involving the right sigmoid sinus, the lateral sinus and the jugular vein. CT body scan showed splanchnic vein thrombosis as well. Proteins S and C activities and anti-thrombin III levels were within the normal range. Lupus anticoagulant and anti-cardiolipin antibody were negative. Treatment was initiated with enoxaparin and patient was discharged asymptomatic on oral anticoagulation.

*Discussion:* According to large series, risk of venous thrombosis has not been high in women using levonorgestrel intrauterine systems. Concomitant conditions such as ET might increase thrombogenic risk

*Conclusion:* ET is a rare cause of CVT but circumstantial conditions like hormonal contraceptives (even those with low thrombogenic risk) might trigger it

ESOC-1494

### 26. Women and Stroke

#### The gender gap: Effect of intravenous fibrinolysis in stroke outcome

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*Background:* Analyze if women benefit more than men, in terms of outcomes, from the use of intravenous thrombolysis (IVT) in acute ischemic stroke.

*Methods:* observational prospective study of patients admitted in the Stroke Center since the introduction of IVT over the first eight years (2002–2010). Non-treated group: 2262 consecutive stroke patients (939 women). Treated (IVT) group: 330 consecutive patients (143 women). Both groups were not homogenous, so propensity analysis was performed and after, a case control, which comprised 1980 patients, was done. 330 IVT and 1650 non treated. We examined outcomes (by the modified Rankin scale-mRS, defining poor outcome as a score >2) after hospital discharge in both groups (treated and non-treated) by sex.

*Results:* IVT was used in the 13% of the patients, without gender difference between treated and non treated group. IVT group was younger and have more severe strokes than non-treated group. These differences disappeared after propensity analysis. There were no sex-differences in both groups (IVT and non IVT). Women untreated were more likely than men to have a modified Rankin Score >2 (64,9% vs. 45.7%,  $P < 0.0001$ ) in the first 15 days after stroke whereas there was no outcome sex differences in the IVT group (45.5% vs 40.6%,  $P = 0.207$ ) Logistic regression analysis pointed women as an independent unfavorable outcome factor in the not treated group (OR 2.195; 95% CI 1.655–2,911) adjusted by confounders, but not in the IVT group.

*Conclusions:* In this observational study women benefited more IVT than men.

ESOC-1477

### 26. Women and Stroke

#### Validating the hypothesis that the interaction sex-by-hemisphere influences functional outcome using data from the Virtual International Stroke Trials Archive (VISTA)

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*Background:* In many neurosciences researcher consider sex differences between the hemispheres highly relevant. In acute ischemic stroke this matter is under-investigated.

**Methods:** We analyze rtPA-treated and control patients by sex from an international collection of clinical trial data: The Virtual International Stroke Trials Archive (VISTA). Because baseline characteristics differ substantially between the sexes, analysis may be biased. Coarsened exact matching, a new matching method tries finding better balance within the covariate distribution between groups, which may help overcome this potential bias. After this pre-processing step, we evaluate functional outcome at day 90 after stroke (measured by modified Rankin Scale) with an proportional odds model and meaningful dichotomizations (mRS 0–1 for excellent, mRS 0–2 for good outcome). We present the results in side-by-side comparison with traditional analyses.

**Results:** Abbreviated results from our single center study that served as groundwork for this analysis are given – upon acceptance of this paper the authors may present the final analysis at the conference: Between-sex analysis revealed that right hemispheric strokes in men were 1.54 (risk ratio) times (95% confidence interval 1.15–2.01) more likely than in women predicting good outcome. Within-sex analysis revealed that women with right hemispheric strokes were 0.72 times (CI 0.54–0.92) less likely to achieve good outcome than women with left hemispheric strokes; conversely, men with right hemispheric strokes were 1.35 times (CI 1.06–1.70) more likely to achieve good outcome than men with left hemispheric strokes.

**Conclusion:** The relationship of sex and hemisphere may determine functional stroke outcome more profoundly than expected.

## ESOC-1478

### 26. Women and Stroke

#### Analyzing sex differences in response to intravenous thrombolysis: Evidence from the Virtual International Stroke Trials Archive (VISTA)

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**Background:** Few studies exist that investigate the sex-related effect on intravenous thrombolysis. Some suggest that women—doing worse in their natural course of disease—reach equal outcomes when given intravenous thrombolysis and that this may be because of a greater treatment effect as compared with men (nullifying hypothesis). We sought confirmation of this hypothesis.

**Methods:** We analyze rtPA-treated and control patients by sex from an international collection of independent clinical trial data: The Virtual International Stroke Trials Archive (VISTA).

We perform two steps: First, we pre-processed data by coarsened exact matching, a new matching methods that gains a better multidimensional covariate balance. Second, we deploy Cochran-Mantel-Haenszel test and multiple regression analysis (adjusted for confounders of age, National Institutes of Health Stroke Scale and multiple risk factors). We present outcomes at day 90 after stroke for ordinal outcomes and meaningful dichotomizations (mRS 0–1: excellent; mRS 0–2: good) as measured by the modified Rankin scale—an outcome scale ranging from 0 (no disability) to 6 (death).

**Preliminary results and conclusion:** 8313 cases were analyzed, 3785 woman (36.3% rtPA) and 4528 men (44.5% rtPA).

Upon acceptance of this paper, the author may present the full analysis at the conference and may put results into context of previous studies.

## ESOC-0858

### 26. Women and Stroke

#### Difference between males and females in the outcome of thrombolytic treatment

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**Introduction:** Recently, it has been shown in animal models that there is a variability in X-chromosome inactivation. Thus, in some brains a mother's X chromosome may dominate to one hemisphere and the father's dominate to the other one. Hence, response of brain to ischemia may differ in men and women. Our goal was to determine if there are differences in the outcomes between males and females after the thrombolytic treatment.

**Methods:** Prospectively collected data from the Safe Implementation of Treatments in Stroke – EAST (12 Central/Eastern European countries) registry between January 2000 and April 2014 were analyzed. Baseline patient characteristics and the outcomes (defined as NIHSS at 2 h, 24 h, 7 days, and mRS at 3 months) were analyzed descriptively. Generalized linear model and logistic regression methods were used to identify differences between sex and the outcomes.

**Results:** Altogether, all 15167 patients treated with thrombolysis within 4.5 hours of symptom onset between January 2000 and April 2014 were analyzed. Of these, 6651 (43.9%) were females. Males and females significantly differed in age, baseline NIHSS, hypertension, hyperlipidemia, atrial fibrillation, history of stroke, pre-stroke mRS 0–1, and smoking status. Overall, males had less severe strokes and also better outcomes compared to females (median NIHSS at baseline, 2 h, 24 h, 7 days, and mRS 0–1 at 3 months was 11, 8, 6, 4, and 41.4% vs. 12, 9, 7, 4, and 35.9%, respectively). However, difference in outcome disappeared after the adjustment.

**Conclusions:** Despite the genetic differences between males and females we could not demonstrate that sex influences outcome after stroke.

## ESOC-0478

## 26. Women and Stroke

## Iatrogenic intracranial hypotension and sinus vein thrombosis

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**Background:** Intracranial hypotension (IH) is characterized by venous distention and sluggish flow associated with sinus vein thrombosis (SVT). Lumbar punctures (LP) and spinal anesthesia (SA) are common iatrogenic causes of IH but their attributes remain unclear.

**Methods:** Patients aged  $\geq 18$  years, diagnosed with acute SVT were identified. Patients with SVT and IH were compared to those with SVT without IH.

**Results:** Overall, 41 patients met inclusion criteria and 10/41 had undergone LP, EA, or SA within  $\leq 10$  days before the diagnosis (9/10 women mean age 30). Patients with IH presented earlier after symptom onset ( $6 \pm 2.2$  days vs.  $15.6 \pm 14$  days;  $p = 0.002$ ), had higher mean National Institutes of Health Stroke Scores (NIHSS) at presentation ( $4.5 \pm 2.0$  vs.  $0.5 \pm 0.5$ ;  $p < 0.01$ ), and higher rates of venous infarction (6/10, 60% vs. 6/31, 19%;  $p = 0.014$ ) and seizures (4/10, 40% vs. 3/31, 10%;  $p = 0.026$ ). In patients with IH after labor (5/10) no or mild hypercoagulability was found while in patients with IH after elective procedures (5/10) substantial factors of hypercoagulability were found. On imaging studies patients with IH more often had superior sagittal sinus thrombi and cortical vein thrombosis with infarction (6/10, 60% vs. 4/31, 13%;  $p = 0.0025$ ). All pts were treated conservatively with anti-coagulants. AED were used in pts with seizures. 9/10 pts had mRS90 of 0–1.

**Conclusions:** Patients with SVT associated with IH typically affects young women with pre-existing coagulation abnormalities and presents with a more severe clinical course with frequent seizures and venous infarcts. However, the outcome seems to be relatively benign.

## ESOC-1087

## 26. Women and Stroke

## Gender differences in patients with craniocervical artery dissection

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**Objectives:** Dissection of the carotid (CAD) or vertebral (VAD) artery is a major cause of ischemic stroke in young adults. We aimed to elucidate the impact of gender-based differences of patients with dissection on risk factors, demographical, clinical and etiological characteristics.

**Methods:** We reviewed retrospectively all patients diagnosed with CAD or VAD admitted to our clinic between January 2000 and December 2014 and enrolled 74 such patients (27 females, 47 males) in the study. We compared age, modified Rankin Scale prestroke and at time of admission, clinical presentation of dissection, location of dissection, vascular risk factors (hypertension, hypercholesterolemia, diabetes mellitus, history of regular smoking at the time of the event), other risk factors known to be associated with artery dissections, nature of dissection (spontaneous or associated with minor trauma), and the rate of mortality between gender.

**Results:** The mean ages were  $52.00 \pm 15.15$  and  $61.96 \pm 14.36$  for female and male patients, respectively. The mean ages were significantly different between two genders ( $p < 0.05$ ). The frequency of VAD was much higher in men than women (59.6% and 40.7% respectively,  $p < 0.05$ ). Although there was no statistically significant difference for disability prestroke and at admission, clinical presentation, vascular risk factors, and mortality

rate, men have significantly more spontaneous dissection (26% for women vs. 91% for men;  $p < 0.05$  and have more other risk factors than women (11% for women vs. 36% for men;  $p < 0.05$ ).

**Conclusion:** Identifying factors related to clinical outcome may be important for starting appropriate treatment and setting targets in the management of patients with dissection.

## ESOC-0124

## 26. Women and Stroke

## Pregnancy loss and risk of ischemic stroke and myocardial infarction in the Risk of Arterial Thrombosis in Relation to Oral Contraceptives (RATIO) study

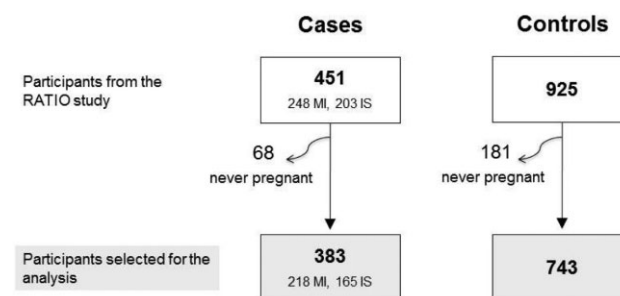
A Maino<sup>1</sup>, B Siegerink<sup>2</sup>, A Algra<sup>3</sup>, I Martinelli<sup>4</sup>, F Peyvandif<sup>4</sup>, F Rosendaal<sup>2</sup><sup>1</sup>Angelo Bianchi Bonomi Haemostasis and Thrombosis Centre, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy<sup>2</sup>Department of Clinical Epidemiology, Leiden University Medical Center, Leiden, Netherlands<sup>3</sup>Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, Netherlands<sup>4</sup>Angelo Bianchi Bonomi Haemostasis and Thrombosis Centre, IRCCS Fondazione Ca' Granda – Ospedale Maggiore Policlinico, Milano, Italy

**Objective:** To investigate whether pregnancy loss is associated with the risk of ischemic stroke (IS) or myocardial infarction (MI).

**Methods:** The RATIO is a case-control study of women (age 18 to 50 years) with IS or MI. For this analysis, we included women who previously had at least one pregnancy. Odds ratios (OR) with 95% confidence intervals (CI) were calculated, indicating the association between pregnancy loss and risk of IS or MI. ORs were adjusted for matching variables and other potential confounders (smoking, hypertension, alcohol consumption, diabetes, hyperlipidemia, body mass index), and calculated for the number of pregnancy losses as well as the gestational week of unsuccessful pregnancies ( $< 13$ ,  $13-20$  and  $> 20$  weeks).

**Results:** 165 IS cases, 218 MI cases and 743 controls were included, with an average of 2.7, 2.5 and 2.5 pregnancies per woman, respectively. 59 (36%) women with IS and 63 (29%) with MI experienced at least one pregnancy loss compared with 234 (32%) controls. Women with  $\geq 1$  pregnancy loss had no increased risk of IS nor MI compared with women without pregnancy loss (OR 1.0, 95% CI 0.7–1.6 for IS; OR 0.7, 95% CI 0.5–1.1 for MI). However, women with recurrent ( $> 3$ ) or late ( $> 20$  weeks) pregnancy loss had a moderately increased risk of any arterial thrombosis (recurrent, OR 1.9, 95% CI 0.8–4.5; late, OR 1.5, 95% CI 0.7–3.2).

**Conclusion:** The association between pregnancy loss and IS or MI might be present only for women with recurrent or late pregnancy loss.



## ESOC-1045

## 26. Women and Stroke

### Stress at work is a significant predictor of hypertension and stroke in female population 25–64 years in Russia: WHO Epidemiological Program Monica-Psychosocial Study

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**Objective:** To explore the job stress effect on risk of stroke and arterial hypertension (AH) in female population of 25–64 y in Russia over 16 years of follow-up.

**Methods:** Under the third screening of the WHO “MONICA-psychosocial” program random representative sample of women aged 25–64 years (n = 870) were surveyed in Novosibirsk. Levels of job stress were estimated by questionnaire based on Karasek’s job demands-control model. From 1995 to 2010 women were followed for the incidence of AH, stroke. Cox regression model was used for risk assessment (HR).

**Results:** The prevalence of high job stress level in women aged 25–64 years was 31.6%.

HR of stroke over 16 years of follow-up was 1.96-fold higher (95.0%CI:1.01–3.79,  $p < 0.05$ ) in women with job stress, HR of AH was 1.39-fold higher (95.0%CI:1.08–1.78,  $p = 0.01$ ) compared to those without stress. There were tendencies of increasing stroke and AH rates in married women experienced stress at work. Stroke developed in women with lower educational level and AH significantly higher developed in women with higher educational level ( $p$  for all  $< 0.05$ ) having job stress. AH and stroke rates was found higher for physical workers with job stress ( $\chi^2 = 5.47$   $df = 1$   $p < 0.05$ ) and AH rates were tend to be higher in managers experienced stress at work.

**Conclusions:** There is high prevalence of stress at work in female population aged 25–64 y in Russia. Women with job stress have significantly higher risk of stroke and AH over 16-th years of follow-up, especially in married ones and in physical workers with job stress.

## ESOC-1480

## 26. Women and Stroke

### Outcome of acute ischemic stroke after stent based thrombectomy: Are there gender differences?

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**Background:** The natural course of stroke has been shown to be worse in women than in men. Several recent studies suggested no gender differences in the outcome among patients treated with systemic thrombolysis. Because the latter achieves recanalization in only about one-third of patients with MCA occlusion, endovascular therapy with stent-based thrombectomy is an alternative for these cases.

**Methods:** Retrospective analysis of patients with major ischemic stroke due to acute proximal MCA occlusion ineligible for systemic thrombolysis who had been treated with stent retrievers’ thrombectomy. We studied whether gender differences in the efficacy and safety outcomes of stent based mechanical thrombectomy were present.

**Results:** 18 patients (9 women, mean age of  $63.0 \pm 16.6$  years; 9 men  $67.2 \pm 16.6$  years ( $t = 0.449$ ;  $p > 0.05$ ) were studied. NIHSS at admission was  $16.89 \pm 3.95$  in women,  $15.0 \pm 5.45$  in men ( $t = 0.841$ ;  $p > 0.05$ ). Recanalization was complete in 8/9 women and 8/9 men. NIHSS after recanalization in women was  $4.78 \pm 4.87$ , in men  $6.33 \pm 8.14$  ( $t = 0.4914$ ;  $p > 0.05$ ). NIHSS improvement before and after recanalization was significant

in women ( $t = 5.3947$ ;  $p = 0.0007$ ) and in men ( $t = 4.14$ ;  $p = 0.0043$ ). Improvements did not differ significantly between women and men ( $t = 1.2301$ ;  $p > 0.05$ ). Good functional outcome at 90 days (mRS 0–2) showed no gender difference (Fisher exact  $p > 0.05$ ). Asymptomatic hemorrhagic transformation occurred in 4/9 women and in 5/9 men.

**Conclusions:** Stent-based thrombectomy for acute MCA occlusions seems relatively safe, recanalizes very efficiently, and improve neurological outcome. This small study shows no gender differences in the outcome among patients treated with stent retrievers’ thrombectomy thus nullifying the usual gender differences in functional outcomes after stroke.

## ESOC-0193

## 26. Women and Stroke

### Acute large vessel occlusion varies with age and gender

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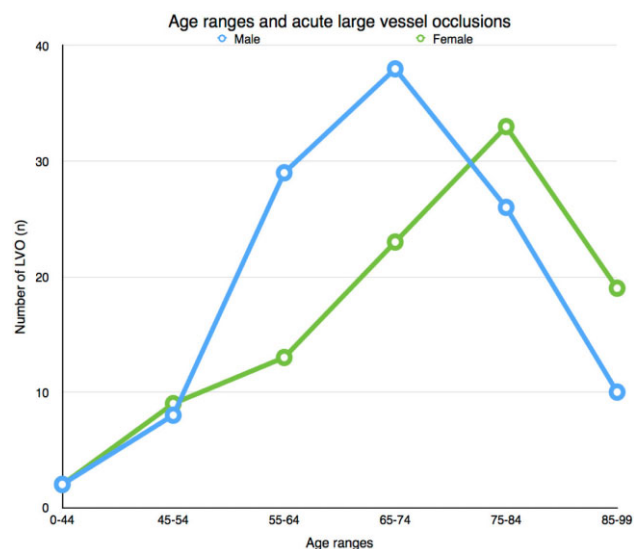
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**Background:** The influences of gender and age on the occurrence of acute large vessel occlusions (LVO) in hyperacute ischemic stroke remains unclear. The aim of this study was to explore the prevalence of acute LVO in relation to gender and age.

**Method:** This analysis was based on 758 consecutive stroke patients with symptom onset within 4.5 hours. Admission cerebral CT and CT angiography was evaluated blinded to clinical findings. Presence and location of LVO’s were calculated in 10-year age ranges and stratified for gender.

**Results:** In the age ranges 55–64 and 65–74 acute LVO were significantly predominant in males as opposed to the age ranges 75–84 and 85–99 where occlusions were significantly more frequent in females, Fig. 1. Overall, 14.9% of male patients had a LVO vs. 12.9% of female patients. Males had significantly higher prevalence of acute LVO in the M2-segment (MCA) ( $p = 0.027$ ), vertebral artery ( $p = 0.012$ ), basilar artery ( $p = 0.046$ ), extra-cranial ICA ( $p = 0.027$ ), dissection of a. vertebralis ( $p > 0.001$ ) as well as occlusions affecting both the intra and extra cranial part of ICA ( $p = 0.040$ ).

**Conclusion:** Occurrence of LVO occlusion co-varies with age and gender. Increased focus on gender differences in stroke may help individualize patient care.





ESOC-0255

**26. Women and Stroke****Gender difference in atherosclerotic stroke**C. Yoon<sup>1</sup>, S J Kim<sup>1</sup>, H K Park<sup>1</sup>, J H Rha<sup>1</sup><sup>1</sup>Neurology, Inha University School of Medicine, Incheon, Korea

*Background and purpose:* The aim of this study was to investigate the gender difference in cerebral atherosclerosis (intracranial atherosclerosis [ICAS] vs. extracranial atherosclerosis [ECAS]).

*Methods:* A total of 703 consecutive patients with acute ischemic stroke that was considered to be caused by symptomatic ICAS or ECAS were enrolled.

*Results:* Compared with males, females tended to have more ICAS than ECAS after controlling age, hypertension, hyperlipidemia, diabetes, smoking and body mass index (odds ratio [OR], 2.121; 95% confidence interval [CI], 1.272–3.538;  $p = 0.004$ ). After stratification by gender, the risk factors for ICAS or ECAS differed between sexes. In males, age (OR, 1.052; 95% CI, 1.025–1.079;  $p < 0.001$ ) was a factor favoring ECAS (vs ICAS), whereas hypertension (OR, 2.235; 95% CI, 1.202–4.156;  $p = 0.011$ ) was a factor related to ICAS (vs ECAS). However, the association was only significant in males.

*Conclusions:* There are gender differences in distribution and risk factors of cerebral atherosclerosis.

## Rare Causes, Stroke in the Young, and Case Reports

### ESOC-1381

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Aneurysms of the cavernous segment of the internal carotid artery with a carotid cavernous fistula and endovascular stent/coil treatment: Case report

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Aneurysms of the cavernous segment of the internal carotid artery is a diagnostic challenge for neurologists. This type of intracranial aneurysm accounts 2% to 9% of all intracranial aneurysms. The risk of subarachnoid hemorrhage is extremely low (0.2–0.4% per year). However, symptoms include progressive cranial nerve deficits, visual symptoms, retro-orbital pain, carotid-cavernous fistula (CCF), subarachnoid hemorrhage, recurrent transient ischemic attacks, spontaneous thrombosis and epistaxis.

**Objectives:** To describe a case of aneurysms of the cavernous segment of the internal carotid with CCF treated by endovascular stent/coil treatment.

**Case report:** An 81 year-old woman was admitted to our hospital for a loss of consciousness. A CT-scan showed a small right frontal ribbon hyper-density and irregular aspect of right ophthalmic vein. The neurological examination showed: drowsiness, right exophthalmos and headache and vision impairment were noted. Electrographic Examination (EEG) recordings showed bifrontal PLEDs suggesting a possible critic nature of patient's loss of consciousness. A MRI reported a frontal right CCF. Conversely, the angiography showed a left carotid siphon aneurysm and rupture of aneurysm of the cavernous segment of the internal carotid with a carotid cavernous fistula. Endovascular stent assisted coil treatment has been placed with the resolution of the clinical picture

**Conclusions:** this is an unusual clinic presentation of aneurysms of the cavernous segment of the internal carotid which benefited from endovascular treatment.

### ESOC-1344

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Alpha-galactosidase deficiency and cerebral venous thrombosis: A case report

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<sup>2</sup>*Medical Genetics, Hospital de São João Faculdade de Medicina da Universidade do Porto, Porto, Portugal*

**Background:** Fabry disease (FD) is an X-linked lysosomal storage disorder, associated with mutations in the *GLA* gene that cause deficiency of alpha-Galactosidase enzyme. Mutations associated with relatively high residual enzyme activity have been reported in young patients with stroke, without other features of FD. Vascular abnormalities in FD do not seem to be exclusive of the arterial system, nevertheless cerebral venous thrombosis (CVT) has been reported only once in a FD survey.

**Case Report:** A previously healthy 44 year-old male, was admitted in July 2014 with headache, photophobia, nausea and vomiting. He was on Azythromycin for an upper respiratory infection and one week before he had run 18 kilometers. Family history was negative. General and neurologic examination were normal. Venous CT scan revealed thrombosis of the straight and left transverse and sigmoid sinuses. The patient was started

on heparin and subsequently discharged, at day 9, on oral anticoagulation. Genetic study of thrombophilias showed a homozygotic MTHFR 677C > T and PAI-146146 mutation. The alpha-Galactosidase activity was slightly reduced in dried blood spot assay (8.04, Ref Val 8.75–15.6) and molecular analysis of *GLA* gene revealed the variant Asp313Tyr.

**Conclusions:** Although there is a lot of debate on the pathogenicity of p.D313Y *GLA* gene mutation, an association with cerebrovascular disease has been repeatedly suggested. The role of alpha-Galactosidase deficiency in CVT, alone or in combination with other prothrombotic conditions, probably deserves to be further elucidated.

### ESOC-1015

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### First diagnosis of polycythemia rubra vera in a general hospital stroke unit

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<sup>2</sup>*Haemostasis and Thrombosis, Royal Perth Hospital, Perth, Australia*

**Introduction:** Identifying the cause of ischemic stroke (IS) guides management. Polycythemia rubra vera (PRV) is a well described although, uncommon cause of stroke that may be easily overlooked.

**Aim:** In this study we aim to report the clinical and radiological characteristics of patients who presented to a general hospital stroke unit who were subsequently diagnosed with PRV.

**Methods:** all 165 patients with confirmed stroke who presented to our hospital in 2014 were included; 3 patients with PRV were identified. Stroke was confirmed on neurological imaging. PRV was diagnosed by the presence of an elevated hemoglobin, low serum erythropoietin level and/or the presence of a JAK-2 mutation.

**Results:** Of the 3 patients who were identified, 2 were male and mean age was 69 years (range 60–79). None were hypoxic on room air at presentation. Mean hemoglobin at presentation was 194.7 g/L (range 177–210, normal 135–180 g/L), hematocrit 0.56 (range 0.51–0.58, normal 0.4–0.54), EPO level 2.3 U/L (range 1.7–26, normal 4.3–29.4 U/L), 2 of 3 patients were JAK-2 mutation positive. 2 of 3 patients had multiple territory cerebral infarctions, with one patient presenting with small vessel disease. All patients made a good recovery with venesection, hydration and antithrombotic medication.

**Conclusion:** PRV may be a not uncommon cause of stroke. Multiple territory infarction was more common, although small vessel occlusive stroke may also occur. Clinicians should be aware of the possibility of PRV being the cause of stroke.

### ESOC-0912

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Multiple embolic stroke during vaginal delivery in a patient with patent foramen ovale

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**Aim:** We report a case of cerebral infarction associated with patent foramen ovale (PFO) during vaginal delivery.

**Background:** Ischemic stroke during the pregnancy or puerperium is rare but associated with high risk of mortality and residual neurological deficits.

**Case report:** A 38-year-old woman was referred to the emergency department with loss of consciousness with generalized tonic-clonic seizure during vaginal delivery. She had three parturitions on the full-term of pregnancy and had no obstetric complications during gestational period of previous pregnancy. On a neurologic exam, she had stuporous mentality and weakness of all four limbs, mainly in the left side. The serologic tests including autoimmune antibodies and thrombosis panel were within normal range. Chest CT showed pulmonary thromboemboli in the left lower lobar artery and these branches, and abdominal CT showed filling defect in the left renal and ovarian veins that were considered thromboemboli. Brain MRI revealed multiple infarctions on the both cerebral hemispheres, but no stenooclusion was seen on MRA. TCD monitoring with agitated-saline contrast revealed curtain-type microembolic signals during a valsava maneuver. TTE was normal, but TEE showed large sized PFO. She was treated with anticoagulation. Three weeks later, she was discharged with neurological improvement except mild dysarthria and clumsiness in the left side. Her modified Rankin scale score after three months was zero.

**Conclusion:** PFO is an important cause of cryptogenic stroke, particularly in younger patients. To our knowledge, this is the first case of multiple embolic stroke related with PFO during vaginal delivery.

## ESOC-1174

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Sneddon's syndrome – Diagnosis, thrombolysis and secondary prevention

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A 37 year old female smoker with migraine with aura, asthma, hypertension, obesity and mild anxiety presented with dysphasia, dysarthria, facial droop and numb R arm, NIH 6. After thrombolysis this fell to NIH 1 at 4 hours, with mild persisting right hand paresthesia, mRS 1. CT showed old right parietal and left frontal infarcts and on MRI DWI an acute left frontal cortical infarct. FLAIR showed bilateral ischemia in the centrum semiovale.

She had suffered a stroke 4 years earlier, with right-sided numbness and clumsiness, left posterior parietal infarct and multiple small sub-cortical infarcts. She displayed livedo reticularis and was diagnosed Sneddon's syndrome (Sneddon, 1965) based on lack of cardio-embolic or large artery sources, negative antiphospholipid and vasculitis screen, and a skin biopsy showing non-vasculitic arteriopathy. The only other abnormality was a raised homocysteine level, 36. She had remained stroke-free on aspirin, but suffered migraines, mild untreated hypertension and continued to smoke.

Only one other case of thrombolysis in Sneddon's syndrome is reported (Sun, 2012), also with a good outcome, supporting its use in this rare condition. The presence of fibrinous thrombi, presumably amenable to thrombolysis, in the skin biopsy along with perivascular lymphocytic infiltrate, suggests a mechanism. The migraines and hypertension are frequent associated features but might divert attention from the true diagnosis, unless the livedo is recognized.

The best secondary prevention is unknown, but this early recurrence and new lesions, with risk of progression to cognitive impairment, prompts us to change from anti-platelet to anti-coagulation therapy.

## ESOC-0978

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### A case of Anderson-Fabry disease with cerebrovascular manifestations

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We describe a patient with isolated neurological manifestation from an Italian family later diagnosed with Anderson-Fabry disease. Clinical examination, neuroimaging (MRI), biochemical and genetic analyses were carried out in all the family. Alpha-galactosidase A activity was detected by fluorimetric assay and genetic analysis was performed by DNA sequencing.

**Case:** A male patient of 50 years with history of fatigue and TIAs presented an ischemic vertebrobasilar stroke, retinopathy and cardiomyopathy. The cardiac imaging showed Left Ventricular Hypertrophy with patchy mid-wall abnormalities.

In patients with Anderson-Fabry disease, stroke-like manifestations are frequent complication, and may be the first threatening clinical event. In young people with undefined stroke or neurological stroke-like conditions, even without signs of renal involvement, it is important to consider the diagnosis of Anderson-Fabry disease and so to perform clinical examination and biochemical analysis to avoid misdiagnosis.

## ESOC-1411

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Think twice: Two cases of bilateral carotid artery dissection

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Carotid artery dissection is a well-known cause of stroke in younger patients; it is unclear from the literature how many cases are bilateral. We discuss the presentation and cause of two cases of bilateral carotid artery dissection and suggest that its prevalence may be underestimated.

A 43 year old male presented with headache, paresthesia of his left arm and face with left-sided Horner's syndrome following a session of vigorous exercise at a charity boot camp. Despite only presenting with left-sided neurology his MRA confirmed bilateral carotid dissections. After thorough investigation his diagnosis was attributed to his excessive exercise.

Secondly, a 41 year old male was found to have bilateral carotid artery dissections five days after a whiplash injury. He presented with headache and signs of right hand dyspraxia, left-sided Horner's syndrome and a hoarse voice. Interestingly, he had been diagnosed with a unilateral dissection two years previous, then presenting with sudden onset headache and right-sided Horner's syndrome with no preceding trauma or sudden neck movements. Extensive investigations revealed a diagnosis of Ehlers Danlos type 4.

Headache combined with neurological signs and symptoms should prompt investigations for carotid artery dissections. We urge physicians to analyze both carotid arteries despite unilateral signs and symptoms. We have learnt the importance of searching for underlying pathology, connective tissue disorders in particular, especially in cases where no obvious trigger is evident or repeat presentations occur.

ESOC-1263

**27. Rare Causes, Stroke in the Young, and Case Reports**  
**A case of brain tumor masquerading as stroke – In post-MRI era**

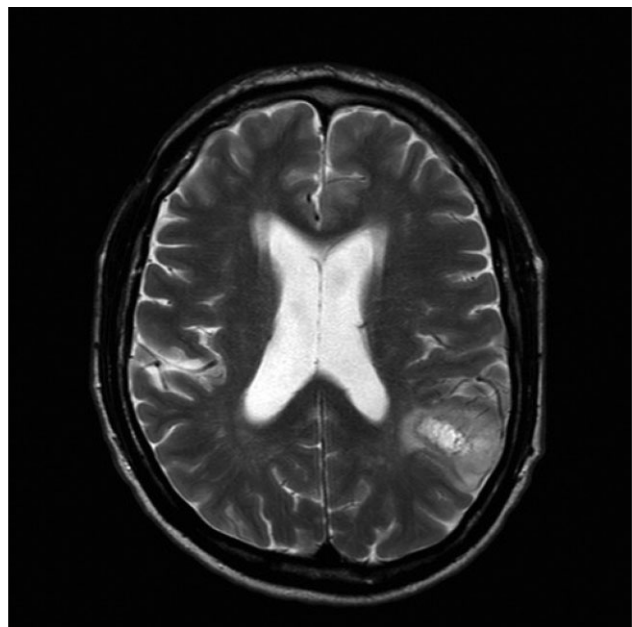
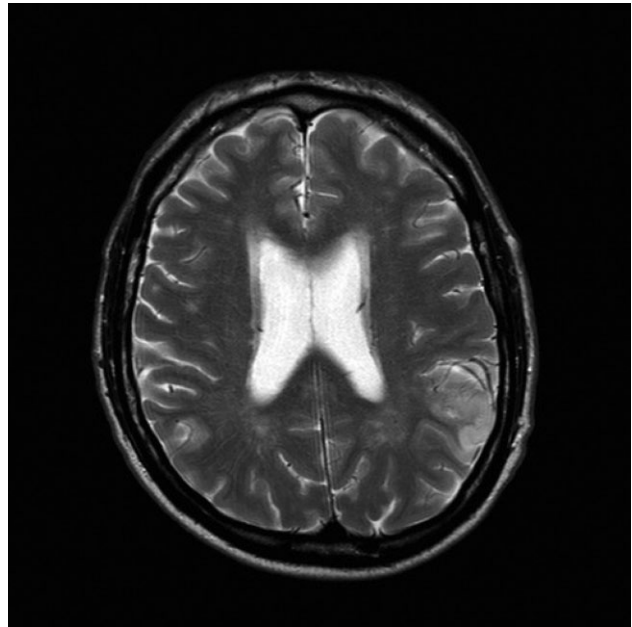
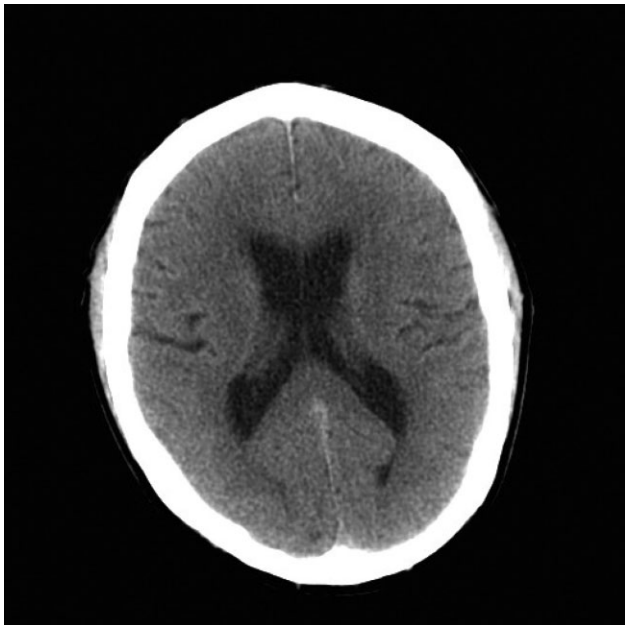
**A Harris<sup>1</sup>**, M Bhogle<sup>1</sup>, L Sekaran<sup>1</sup>, D Phiri<sup>1</sup>, N Mohammed<sup>1</sup>, S Sethuraman<sup>1</sup>

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Brain tumors masquerading as stroke were common in the pre CT/MRI imaging era. Brain tumors with imaging suggestive of stroke constitute about 5% of stroke presentations. The delay in diagnosis affects the management.

Our patient presented with right arm weakness and dysphasia 10 months ago. The CT brain and Carotid Doppler was normal then. In spite of starting him on anticoagulation for atrial fibrillation, he presented to different specialities due to ongoing episodes of dysphasia and seizures. His MRI Brain at 7 and 9 months showed a hyperintense lesion on T2 weighted sequences with no restricted diffusion. Further investigation in view of ongoing symptoms 10 months later led to a diagnosis of glioblastoma.

It requires high index of suspicion when patients present with recurrent symptoms of stroke despite treatment. Potential delays are still possible despite better imaging. Further studies and research are required to avoid delays in the diagnosis and management.



ESOC-1173

**27. Rare Causes, Stroke in the Young, and Case Reports**  
**Monocular diplopia after left posterior cerebral artery territory infarction**

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*Background:* Monocular diplopia is typically considered as an “eye disorder” but can be exceptionally present in central nervous disorders.

*Methods:* We report a 78 year-old man presenting acutely a « blurred vision » on his right side and episodes of right monocular diplopia. The next day, bedside examination of the visual fields by confrontation showed a right homonymous hemianopia. Three days after the event, the patient

complained of a disturbing right monocular diplopia. Examination of the visual fields by confrontation at that time appeared normal and the patient described a right monocular diplopia increasing when looking upside and to his right. Pinhole test did not improve the diplopia. Color vision, reading, object and faces recognition were spared.

**Results:** CT and MRI showed a left posterior cerebral artery infarction. EEG was normal. Ophthalmologic examination was normal. Formal visual field assessment with Goldman perimetry demonstrated right homonymous hemianopia.

**Conclusion:** True monocular diplopia can be observed in left posterior cerebral artery infarction and therefore does not exclude a central neurological disorder.

## ESOC-1179

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Pituitary apoplexy: An unusual complication of carotid endarterectomy

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**Background:** Pituitary apoplexy is a well-described complication of the post-partum period. It rarely occurs in association with other facilitating factors and has been reported after major cardiac surgery. To our knowledge, this is the first report of pituitary apoplexy following carotid endarterectomy.

**Methods:** We present a 76-year-old male with a past medical history of hypertension, right MCA minor strokes and a known pituitary adenoma with invasion of the cavernous sinus space. US and MRA follow up demonstrated a progressive stenosis of the right carotid artery (>70%). A right carotid endarterectomy was performed under general anesthesia. The patient was confused and agitated in the immediate postoperative period. The next day, he presented a bilateral and symmetric ptosis, areflexic pupils and divergent strabismus. Only adduction eye movements were possible, voluntary and reflex vertical movements were abolished. The rest of the neurological examination was unremarkable.

**Results:** MRI demonstrated pituitary apoplexy. Biological evaluation demonstrated pituitary insufficiency. The patient was treated with thyroid hormones and hydrocortisone. There was no improvement in his eye movements.

**Conclusion:** To our knowledge, this is the first report of a case of pituitary apoplexy following carotid endarterectomy.

## ESOC-1182

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Coma and cerebral venous thrombosis associated with meningitis and posterior fossa empyema in an 18-year-old patient with familial cholesteatoma

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**Background:** Cholesteatoma are generally considered as benign conditions. We describe a young patient with multiple life-threatening complications of a cholesteatoma.

**Methods:** We present an 18-year-old male with a known familial cholesteatoma who developed bacterial meningitis. Despite broad-spectrum antibiotics, he rapidly developed high fever, increased neck stiffness and altered consciousness. His neurological exam was otherwise unremarkable.

**Results:** Urgent MRI demonstrated a right cholesteatoma with intracranial extension, a right epidural posterior fossa empyema with mass effect on the cerebellum and the brainstem, compression of the right lateral sinus; the ipsilateral right sigmoid sinus was thrombosed and hypersignal lesions of the right occipital and external temporal lobes (DWI) were observed. The patient underwent urgent neurosurgery (burr hole and catheter drainage) and treated with anticoagulants. The patient experienced a rapid and complete clinical and radiological recovery.

**Conclusion:** We describe a young patient with a known familial cholesteatoma who developed meningitis and, despite treatment with broad spectrum antibiotics, an epidural posterior fossa empyema causing compression of the cerebellum, the brainstem, the lateral sinus – causing sigmoid sinus thrombosis and temporo-occipital ischemic lesions. Urgent surgical treatment of the empyema was needed with anticoagulants, allowing a full recovery.

## ESOC-1281

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Varicella-associated angiitis in pediatric stroke: A case report

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**Background:** Varicella-associated arteritis is one of the most frequent causes of pediatric stroke, but in many cases it is difficult to diagnose because of the late onset of manifestations after the acute infectious episode.

**Case report:** an 8-year-old boy presented at the emergency room of our hospital after the sudden onset of speech difficulties and severe right hand weakness, 3 months after a systemic varicella infection with pharyngeal involvement. The neurologic examination revealed right facial palsy, dysarthria and right distal upper limb plegia. MRI scan revealed an acute ischemic lesion in the left posterior lenticulo-capsular region, characterized by restricted diffusivity in DWI sequences and hyperintensity in T2 sequences. MRI-angiography showed narrowing at the upper-posterior branch of the left middle cerebral artery. Routine blood tests analysis, autoimmune and thrombophilic screening were normal. In relation to the history of recent varicella infection, a lumbar puncture for the cerebrospinal fluid (CSF) analysis was performed. CSF proteins and glucose were normal and cell count resulted increased. Polymerase chain reaction (PCR) for VZV-DNA was negative but intrathecal CSF synthesis of Varicella IgG antibodies was detected. Diagnosis of varicella-zoster virus arteritis was therefore made and antiviral therapy with acyclovir iv and acetylsalicylic acid were administered.

**Discussion:** the diagnosis of varicella-associated arteritis always need to be considered in pediatric patients with recent VZV systemic infection history. A negative VZV DNA PCR does not exclude the diagnosis of VZV vasculopathy whereas the detection of anti-VZV IgG antibody in CSF was a more sensitive indicator of VZV vasculopathy.

## ESOC-0852

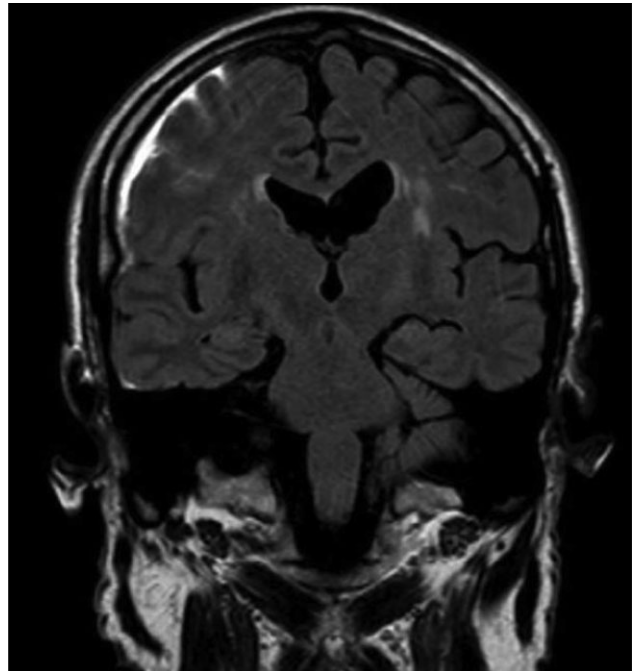
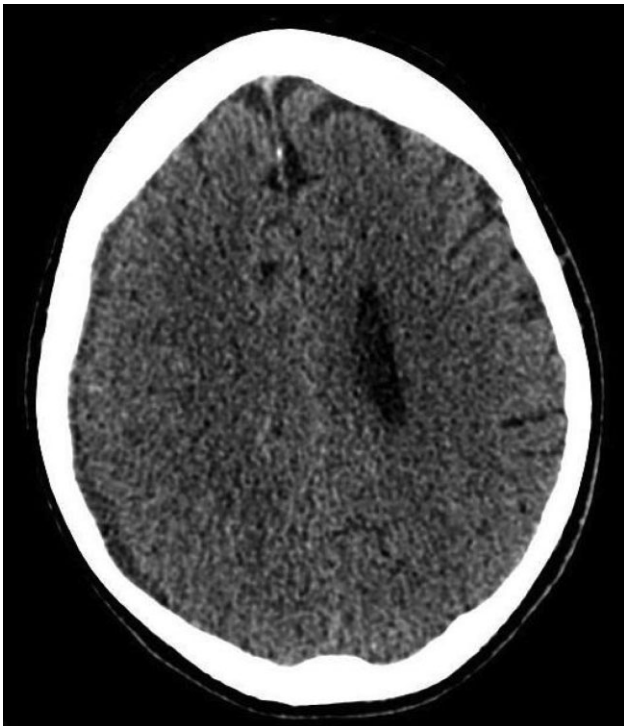
**27. Rare Causes, Stroke in the Young, and Case Reports****Subdural hematoma: A capsular warning syndrome mimic**K Mahawish<sup>1</sup><sup>1</sup>*Elderly Care, Warrington Hospital, Warrington, United Kingdom*

Capsular warning syndrome (CWS) is rare, accounting for 1.5% of transient ischemic attacks and carries a poor prognosis, with a 7-day stroke risk of 60% without prompt antithrombotic treatment.

I present the case of a 69 year old gentleman with a past medical history of hypertension and radical nephrectomy for renal cell carcinoma. He presented with a 48 hour history of recurrent episodes of dysarthria associated with left facial and arm weakness, each episode lasting 10 – 15 minutes followed by full resolution; features typical of CWS.

A contrast enhanced CT brain scan demonstrated a low density 5 mm subdural overlying the right cerebral convexity with localized mass effect. MR brain imaging demonstrated a small right subdural, however no restricted diffusion on DWI, excluding acute ischemia. The patient was managed non-operatively, and lamotrigine commenced for presumed seizures. The symptoms resolved within a few days and the patient discharged.

There are a number of reports of recurrent transient neurological features associated with subdural hematoma in the literature. Cortical features, mainly dysphasia, tend to predominate. The pathophysiology remains unclear and hypothesized to be due to; compression of adjacent cortical blood vessels; seizure activity; cortical depression due to mechanical stimulation of the cortex; fluctuations in intracranial pressure; and small, repeated hemorrhages into the subdural space. Factors precipitating neurological deterioration within the literature include periods of relative hypotension and changes in posture, with symptoms uniformly resolving following hematoma evacuation. Here, the termination of symptoms following anticonvulsant treatment strongly suggests seizures as a cause.



## ESOC-1507

**27. Rare Causes, Stroke in the Young, and Case Reports****Urgent decisions and a tight spot: Cardioembolic infarction of a herniated cerebellar tonsil**R Mc Donagh<sup>1</sup>, J A Harbison<sup>1</sup><sup>1</sup>*Medicine for the Elderly, St James's Hospital, Dublin, Ireland*

We present the case of a previously well 30 year old woman presenting with a sudden onset of dizziness and headache. She was initially investigated with a CT Brain and lumbar puncture, which yielded no diagnosis. Subsequent MR scan revealed multiple posterior circulation infarcts, along with a previously undiagnosed Arnold-Chiari malformation and syringomyelia. Edema of an infarct in the herniated tonsils caused progressive neurology. This occurred between 48 and 72 hours after the stroke when edema would be expected to be maximal, and necessitated cervical decompression surgery. The etiology of her stroke was a paradoxical embolus via a patent foramen ovale (PFO). There are no cases found on review of literature that link PFO or stroke with syringomyelia. Although her syringomyelia had not caused our patient any symptoms prior to this admission, it clearly complicated the management of her stroke.

This case also highlights issues surrounding brain imaging in acute neurological presentations. CT brain is generally the investigation performed to outrule contraindication to lumbar puncture. CT imaging may not clearly identify an Arnold-Chiari malformation, particularly when limited to axial views. The finding may influence the decision to perform a lumbar puncture, although it is not an absolute contraindication, particularly where the purpose is to out rule subarachnoid hemorrhage in the context of a normal CT brain.

MR is the scan of choice in this case, where a patient presents with acute neurological signs suggestive of a potential posterior circulation stroke. However, MR is not widely available outside working hours.

## ESOC-0774

**27. Rare Causes, Stroke in the Young, and Case Reports****Bihemispheric stroke in eosinophilic granulomatosis and polyangiitis**M O McCarron<sup>1</sup>, M Kelly<sup>2</sup><sup>1</sup>Neurology, Altnagelvin Area Hospital, Derry, United Kingdom<sup>2</sup>Respiratory Medicine, Altnagelvin Area Hospital, Derry, United Kingdom

**Background:** Stroke can be more difficult to diagnose in patients under 50 years, in the presence of other organ disease and fluctuating agitation. We present a 49 year old man who had bihemispheric infarction in the context of emerging eosinophilic granulomatosis with polyangiitis (EGPA).

**Case report:** A 49 year old man presented with diarrhoea and vomiting and subsequently had an epileptic seizure. He became hypoxic and required intubation and ventilation. Skin bruises were noticed. Subsequently he became intermittently very agitated with episodes of tachypnoeic and apparent apnoea. He had no obvious lateralizing neurology.

**Results:** Cerebrospinal fluid was normal. EEG revealed an encephalopathy. Hematology demonstrated increasing eosinophilia, peaking at  $15.1 \times 10^9$ . CT scan of chest showed extensive bilateral interstitial thickening with interlobar fluid and bibasal consolidation. There were multiple watershed areas of restricted diffusion in both hemispheres on MRI of brain. There was proteinuria.

Empirical steroid therapy correlated with gradual clinical improvement. The eosinophilia resolved. One year on he is stable on mycophenolate.

**Conclusions:** EGPA is a systemic vasculitis of small to medium sized arteries with lung, skin, brain and kidney features. As stroke in EGPA may not be clinically obvious, early neuroimaging is important.

## ESOC-0801

**27. Rare Causes, Stroke in the Young, and Case Reports****Cerebrovascular events as presenting manifestations of myeloproliferative neoplasm**E Ong<sup>1</sup>, F Barraco<sup>2</sup>, A Paire<sup>2</sup>, V Desestret<sup>1</sup>, N Nighoghossian<sup>1</sup>, L Derex<sup>1</sup>, A Vighetto<sup>1</sup>, D Biotti<sup>1</sup><sup>1</sup>Neurology, Hopital Wertheimer, LYON, France<sup>2</sup>Neurology, Hopital Lyon Sud, LYON, France

**Objective:** To determine the incidence and main characteristics of cerebrovascular events as presenting manifestation of Myeloproliferative Neoplasm (MPN).

**Materials and methods:** The Hematology in Lyon registry (HEMILY) is a prospective database (763 patients) collecting all MPN diagnosed since 2005 in the Rhône-Alpes district (France). MPN were divided into 4 groups: polycythemia Vera (PV), essential thrombocythemia (ET), myelofibrosis (MF) and atypical MPN. The ischemic stroke subtype was classified according to the TOAST criteria.

**Results:** A stroke history revealed MPN in 35 patients (4,3%). Twenty-two patients (63%) had an ischemic stroke, eight patients (23%) a transient ischemic attack, four patients (11%) a cerebral venous thrombosis and one patient (3%) a hemorrhagic stroke. All patients had hemoglobin count and/or platelets count abnormalities. Twelve patients (34%) had PV, twenty-one patients (60%) had ET, one patient (3%) had MF and one patient (3%) an atypical/unclassified MPN. The JAK2V617F mutation was found in 83% of patients. In eighteen patients (51%), an additional mechanism of stroke was present (atherosclerosis in ten patients, atrial fibrillation in one patient and dissection in one patient). The median NIHSS at entrance was 2. The median modified Rankin Scale at 3 months was 0. Compared to the global MPN population, stroke MPN patients

presented a significantly higher level of hemoglobin ( $p < 0,001$ ) and were more frequently positive for the JAK2 V617F mutation ( $p = 0,044$ ).

**Conclusion:** Stroke revealing MPN is rare. However careful attention should be paid to the blood count even in patients with an obvious stroke etiology.

## ESOC-1419

**27. Rare Causes, Stroke in the Young, and Case Reports****Unusual CT head findings in a stroke patient**S Ponnambath<sup>1</sup>, L Gbadamoshi<sup>1</sup>, L Shaw<sup>1</sup><sup>1</sup>Department of Geriatric Medicine, Royal United Hospital, Bath, United Kingdom

**Case report:** A 63 year old lady presented with right-sided weakness and aphasia while she was abroad on holidays. Past history included hypertension, diabetes mellitus, implantable cardioverter defibrillator inserted for cardiomyopathy, hypothyroidism, cognitive impairment, hearing loss in left ear and vitamin D deficiency. Examination revealed facial weakness and decreased power on right side and dysphasia. CT head scan did not show any bleed and she received emergency thrombolysis. Following treatment her weakness improved but expressive dysphasia persisted. She returned to UK for further management. Repeat CT showed small area of acute left MCA territory infarction and extensive bilateral basal ganglia calcification and further calcification in occiput and cerebellum. This raised the possibility of Fahr's disease (FD). Bloods were unremarkable. She had declining memory over 3 years which got worse over past 6 months. She was reviewed by psychiatrist and was diagnosed with fronto-temporal dementia. The findings as a whole is most likely secondary to FD.

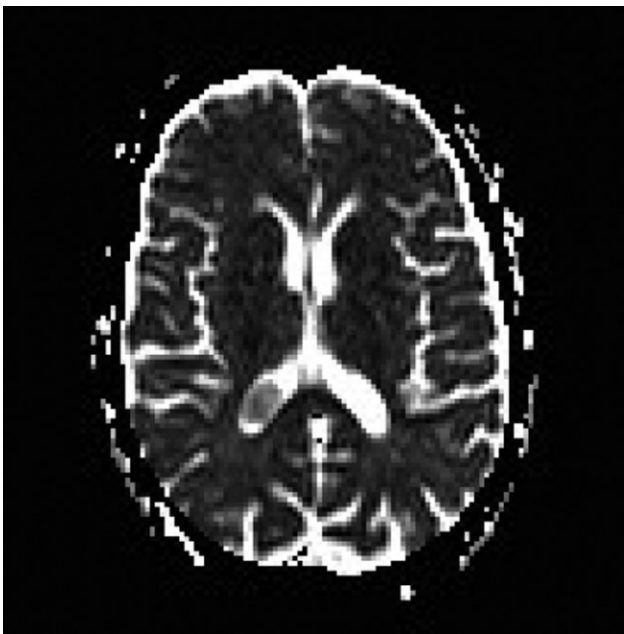
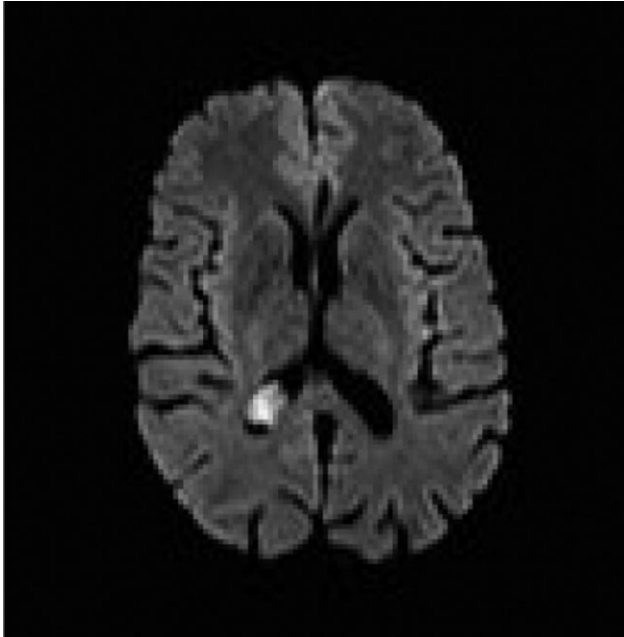
**Conclusion:** FD is a rare neurological disorder characterized by abnormal deposits of calcium in basal ganglia and cerebral cortex. It may present with seizures, parkinsonian features, speech disturbance and neuropsychiatric symptoms. We should keep an open mind when we see calcifications on CT scan. It could be secondary to a rare cause. It is relevant as the affected individual and their families could benefit from genetic counselling.

## ESOC-1145

**27. Rare Causes, Stroke in the Young, and Case Reports****A rare choroid plexus infarct in a patient with vertebral artery dissection**J Stapleton<sup>1</sup>, L Valenzuela<sup>1</sup>, M Ibrahim<sup>1</sup>, L Sekaran<sup>1</sup>, D Phiri<sup>1</sup>, S Sethuraman<sup>1</sup><sup>1</sup>Medicine, Luton & Dunstable University Hospital, Luton, United Kingdom

Infarcts of choroid plexus are rare, usually unilateral, and clinically silent on its own. Our patient aged 51 with background of epilepsy presented with sudden onset left-sided ataxia, left facial paresthesia, and dizziness. He was found to have bilateral rotatory nystagmus, left-sided Horner's syndrome, dysmetria, dysdiadochokinesia and unsteadiness of his feet. Motor power was normal in both upper and lower limbs. He had reduced sensitivity to pain and temperature on the right side and reduced sensitivity to touch on the left side of his face.

Examination of other systems was unremarkable. MRI brain showed restricted diffusion in DWI and ADC map on the right choroid plexus with multiple infarcts involving left medulla, and cerebellum. MR carotid angiogram confirmed left vertebral artery dissection. He was started on anticoagulation and improved with rehabilitation.



## ESOC-0873

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Bilateral paramedian thalamic stroke due to artery of Percheron occlusion in a patient with atrial fibrillation and newly diagnosed kidney cancer

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Bilateral thalamic infarct is a rare presentation of stroke. Usually, it occurs as a consequence of anatomical predisposition combined with stroke risk factors such as embolic diseases.

We report a case of a 61-year-old man who is an active smoker with untreated hypertension. The patient was found unconscious by his wife in the early morning. The exact time of the onset was unknown. In Emergency Room, his Glasgow Coma Scale score was 10. The left pupil was dilated and showed no reaction to light. His vertical gaze was paralyzed and the left eye was deviated downwards and outwards. Moreover, he had left-sided hemiparesis. Although CT scan gave negative results, the ischemic changes, that were consistent with acute infarction in bilateral thalami, were observed in magnetic resonance imaging (diffusion weighted imaging).

Patient was treated conservatively. The diagnostic workup showed the presence of hyperlipidemia and paroxysmal atrial fibrillation. Moreover the patient was diagnosed with renal cancer with hepatic metastases. The routine MRI showed subacute bilateral paramedian thalamic and antero-medial midbrain infarction suggesting occlusion of the artery of Percheron. The functional outcome, which was pure, might have been influenced by comorbidity.

The presented case is an example of a bilateral paramedian thalamic and rostral midbrain stroke from the spectrum of bilateral thalamic infarcts. The presenting author has been supported by National Science Center (grant UMO-2011/01/B/NZ7/05402).

## ESOC-1459

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Strokes related to suicide attempts: Frequency, mechanisms and outcome

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*Background:* Suicide attempts (SA) are frequent, but only few patients with strokes related to suicide attempts (SRSA) are described. We aimed at determining frequency, mechanisms and outcome of such patients through systematic observation.

*Methods:* We prospectively collected data on patients with ischemic SRSA admitted to our university hospital over 10 years. We calculated the proportion of SRSA among every strokes and the proportion of SA immediately before stroke among all SA. Medical history, psychiatric co-morbidity, and stroke severity were reviewed and stroke severity were measured. A thorough etiological work-up for stroke was performed. Outcome was measured at 12 months using the modified Rankin scale (mRS). Known completed suicides were examined.

*Results:* We identified five SRSA among 6'278 strokes (0.08%) and among 3'701 SA (0.14%) arriving at our institution. SRSA were younger (median 52 years) and less severe than usual stroke patients. Multiple mechanisms were present: hanging with carotid artery dissections, hypovolemic from multi-site venesection, coagulation activation from self stabbing and atrial fibrillation during drowning. Psychiatric comorbidity included acute depressive episodes, recurrent psychotic depression, and bipolar disorder. At 12 months, neurological outcome was good with a median mRS of zero, but one patient committed suicide 6 days after his SA.

*Conclusion:* SRSA is rare and may be missed without appropriate neuro-imaging in patients with neurological signs after SA. Stroke mechanisms are heterogeneous and result from various suicidal methods. A good neurological outcome was observed and was likely related to younger age and low initial stroke severity.



## ESOC-1308

**27. Rare Causes, Stroke in the Young, and Case Reports****An unusual cause of carotid-occlusion and stroke in a young woman**

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**Background:** Takayasu arteritis (TA) is a rare chronic systemic disease affecting predominantly young women with an age of onset between 10 and 40 years. While pathogenesis is still not fully understood, several etiological factors have been proposed, including genetic predisposition. Active inflammation is mainly found in large- and medium-sized arteries with predilection for the aorta and its branches.

In the early phase unspecific systemic symptoms may appear, whereas vascular symptoms are commonly seen as the disease progresses.

**Case:** A 26-year old female student of Finnish origin experienced acute onset of speech disturbance and right hemiparesis. The medical history revealed colitis ulcerosa. Neurologically she presented with forced conjugate gaze to the left, global aphasia and right-sided hemiplegia. The NIHSS was 21 points.

MRI demonstrated an occlusion of the left carotid artery and the M1-segment. The CT-angiography suggested an acute dissection of the aortic arch (Stanford Type I).

Thoracotomy revealed no dissection of the aortic arch. After reviewing the MRI-/ CT-images the initially suspected dissection of aorta were interpreted as narrowing due to inflammation as seen in vasculitis. Furthermore, wall thickening of other aortic branches was shown. Later, the diagnosis of TA was made according to the American College of Rheumatology guidelines, supported by FDG-PET demonstrating active vascular inflammation. Steroid treatment was initiated while the patient recovered from stroke.

**Discussion:** Stroke as a first clinical symptom in TA is rare, specifically in non-Asian populations. However, our case report suggests that TA should be considered as differential diagnosis in young women with stroke.

## ESOC-1436

**27. Rare Causes, Stroke in the Young, and Case Reports****Delayed hyperperfusion syndrome after extra-intracranial bypass: A case report**

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**Introduction:** Extra-intracranial bypass is a therapeutic option for patients with chronic occlusion of the internal carotid artery (ICA) and recurrent ischemic cerebrovascular events. This procedure has no proven benefit in clinical trials but can be considered an option in selected patients. We report one patient who suffered an intracerebral hemorrhage due to hyperperfusion syndrome after the procedure.

**Materials and methods:** A 64 year-old patient with a past medical history of Arterial hypertension, smoking, hyperlipidemia, ischemic heart disease and chronic left ICA occlusion, who presented four minor strokes in a period of 6 months involving the left ICA territory without significant sequelae, despite optimized medical treatment.

**Results:** Cerebral MRI showed multiple borderline ischemic lesions in the left MCA-ACA and MCA-PCA territories. Cerebral angiography confirmed complete left ICA occlusion and compensation by anterior and posterior communicating arteries. Cerebrovascular reactivity measured

by Transcranial Doppler and perfusion SPECT before and after the Acetazolamide test showed and exhausted reserve.

Extra-intracranial bypass (superficial temporal artery with MCA) was performed, and a follow-up cerebral angiography showed significant hemodynamic improvement and reduction of collateral circulation. Blood pressure (BP) was difficult to control during the postoperative period and the patient suffered new ischemic events. Antiplatelet therapy was initiated. Three weeks after the procedure, the patient suffered a left fronto-parietal intracerebral hemorrhage.

**Conclusions:** Delayed intracerebral hemorrhage due to a reperfusion syndrome is a rare complication after extra-intracranial bypass. Poor BP control, previous stroke and antiplatelet therapy may have contributed to its occurrence in this case.

## ESOC-0834

**27. Rare Causes, Stroke in the Young, and Case Reports****Breaking age limits – Successful stroke thrombolysis in the oldest old, a 102-year-old gentleman**

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**Objective:** For very old patients with acute ischemic stroke, IV thrombolysis remains a controversially debated off-label treatment option despite recent evidence from the International Stroke Trial-3 indicating that benefit may not be diminished in elderly patients. We report successful stroke thrombolysis in a 102-year-old gentleman.

**Case:** The patient was admitted to our emergency room with acute right-sided hemiparesis resulting in a National Institute of Health Stroke Scale (NIHSS) score of 6. Prior to the actual event he only had mild cognitive impairment, ambulated with a wheeled walker, and needed little help with activities of daily living. His past medical history was remarkable for hypertension, diabetes, pace-maker implantation due to AV block, and two prior cerebrovascular ischemic events without residual symptoms. Preexisting medication included aspirin, lansoprazole, bisoprolol, spironolactone, and insulin. Because of the patient's relative fitness prior to the actual event, the admission non-contrast CT scan (showing only moderate leukoaraiosis) and favorable time window, we decided to carry out off-label treatment following informed consent with 50 mg alteplase starting 90 minutes after symptom onset. IV thrombolysis was followed by complete resolution of symptoms. Further work-up suggested microangiopathy as stroke etiology. He was put on clopidogrel and discharged 5 days after admission.

**Conclusion:** To our knowledge, this is the oldest reported stroke patient treated with IV thrombolysis, 22 years beyond the product information's age limit (80 years). In selected centenarians with acute stroke, IV thrombolysis may be an off-label treatment option.

## ESOC-0845

**27. Rare Causes, Stroke in the Young, and Case Reports****Record door-to-needle time in stroke thrombolysis – Doing it in 3 minutes**

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**Objective:** In stroke patients receiving IV thrombolysis, in-hospital delays should be kept as short as possible. We report on a patient with a record door-to-needle time (DNT) of 3 minutes achieved by applying a stroke care protocol inspired by the Helsinki model.

**Case:** After ambulance prenotification with patient details (name; sex – male; age – 83 years; date of birth; symptoms – acute right-sided brachiofacial hemiparesis and dysarthria; onset time; past history – longstanding hypertension, 2 transient ischemic attacks 13 and 4 years ago; medication – clopidogrel, enalapril, amlodipine, escitalopram; weight) the stroke neurologist alerted the administrative, emergency, laboratory, and radiological personnel involved in hyperacute stroke care to meet the patient, who was transferred on the ambulance stretcher directly onto the CT table bypassing the emergency room. After a rapid clinical evaluation and a CT scan (showing confluent leukoaraiosis), a pre-prepared IV bolus of alteplase was given immediately following the neurologist's scan interpretation. DNT and onset-to-treatment time were kept to 3 and 51 minutes, respectively. IV thrombolysis was followed by near-complete resolution of symptoms, the National Institute of Health Stroke Scale score improved from 6 to 1 (residual slight dysarthria). Repeat CT exam did not depict infarct demarcation. Further work-up suggested microangiopathy as stroke etiology.

**Conclusion:** This is the first stroke patient with a reported record DNT as short as 3 minutes. In selected patients, dedicated stroke care and application of the Helsinki model may enable very short DNTs by organizing in-hospital management while the patient is being transported.

## ESOC-0123

**27. Rare Causes, Stroke in the Young, and Case Reports****Cancer in young adults with ischemic stroke**

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**Background:** Cancer is a risk factor for ischemic stroke. However, little is known about cancer among young patients with ischemic stroke. We studied the frequency of cancer and its relation with long-term risk of death among young patients with first-ever ischemic stroke.

**Methods:** 1002 patients aged 15 to 49, registered in the Helsinki Young Stroke Registry and with a median follow-up of 10.0 years (IQ range 6.5–13.8) after stroke were included. Historical and follow-up data were derived from the Finnish Care Register and Statistics Finland. Survival between groups was compared with the Kaplan-Meier life-table method, and Cox proportional hazard models were used to identify factors

associated with mortality. The study protocol was approved by an institutional Ethics Committee.

**Results:** Cancer diagnosis was made in 77 (7.7%) patients, of whom 39 (3.9%) had cancer diagnosed prestroke. During the poststroke follow-up, 41 (53.2%) of the cancer patients died. Median time from prestroke cancer to stroke was 4.9 (1.0–9.5) years and from stroke to poststroke cancer 6.7 (2.7–10.9) years. Poststroke cancer was associated with age >40 years, heavy drinking and cigarette smoking. The cumulative mortality was significantly higher among the cancer patients (68.6%, 95% CI 52.0–85.3%) compared with patients without cancer (19.7%, 95% CI 16.3–23.2%). Active cancer at index stroke, melanoma, and lung/respiratory tract cancer had the strongest independent association with death during the follow-up when adjusted for known poststroke mortality prognosticators.

**Conclusions:** Cancer is common in the patient population with stroke at a young age, and is generally associated with unfavorable survival.

## ESOC-0604

**27. Rare Causes, Stroke in the Young, and Case Reports****Fatal stroke mimic**

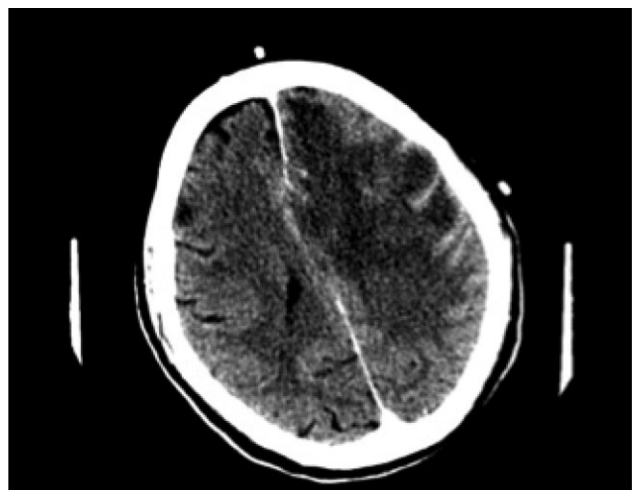
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Acute Fulminating Haemorrhagic Leukoencephalitis (AHLE) or Hurst's disease is a hyperacute and fatal form of ADEM (Acute Disseminating Encephalomyelitis). It has a similar presentation as acute Stroke and radiologically it can mimic a tumor or an abscess. The infrequency with which this is encountered makes it a formidable diagnostic challenge.

A 73 year old gentleman was admitted with sepsis on a background of Myelodysplasia. He was managed under the hematology team with broad spectrum IV antibiotics, blood transfusions and G-CSF. Within a week of admission he developed acute delirium with a normal CT head. The next day he woke up with a dense right hemiplegia, aphasia and reduced GCS (E2, V4, M5). The Stroke team were contacted and he had a 12 hour interval CT head that showed extensive hypo-attenuation in the left hemisphere with cortical sparing. This was followed by a CT head with contrast that showed aggressive expansion of this area of hypo-attenuation but no evidence of an abscess or tumor. Within 24 hours he deteriorated further and required intubation. He had an MRI scan that revealed an aggressive lesion thought to be ADEM. This diagnosis was confirmed to be Hurst's disease after a consensus between the Stroke, Neurology and Neuroradiology teams.

This case identifies an extremely rare condition that can present as a stroke mimic.



## ESOC-0674

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Moyamoya disease (case report)

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Moyamoya disease is a rare chronic progressive disease of brain vessels in which certain arteries in the brain are constricted. During the disease a collateral circulation develops around the blocked vessels to compensate for the blockage, and on angiography these collateral vessels have the appearance of a “puff of smoke.” Moyamoya is extremely rare disease, especially outside of Japan.

The article presents case report of Moyamoya disease in patient 27-year-old from Tomsk, Russia. The diagnosis of moyamoya is suggested by MRI-angiogram results and an aspect of the disease in accordance to the diagnostic criteria. The clinical features is an acute stroke in right middle cerebral artery with dysarthria and paralysis of VII and XII cranial nerves. MR angiography (Pic. 1) was revealed stenosis of the main vessels circle of Willis (stenosis of the internal carotid artery, anterior and middle cerebral artery, anterior communicating artery on both sides) with the formation of collaterals vessels. Inadequate blood supply caused the development of multiple ischemic brain damage with different degrees of limitation: lacunar infarctions in right and left hemispheres, post ischemic cyst in region vascularization of left middle cerebral artery.



**Fig. 1** The patient was treated by vascular and metabolic therapy. On discharge the patient's condition improved significantly: decreased facial asymmetry, completely recovered speech articulation. Recommendations were made for planned specialized high-tech surgical treatment.

## ESOC-0557

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Prevalence of Fabry disease in a cryptogenic ischemic stroke young patients cohort in Mexico

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**Background:** although Fabry disease is a rare lysosomal disease related to  $\alpha$ -galactosidase deficiency, ischemic stroke could be the first manifestation in young patients, even before kidney disease. Our aim was to establish the prevalence of Fabry disease in a young patients cohort (<50 years) classified as cryptogenic ischemic stroke.

**Methods:** we recruited Mexican mestizo patients younger than 50 years from our institutional database, classified as cryptogenic stroke according to ASCOD etiologic criteria, with the qualifying event from 1991 to 2004. Demographic, clinical, laboratory, imaging and functional outcome characteristics were collected. All male patients were screened with  $\alpha$ -galactosidase activity levels, and mutations in the  $\alpha$ -galactosidase gene was performed in female patients.

**Results:** A total of 58 patients were included (31 men; median age 35 years, interquartile range 26–44), with a median follow-up of 59 months (interquartile range 14–141). Main risk factors documented were smoking (17.2%), hypertension (8.6%) and hyperlipidemia (6.9%). Partial anterior circulation (46.6%) and posterior circulation (32.8%) infarctions were the clinical features more frequently observed. Modified Rankin score of good prognosis (0–2) was present in 62.1% patients at discharge and 75.9% at final follow-up; no deaths were recorded. Mean  $\alpha$ -galactosidase activity levels in men were 3.88  $\mu$ mol/L/h. Only one female case was reported as definite Fabry disease in our sample (1.72%, CI 95% 0.96–1.11;  $p = 0.28$ ) and none in men.

**Conclusion:** In our cohort of young patients with ischemic stroke classified as cryptogenic, uncommon metabolic and genetic conditions should be screened as possible targets for additional therapy.

## ESOC-0484

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Persistent trigeminal artery and valsalva maneuver – Risky combination for transient ischemic attack

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The persistent trigeminal artery (PTA) represents the most frequently reported persistent carotid-basilar anastomosis between the carotid and vertebro-basilar circulation with incidence of 0,1 to 1.0% in adult population. The PTA ist the biggest of the four known embryonic anastomoses. It's natural obliteration occurs normally between 11.5 to 14 mm embryonic period. If not, the vessel persists open. The Saltzman Classification differentiate three Types.

We present a 48 years old male with acute onset of persistent linear horizontal nystagmus to the right, rotatory vertigo and ataxia of the right upper extremity. The symptoms occurred after massive vomiting due to endoscopically verified gastritis. Acute stroke MRI showed no diffusion lesion but a perfusion reduction over the right cerebellar hemisphere. The functional transcranial colour-coded duplex sonography showed PTA and hypoplastic basilar artery. The vomiting was simulated by valsalva maneuver and caused reproducible reduction of blood flow velocity in the PTA.

We supposed an insufficient autoregulatory function (embryonic vessel) and / or an incomplete steal phenomenon in combination with an additional poor anterograde flow from BA.

We present an overview about embryonal development of the brain arteries and a detailed case report with rare hemodynamic cause of TIA in the posterior circulation.

## ESOC-0660

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Giant cell arteriitis and stroke

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Stroke due to giant cell arteriitis (GCA) of brain-supplying vessels is rare. We report 6 patients that were admitted with acute neurological deficits due to cerebral infarction. In addition to typical symptoms (blurred vision, jaw claudication and headache), the diagnosis was supported by elevated C-reactive-protein, leucocytes and erythrocyte-sedimentation-rate. A positive biopsy of the external temporal artery (n = 3) or a halo-sign in ultrasound confirmed the diagnosis. All patients had multi-segmental stenosis (MRA) with hypoechoic thickening of the vertebral artery (ultrasound) or contrast enhancement in high resolution MRI of the intracranial carotid artery.

Therapeutic management: High-dose oral steroids, simvastatin, ASA and clopidogrel were initiated. Additionally, 5 patients received cyclophosphamide according to the CYCLOPS-scheme. In one patient, tocilizumab was applied as option to avoid progression. Patient outcome varied considerably. While 3 patients could complete 6 courses of CYCLOPS with a stable clinical outcome and with an adverse effect of pneumonia in only one case, 3 other patients died within a few weeks after diagnosis. These patients showed a rapid deterioration with progressive strokes due to inflammatory vessel occlusions. In two patients, an endovascular angioplasty was performed as ultima ratio but did not prevent further progression and lethal outcome.

*Discussion:* Therapeutic options for the management of GCA patients with cerebral involvement frequently fail to prevent further progressive disease. New therapeutic interventions need to be validated to improve GCA patient care.

## ESOC-0466

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Steno-occlusive lesion of the intracranial internal carotid artery: One vascular occlusion site, two pathogenic mechanisms in two very young patient-cases report

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*Background:* Ischemic stroke in the young patient has multiple causes. Many times we have to assess, all the vascular aspects of the artery wall, the blood constituents and the possibility of cardioembolism. In this presentation I show two rare, but important to consider, mechanisms of ischemic strokes in two very young women (25 and 27 years old) with obstruction of the intracranial ICA with consecutive cerebral infarcts.

*Methods:* Both cases have had the same clinical presentation with sudden right-sided limb weakness and speech disorder. The CT scan show left

middle cerebral artery infarct predominantly in the capsulo-lenticulo-striatal area. In both cases the echocardiography was normal. Doppler ultrasound revealed an high resistance flow pattern in left common and internal carotid arteries. Doppler transcranial in one case showed a spectral alteration of velocimetric curve of left distal ICA and M1 suggestive for tight stenosis. DSA indicated a classic "string of beads" appearance of left carotidian "T" and of M1 diagnostic for medial fibrodysplasia. The other case had an occlusion of terminal left ICA with poststenotic flow in MCA at transcranial Doppler and DSA confirm the occlusion of left "T" carotidian with no fill of A1 and minimal fill of M1 and, very important, with impressive left fronto-temporal collateral circulation suggestive for unilateral left moyamoya disease.

*Results:* Two young female patient with an ischemic MCA stroke that are carriers of a two serious chronic conditions: fibromuscular dysplasia and unilateral moyamoya disease.

*Conclusions:* Even if, is only diagnostic, DSA has to be perform in young people with ischemic stroke without dissection, cardioembolism and thrombophilia.

## ESOC-0179

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Post-thrombolysis intracerebral hemorrhage in stroke mimic: Two cases and review of literature

N Goyal<sup>1</sup>, S Male<sup>1</sup>, T Georgios<sup>1</sup>, R Zand<sup>1</sup>

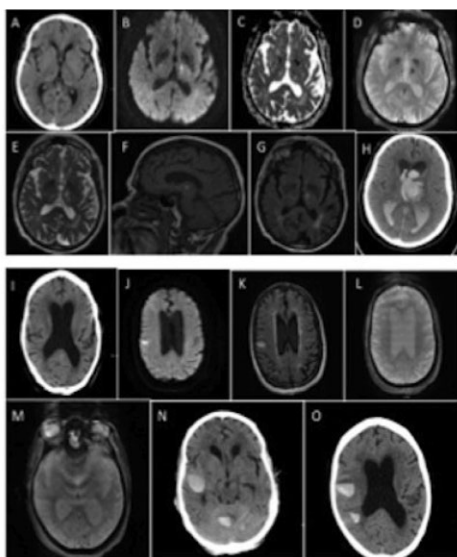
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*Background and purpose:* Symptomatic-intracerebral-hemorrhage (sICH) is a potential life-threatening complication associated with IV-tPA treatment of acute-stroke. There are however several studies confirming the safety of IV-tPA in stroke-mimic. Here we present two-cases of stroke-mimic, who had sICH after IV-tPA administration.

*Case reports:* Case 1: A-77-year-old-man with history of hypertension presented with dysarthria and confusion (NIHSS-3). CT-scan-head did not show any acute-abnormality. Pre-thrombolysis-Diffusion-Weighted-only-imaging showed a small area of diffusion-restriction in the left-thalamus. The patient received IV-tPA and the MRI was completed after the infusion. Unexpectedly, the complete MRI was consistent with a late-subacute-thalamic-hemorrhage (extracellular-methemoglobin). Despite thrombolysis-reversal attempts, the patient developed a catastrophic-intracerebral-hemorrhage. Later it was concluded that the etiology of patient's initial presentation was possibly alcohol-withdrawal-seizure versus metabolic-encephalopathy.

*Case 2:* A-66-year-old-man with history of hypertension presented with confusion, dysarthria and right-sided-gaze-preference (NIHSS-6). CT-scan-head did not show any acute-abnormality and subsequently he received IV-tPA. Immediate-post-thrombolysis-MRI demonstrated numerous chronic-micro-hemorrhages and a small hyperacute-ICH, but did not show any diffusion-lesion corresponding with an acute-infarction. Although the patient experienced worsening of his neurological status, the ICH was controlled with thrombolysis-reversal and strict blood-pressure control. The 24-hour CT-head showed multiple hemorrhagic foci in both hemispheres.

*Conclusion:* On literature-review, we did not find any case of stroke-mimic with post-thrombolysis ICH. Although these two-cases do not undermine the safety of IV-tPA in patients with stroke-mimic, it highlights the fact that the risk of sICH is more than zero among stroke-mimic patients.



**Case 1 - A:** CT head demonstrates normal brain parenchyma. **B & C:** MRI DWI (**B**) demonstrates diffusion restriction in his left thalamus with corresponding signal drop on ADC (**C**). **D:** T2\*-weighted GRE image demonstrates hypointensity in the left thalamus. **E, F and G:** Axial T2 (**E**), sagittal T1 (**F**), and T2-FLAIR (**G**) sequences demonstrate hyperintensity in the left thalamus. **H:** CT head without contrast demonstrates left thalamic hemorrhage with intraventricular extension and early hydrocephalus. Constellation of all MRI sequences was consistent with a late sub-acute thalamic hemorrhage (extracellular methemoglobin).

**Case 2 - I:** CT head without contrast demonstrates normal brain parenchyma without any acute abnormality. **J:** MRI brain, DWI demonstrates small hyperintense area in the right frontal cortex. **K:** T2-FLAIR demonstrates corresponding hyperintensity. **L & M:** T2\*-weighted GRE images demonstrate an isointense core with rim of hypointensity, along with numerous areas of micro-hemorrhages. **N & O:** CT head demonstrates multiple foci of parenchymal hemorrhage.

### ESOC-0033

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Multimodal imaging follow-up of stroke-like episodes in MELAS: Pseudonormalization?

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**Background:** The pathogenesis of stroke-like episodes (SLEs) in MELAS (mitochondrial myopathy, encephalopathy, lactic acidosis and stroke-like episodes) is still poorly understood. Recent serial MRI studies showed a characteristic evolution of lesions suggesting a metabolic cytopathy: i. The acute phase is usually characterized by anatomically progressive restricted diffusion and high T2 signal. ii. The subacute lesions usually show normal or slightly increased diffusivity, while the T2 hyperintensity becomes less prominent. iii. In the chronic phase both diffusivity and T2 signal seem to return to normal.

**Objective:** We followed up two SLEs in a MELAS patient with 3T MRI (T2, FLAIR, DWI and MRA) and regional cerebral perfusion SPECT (HM-PAO Tc-99m) to further characterize imaging abnormalities.

**Results:** Serial MRI confirmed the above described evolution of signal changes from low to high and then normal diffusivity together with the regression of T2/FLAIR hypersignal. It showed a progressive spread of lesions through vascular territories followed by a slow regression of signal abnormalities. However brain tissue involved in a previous SLE with

apparently normal signal showed marked volume loss. SPECT detected a significantly decreased cortical perfusion both in the previously affected areas and the acute lesion.

**Conclusion:** Our findings confirm the non-vascular nature of SLEs and suggest that the regression of T2 and DWI abnormalities is only a pseudo-normalization. Although the microstructural density of affected brain tissue may be similar to normal in the chronic phase, the integrity and metabolism are not as indicated by atrophy and decreased perfusion.

### ESOC-0222

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Tobacco use and cryptogenic stroke in young adults: A Population-based case-control study

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**Objective:** Cryptogenic stroke is the leading subtype of ischemic stroke in the young. We sought to evaluate the association of traditional cardiovascular risk factors with cryptogenic stroke by use of a case-control study.

**Methods:** Patients aged 16–54 years, consecutively treated for first-ever cryptogenic ischemic stroke in an academic stroke unit were compared with subjects from the general population living in the same geographic area. Patients without ASCOD (A: atherothrombosis, S: small vessel disease, C: cardiac source, O: other cause, D: dissection) grade 1 (potentially causal) cause of stroke were classified as cryptogenic. Control subjects were 1:1 matched for age and sex with patients. We further evaluated the association of significant risk factors with non-obstructive (<50% stenosis) carotid plaque and intraluminal thrombus among patients. Odds ratios were calculated using logistic regression analysis.

**Results:** A total of 155 patients with cryptogenic stroke (66.4% men; mean age [SD], 43.5 [8.4] years) were included. Cryptogenic stroke was associated with current tobacco use (42.6% in patients versus 23.9% in control subjects, odds ratio 2.38, 95% confidence interval 1.40 to 4.05,  $P=0.002$ ). Current tobacco use was associated with non-obstructive carotid plaque (odds ratio 6.22, 95% confidence interval 2.43 to 15.9,  $P=0.001$ ) and intraluminal thrombus (odds ratio 13.7, 95% confidence interval 1.42 to 132.7,  $P=0.03$ ) among patients.

**Conclusion:** Our case-control study showed a strong association of current tobacco use with cryptogenic stroke in young adults. Our findings suggest that current tobacco use may be responsible for a substantial number of cryptogenic strokes in young adults.

### ESOC-0093

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Delay in diagnosis of arterial ischemic stroke in children

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**Aims:** The aims were to identify the time of diagnosis arterial ischemic stroke (AIS) in children and to investigate the features, which influence the diagnostic delay.

**Methods:** 67 stroke pts with a median age of  $5,28 \pm 4,28$  years were included. Time to diagnosis, time/modality of neuroimaging and its results, risk factors and prior diagnoses were analyzed.

**Results:** The time to diagnosis was >24 hours in 38 (56,7%) children. 30 (44,8%) pts had an initial CT scan, 11 (16,4%) pts had an initial MRI and 7 (10,4%) pts underwent both procedures. On the first day CT was performed in 15 out of 30 pts, it led to AIS diagnosis in only 3 pts. MRI was done on the first day in 5 out of 11 pts; it led to the correct diagnosis in all 5 pts. The most often misdiagnoses were encephalitis (n = 10), epilepsy (n = 6) and craniocerebral trauma (n = 7). Encephalitis correlated with gradual symptoms onset, infectious signs and no neuroimaging in the first week (R = 0,47; p = 0,001). Epilepsy correlated with gradual symptoms onset, seizures and no neuroimaging in the first week (R = 0,45; p = 0,003). Craniocerebral trauma correlated only with any head injury (R = 0,48, p = 0,000035). Any misdiagnosis correlated to gradual onset of symptoms, diffuse cerebral signs and neuroimaging >1 week (R = 0,59; p = 0,000005).

**Conclusion:** The diagnosis AIS was delayed for more than 24 hours in 56,7% pts. The delayed diagnosis is usually related to gradual onset of symptoms, no acute neuroimaging, using CT scan instead of MRI on the first day, and erroneous interpretation of symptoms.

## ESOC-0291

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Arterial ischemic stroke after mild head trauma in children

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**Aim:** The aim was to evaluate the importance of mild head trauma (MHT) for arterial ischemic stroke in children.

**Methods:** 81 stroke pts (aged 4,93 ± 4,13 years) were included. All pts were divided into two groups. The main group (n = 24) consisted of patients within 1 month prior to stroke was observed MHT. The other pts formed the comparison group, n = 57. The demographic data, clinical course and neuroimaging were analyzed.

**Results:** The average age of the patients of the main group was two times lower than patients in the comparison group: 2,43 ± 2,9 years vs 5,98 ± 4,14 years, p = 0,0003. The median Pediatric National Institutes of Health Stroke score in MHT pts was lower than in other pts: 10,5 ± 3, vs 13,86 ± 6,84; p = 0,026. The period until the neurological symptoms tends to be resolved was shorter in the main group than in the comparison group: 5,125 ± 4,44 days vs 8,19 ± 6,39 days, p = 0,038. There were the prevalence of basal ganglia infarcts (83,3% vs 19,3%, p = 0,0007), lenticulostriate arteries mineralization (72,2% vs 7,14%, p = 0,0014), and the rarity of cerebral arteriopathy (25% vs 81%, p = 0,009) in MHT pts in compare with other pts. The predictors for stroke associated with MHT are age up to 2 years and mineralization in the lenticulostriate arteries (RR ± S = 8,357 ± 0,67).

**Conclusion:** The mild head trauma is an important cause of arterial ischemic stroke in infants and toddlers. The condition for the stroke development is mineralization of lenticulostriate arteries. The middle severity in the acute period, short unstable period, subcortical infarcts, and no cerebral arteriopathy are typical for stroke after MHT.

## ESOC-0734

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Multiple cerebral infarcts in a young patient with heroin-induced hypereosinophilic syndrome

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**Background:** Hypereosinophilic syndrome (HES) is as a primary or secondary leukoproliferative disorder characterized by sustained eosinophilia (>1,500/μL) with consecutive eosinophilic infiltration and mediator release leading to target organ dysfunction. Neurological involvements in form of polyneuropathy, encephalopathy and cerebral infarctions have rarely been described. Local hypercoagulability and direct endothelial damage by the "Eosinophil major basic protein" have been discussed as underlying pathophysiologies of microvascular alteration. In addition, Loeffler endocarditis leading to thromboembolism has been associated to HES.

Case report of a young heroin consumer with multiple cerebral infarctions in the setting of HES:

A 29-year-old male presented with mild right-sided hemiparesis. Additionally, he complained a subacute left-sided hemihypesthesia. Both CT and MRI showed multiple small cerebral and cerebellar infarctions. MR-angiography as well as neurosonological examination revealed no evidence for cerebral vasoconstriction. Echocardiography findings were normal. White blood cell (WBC) count showed elevated levels of 40,880/μl (27,860/μl eosinophilic granulocytes). The patients reported transnasal heroin abuse for several years. After exclusion of primary clonal and other reactive causes of eosinophilia (such as lymphoproliferative, infectious or autoimmune diseases) heroin remained the only possible trigger. Under corticosteroid therapy and cessation of heroin the WBC and particularly the eosinophilic granulocytes count dropped within few weeks to almost normal values.

**Conclusion:** Hypereosinophilic syndrome is a heterogenous disease and it represents a rare cause of cerebral infarctions. To our knowledge, this is the first description of stroke in the setting of heroin-induced hypereosinophilia. Thus, besides vasoconstriction, HES should be considered in drug-induced cerebral infarctions.

## ESOC-0669

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### A case of probable post-irradiation subclavian, vertebral and carotid arteriopathy

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A 46 year old right handed lady was admitted with a three day history of migrainous type features, neck pain and, on the morning of admission, sudden numbness and weakness of the left side of the body lasting ten minutes before resolving. On examination, the right upper limb appeared weaker than the left and there was left lower limb ataxia.

Past medical history included Hodgkin's lymphoma twenty-nine years previously, treated by chemotherapy, an autologous bone marrow transplant and radiotherapy to the left side of her neck.

Imaging demonstrated occlusive arterial disease involving the left vertebral, subclavian and internal carotid arteries, as well as calcification at the right vertebral artery origin.

It would be rare for typical atherosclerotic disease to affect this pattern of vessels. Moreover, as the patient has no conventional risk factors for atherosclerosis (normotensive, non-smoker, normal lipid profile, no family history of cerebrovascular or cardiovascular disease) and received radiotherapy to the left side of her neck, radiation-induced stenosis of these major vessels seems the most plausible explanation.

Clinically, the patient poses a significant management challenge. Aged 46, despite dual anti-platelet therapy, she has had two further symptomatic episodes, one right-sided and one left-sided. Symptomatic patients with carotid artery stenosis >50–70% require either carotid endarterectomy or carotid angioplasty and stenting. Technically, this may be difficult with the extent of the arteriopathy and fibrotic tissue formation.

This case highlights radiation-induced arteriopathy as a potential cause of stroke in young patients presenting with unusual patterns of atherosclerotic disease.

#### ESOC-0143

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Hyponatremic encephalopathy: An unusual stroke mimic

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Acute stroke is a common presentation to hospital requiring prompt assessment, investigation and management. Stroke mimics, including space occupying lesions, sepsis, seizures and hypoglycemia are well documented in the literature.

We present the case of a 74 year old gentleman admitted with subacute expressive and receptive dysphasia with subsequent development of a right homonymous hemianopia and mild right hemiparesis. NIHSS (National Institute of Stroke Score) was 10, indicative of a moderately severe stroke. Admission CT brain imaging excluded acute pathology and antiplatelets commenced for suspected ischemic stroke.

This diagnosis was not supported by subsequent brain MR imaging using standard and DWI sequences (Figs 1 and 2). Severe hyponatremia was noted (i.e.  $\text{Na} \leq 120$  mmol/L) with investigations in keeping with Syndrome of Inappropriate Anti-Diuretic Hormone (SIADH). Following fluid restriction and cessation of omeprazole (a PPI well documented to cause hyponatremia) the neurological features resolved, corresponding with a correction in the plasma sodium (Fig. 3) over the subsequent seven days.

Hyponatremia is the most common electrolyte abnormality encountered in clinical practice but is frequently under-diagnosed and undertreated. Neurological features manifest in one-fifth of patients with severe hyponatremia, with an equal proportion of such patients presenting with focal neurological signs. Patients presenting with focal neurological signs should be treated with standard stroke therapy including thrombolysis as the risk of complications in mimics is exceedingly small, unless the physician is convinced to the contrary.

Hyponatremia as a stroke mimic is recognized in the literature and carries an excellent prognosis with prompt treatment.

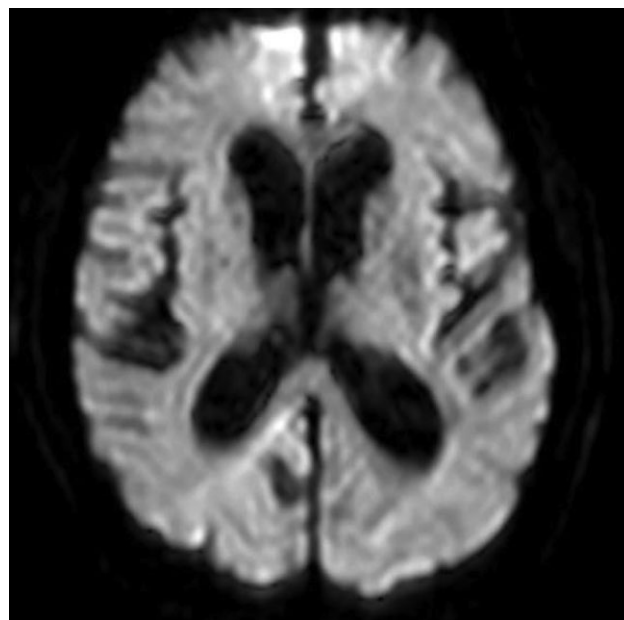


Fig. 1

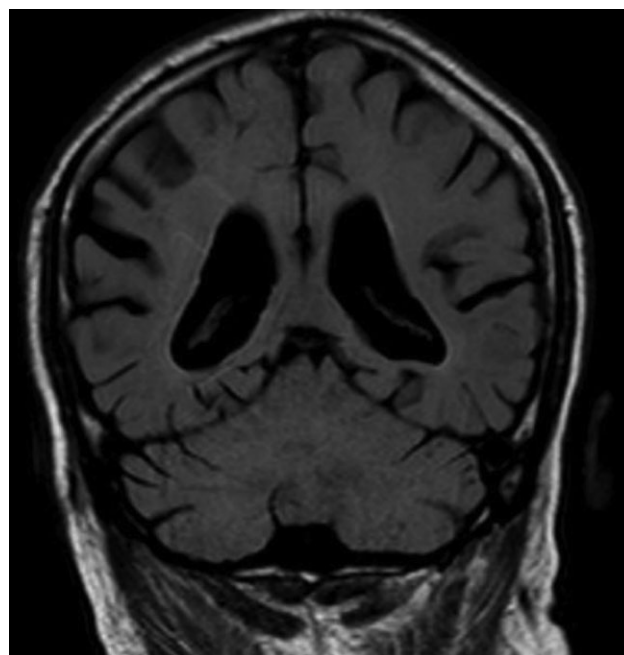


Fig. 2

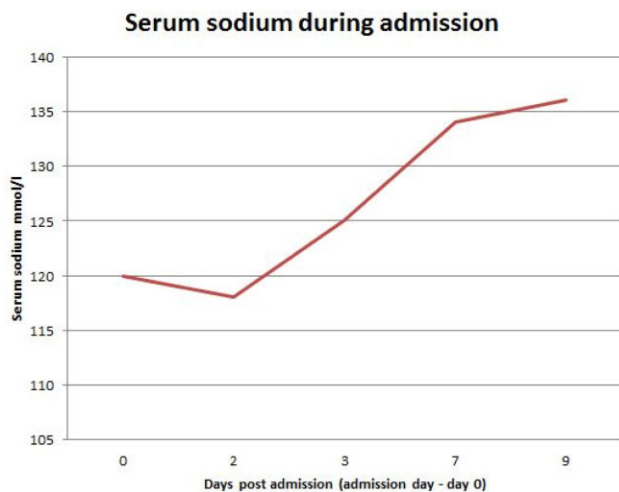


Fig. 3

## ESOC-0497

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Evolution of risk factors and phenotype between first-ever and recurrent young-onset ischemic stroke

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**Background:** Etiological diversity makes diagnosis and secondary prevention of ischemic stroke (IS) at young age challenging. We studied whether risk factors and patient phenotype change in between first-ever and first recurrent young IS (restroke).

**Methods:** Of the 1008 first-ever IS patients in the Helsinki Young Stroke Registry, we included 110 patients (age  $44.1 \pm 5.5$  years) experiencing a restroke during mean follow-up of 9.3 ( $\pm 4.1$ ) years, phenotyped with ASCO classification, and rated for 3-month modified Rankin Scale (mRS) after first-ever and restroke. Related-samples statistics were applied: Friedman's 2-way analysis of variance, Wilcoxon signed ranked test, and McNemar test.

**Results:** Compared with first-ever stroke, hypertension (51% vs. 75%,  $P < 0.001$ ), type 2 diabetes mellitus (14% vs. 21%,  $P = 0.021$ ), and cardiovascular disease (15% vs. 24%,  $P = 0.021$ ) were more common at restroke, while cholesterol level ( $5.2 \pm 1.1$  vs.  $4.6 \pm 1.1$  mmol/L,  $P < 0.001$ ) and prevalence of smoking (56% vs. 35%,  $P < 0.001$ ) had declined. No difference emerged in vascular territories or symptom severity, but mean 3-month mRS leveled higher after restroke ( $1.6 \pm 1.2$  vs.  $2.3 \pm 1.5$ ,  $P < 0.001$ ). Between first-ever and restroke, no significant differences existed in proportions of definite atherosclerosis (16% vs. 15%), small-vessel occlusion (16% vs. 23%), cardioembolism (11% vs. 13%), or other determined etiology (14% vs. 13%). Furthermore, proportions without definite or probable cause (ASCO 1 or 2) were similar (27% vs. 24%).

**Conclusions:** Despite favorable trends in some risk factors—including smoking and cholesterol levels—these young patients were more diseased and disabled after restroke. However, underlying causes remained unaltered and initially cryptogenic cases remained cryptogenic by ASCO classification.

## ESOC-0035

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Vertebral artery dissection mimicking cervical radiculopathy

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**Background and purpose:** Vertebral artery dissection may produce the clinical picture of a cervical radiculopathy.

**Method:** Case reports of 2 case with cervical pain radiating down the arm occurring subsequent to prolonged neck hyperextension for dental extraction. Both occurred in male patients aged 62 and 58 yrs respectively.

**Results:** Neurological examination showed very sluggish ipsilateral C5–C6 deep tendon reflexes with a normal sensory examination without significant motor weakness. DSA ( Digital Subtraction Angiography) done showed vertebral artery dissection affecting V2 segment in one patient & V3 segment in the other patient.

**Conclusion:** Even though ipsilateral cervical pain is a common manifestation of vertebral artery dissection, radicular pain is rare. An ipsilateral cervical radiculopathy has been reported in 7% of extra cranial vertebral artery dissections. Pain & Weakness in the C5–C6 distribution associated with V2 dissection has been attributed to direct mechanical compression & stretch of the nerve root from extra luminal hematoma. In V3 dissection the role of central mechanisms with C1–C2 afferents results in the referred pain.

Cervical Artery dissection should be considered in other wise unexplained head & neck pain syndromes.

## ESOC-0036

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Transient locked in syndrome due to basilar artery occlusion

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**Introduction:** The locked in syndrome is characterized by quadriplegia and anarthria without loss of consciousness. Basilar occlusion has been described as a cause of locked in syndrome and has typically been described as carrying a high mortality rate.

We present a case of basilar thrombosis which manifested with a transient locked in syndrome.

**Maternal and methods:** A 65 yrs old male with a history of hypertension & Diabetes presented with a 20 minutes episode of circum-oral numbness and tingling in both extremities. Transcranial Doppler & CTAngiogram (CTA) of brain revealed high grade proximal basilar stenosis.

He experienced ongoing episodes of transient double vision. Approximately 1 month after the initial presentation he developed acute onset of dysphagia and inability to speak followed by quadriplegia. The patient had intact memory of all events at that time and he recovered the motor power over the next 3 hours. He made a complete recovery. Patient had to be intubated during the episode.

**Results:** MRI of the brain did not show any Diffusion weighted imaging (DWI) abnormalities. MRA showed a loss of flow void in the proximal basilar artery. Trans cranial Doppler (TCD) was suggestive of proximal basilar occlusion. CTA confirmed the proximal basilar occlusion.

**Conclusion:** This case illustrates a unique presentation of basilar artery occlusion. Transient locked in syndrome is a rare condition and when present points to non vascular etiologies. However, our case illustrates the significant variability in presentation of locked in syndrome and also of Transient Ischemic attack(TIA).



## ESOC-0029

## 27. Rare Causes, Stroke in the Young, and Case Reports

## Non-vitamin K oral anticoagulants for treating cervical artery dissection

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**Background:** Cervical artery dissection (CeAD) patients with or without stroke are frequently treated with either antiplatelet agents or vitamin K antagonists (VKAs), but no data are reported on the use of non-vitamin K oral anticoagulants (NOACs).

**Materials and methods:** Between November 2011 and January 2014, we recorded data from our stroke patients with vertebral (VAD) or internal carotid artery dissection (ICAD). Patients using oral anticoagulants were included in the study and were divided into 2 treatment groups: patients using NOACs and those using VKAs. Excellent outcome was defined on modified Rankin Scale (mRS)  $\leq 1$  at 6 months.

**Results:** Out of 68 stroke patients (67% male; median age 45 [39–53]), six (8.8%; 2 with VAD and 4 with ICAD) were treated with NOACs: three with direct thrombin inhibitor dabigatran and three with direct factor Xa inhibitor rivaroxaban. National Institutes of Health Stroke Scale score at baseline was 4 (3–7) in the NOAC vs. 2 (1–7) in the VKA groups. Complete recanalization at 6 months was seen in most patients in the NOAC (n = 5; 83%) and VKA (n = 34; 55%) groups. All the patients using NOACs had mRS  $\leq 1$  at 6 months and none had an intracerebral hemorrhage (ICH). In the VKA group most patients (n = 48; 77%) had mRS  $\leq 1$ , one patient (1.7%) had an ICH and one died.

**Conclusions:** Treatment of ischemic stroke patients with CeAD with NOACs did not bring up safety concerns and resulted in similarly good outcomes in this small consecutive single-center patient sample.



Fig. 1

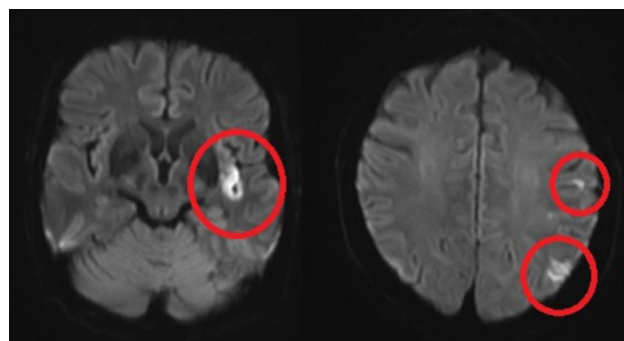


Fig. 2

## ESOC-0555

## 27. Rare Causes, Stroke in the Young, and Case Reports

## A case of genuine paradoxical embolism causing stroke after valsalva maneuver

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A 63 year old female smoker with a pleural effusion presented with sudden onset isolated aphasia during pulmonary function testing. Brain imaging with computed tomography (CT) showed subtle increased density in a branch of the left middle cerebral artery in the sylvian fissure (Fig. 1) suggestive of thrombus. Thrombolysis was not administered as symptoms were resolving, leaving mild aphasia. Magnetic resonance brain imaging showed areas of restricted diffusion in the left insula and foci within the grey matter of the left parietal lobe suggesting embolic etiology (Fig. 2). CT of the whole body showed evidence of bilateral pulmonary embolic disease (Fig. 3) but not malignancy. Echocardiography showed an aneurysmal intra-atrial septum with resting left to right shunt consistent with a patent foramen ovale (PFO), and an unexpected finding of a severe dilated cardiomyopathy. We postulate her stroke was caused by genuine paradoxical embolism across a PFO during Valsalva maneuver with proven unprovoked venous thromboembolism, and lifelong anticoagulation is therefore indicated.



Fig. 3

## ESOC-0473

**27. Rare Causes, Stroke in the Young, and Case Reports****Stroke and cerebral vasculitis: A 10-year clinical experience**P Kempster<sup>1</sup>, C McLean<sup>2</sup>, T Phan<sup>1</sup><sup>1</sup>Neurosciences, Monash Health, Clayton, Australia<sup>2</sup>Pathology, Alfred Health, Melbourne, Australia

**Background:** Angiitis of the central nervous system (CNS) is difficult to diagnose but potentially fatal. It usually causes infarction of brain tissue. When stroke occurs in a younger individual or is associated multiple infarcts on imaging, clinicians must decide how far to pursue a possible diagnosis of vasculitis. The aim of this study is to establish the prevalence of primary and secondary cerebral angiitis among patients presenting with stroke.

**Methods:** Hospital attendances over a 10-year period were surveyed by searching for diagnostic codes and key words specific for cerebral vasculitis/angiitis. Case notes were reviewed by the authors using 2 sets of criteria for angiitis of the CNS.

**Results:** Thirty-two patients were initially considered likely to have cerebral angiitis by treating physicians. Thirteen had been admitted to hospital with stroke. During this period, there were 7475 admissions for ischemic and hemorrhagic stroke. Six patients had a final diagnosis of vasculitic stroke but only one had definite CNS angiitis with a first presentation as ischemic stroke (0.02%). Most patients who did have cerebral vasculitis developed multifocal or subacute neurological deficits, or already had an immunological disorder known to be associated with secondary CNS angiitis. Of 19 patients given an alternative final diagnosis, the commonest were atherosclerotic/ embolic cerebrovascular disease (9) and reversible cerebral vasoconstriction syndrome (7).

**Conclusions:** Stroke is rarely the first manifestation of cerebral vasculitis. Our findings suggest that routine screening for angiitis in stroke patients may not be warranted.

## ESOC-0430

**27. Rare Causes, Stroke in the Young, and Case Reports****Stroke among centenarians in Denmark**L Ravnskjær<sup>1</sup>, T S Olsen<sup>2</sup>, K K Andersen<sup>1</sup><sup>1</sup>Statistics Bioinformatics and Registry, Danish Cancer Society, Copenhagen Ø, Denmark<sup>2</sup>Department of Neurology, Bispebjerg University Hospital, Copenhagen, Denmark

**Background:** The oldest old is the fastest growing segment of the total population. The projected increase of centenarians being 400% by 2030. We studied incidence, risk profile and mortality of centenarians with stroke in Denmark.

**Methods:** We identified all hospital admissions for stroke in the adult Danish population 2003–2012 (23.5 million person-years). Demographic data on the Danish background population was obtained from Statistics Denmark. Age, sex, risk profile, stroke severity (Scandinavian Stroke Scale, SSS 0 (worst)-58 (best)), subtype and 1-month mortality was obtained from the Danish Stroke Register covering all admissions for stroke in Denmark (n = 82 081).

**Results:** In total 95 patients (1.1/1000) were ≥100 years (range 100–108); 83% women; 94% infarcts; 80% single living; 62% living in own home. Incidence of hospitalization for stroke for a 100 year old person in the Danish population was 21.1 per 1000/year. Risk factor prevalence was generally lower among centenarians. Using 70–79 year-olds as reference: diabetes 3.2% vs. 15.5%; previous myocardial infarction 5.3% vs. 11%; smoking 5.3% vs. 31.2%; high alcohol consumption 0% vs. 6.3%. Prevalence of atrial fibrillation (AF) was higher 28.4% vs. 16.4%; prevalence of

hypertension was the same 54.7% vs. 54.6%. Strokes were more severe in centenarians: SSS 28.8 vs. 42.8 in 70–79 year-olds. Among centenarians 1-month mortality was 31.6% compared to 8.6% in 70–79 year-olds.

**Conclusion:** Centenarians with stroke were predominantly women 2/3 living in own home. Except for AF and hypertension the risk profile was more favorable in centenarians. However, incidence and case-fatality was high and strokes were severe.

## ESOC-0239

**27. Rare Causes, Stroke in the Young, and Case Reports****Familial paraganglioma syndrome: A rare cause of carotid artery occlusion**F Rosafio<sup>1</sup>, M L Dell'Acqua<sup>1</sup>, S Vallone<sup>2</sup>, B Madeo<sup>3</sup>, G Bigliardi<sup>1</sup>, L Vandelli<sup>1</sup>, L Picchetto<sup>1</sup>, R Pentore<sup>1</sup>, F Barbi<sup>1</sup>, A Zini<sup>1</sup><sup>1</sup>Stroke Unit – Department of Neuroscience, S.

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**Background:** Head and neck paragangliomas (HNPs) are rare tumors arising from chromaffin cells of the autonomic paraganglia, most frequently within the covering of the carotid artery. Carotid body paraganglioma are often clinically silent, typically presenting as slowly enlarging mass in lateral neck. Approximately 30% of all HNPs are hereditary, frequently bilateral and can associate with secreting thorax and abdominal paraganglioma (pheochromocytoma-paraganglioma syndrome).

**Case report:** A 45-year-old man, with history of occasional bilateral tinnitus and scintillating scotoma in the last 5 years, was admitted for sudden-onset of headache and visual loss. Neurologic examination showed an inferior altitudinal visual field impairment in the left eye. Familial history was positive for laterocervical space-occupying masses in paternal family. Neuroimaging (CTA, Angiography and brain MRI) showed complete occlusion of the left carotid artery, bilateral HNPs, more extended on the left side, and no brain parenchymal lesion. Laboratory tests showed increased levels of normetanephrines. Whole body Ga68-DOTA-NOC-PET detected tracer accumulation in the laterocervical area bilaterally, in the left adrenal gland and in one left para-aortic lymph node. **Conclusion:** We describe a case of acute retinal ischemia secondary to left carotid artery occlusion, likely due to an aggressive carotid HNP, in a patient with a familial pheochromocytoma paraganglioma syndrome. Although HNPs are usually indolent lesions, we report a case of cerebrovascular disease caused by an aggressive paraganglioma. We suggest to follow-up and treat HNPs, in order to avoid not only symptoms due to mass and secreting effects, but also possible thrombotic complications.

## ESOC-0510

**27. Rare Causes, Stroke in the Young, and Case Reports****Early pregnancy cerebral venous thrombosis and status epilepticus treated with enoxaparin, levetiracetam and lacosamide throughout pregnancy**J Ruuskanen<sup>1</sup>, R A Ketola<sup>2</sup>, S Timonen<sup>3</sup>, H Malm<sup>4</sup>, P Ylikotila<sup>1</sup><sup>1</sup>Clinical Neurosciences, Turku University Hospital, Turku, Finland<sup>2</sup>Forensic Medicine, University of Helsinki, Helsinki, Finland<sup>3</sup>Gynaecology and Obstetrics, Turku University Hospital, Turku, Finland<sup>4</sup>Teratology Information Service, Helsinki University Central Hospital, Helsinki, Finland

Cerebral venous thrombosis (CVT) accounts for less than 1% of all strokes. Pregnancy predisposes to CVT, with most cases occurring during the third trimester or post-partum. Mortality for CVT has been reported to be as high as 15%. Seizures and status epilepticus associate with poor prognosis, further justifying aggressive treatment also during pregnancy. A rare case of a massive CVT in early pregnancy, complicated by multiple intracranial hemorrhages and status epilepticus was successfully treated with heparinoids, benzodiazepines, propofol, fosphenytoin, levetiracetam and lacosamide. Enoxaparin, levetiracetam and lacosamide were continued throughout pregnancy. The infant was delivered at pregnancy week 36 by cesarean section, showed no structural anomalies but was sleepy and feeding poorly during the first weeks after the delivery. Lacosamide and levetiracetam concentrations in cord blood corresponded to those in the maternal blood. Levetiracetam was undetectable and lacosamide was present in very low levels in breast-milk and in the infant blood five days after the delivery.

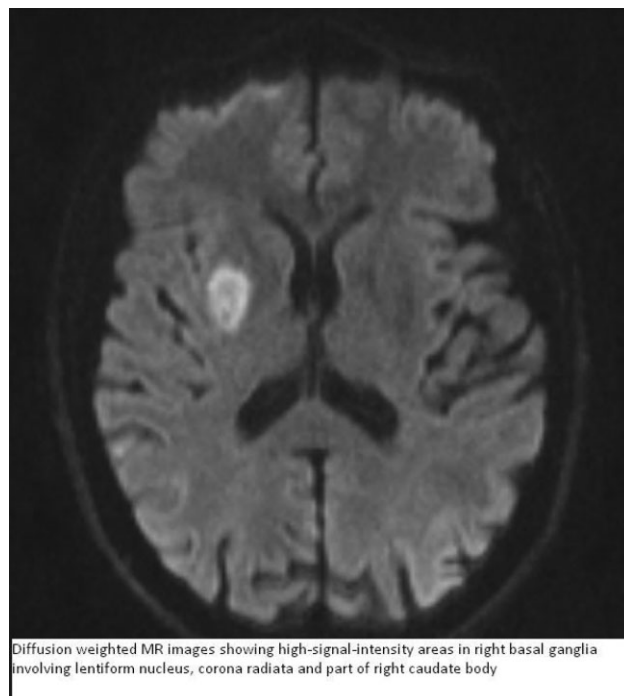
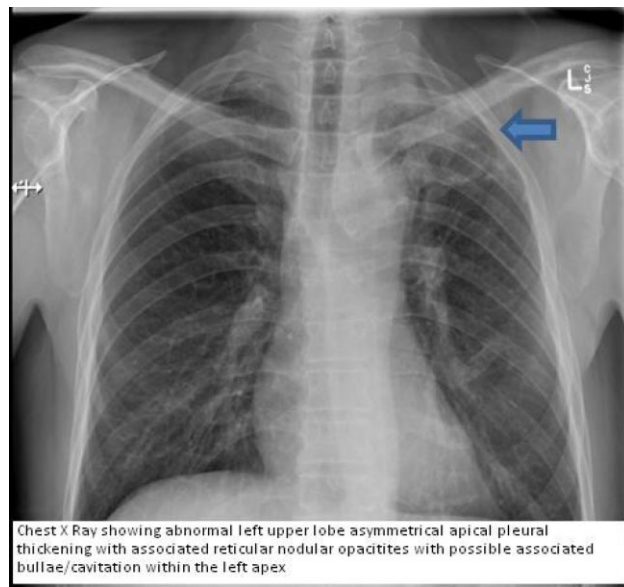
This is the first report of a pregnancy outcome after in utero lacosamide exposure, and of lacosamide levels in cord blood, breast milk and breast-fed infant. Levetiracetam is compatible with breast-feeding. For lacosamide, the estimated relative infant dose for a fully breast-fed infant is 1.2% of the maternal daily dose. It is therefore likely that the transient neonatal symptoms were due to the in utero exposure to these drugs rather than exposure via breast-milk. The infant showed normal developmental milestones at 6 months of age. The mother has recovered remarkably well.

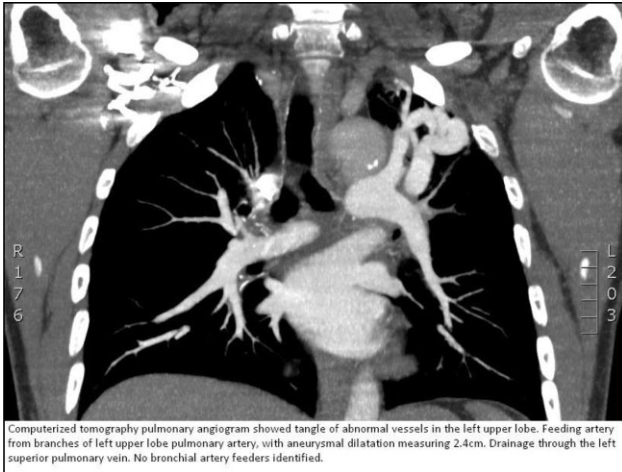
## ESOC-0210

**27. Rare Causes, Stroke in the Young, and Case Reports****Let's not forget basic investigations in the era of magnet, how a chest X ray helped our gentleman**D Shah<sup>1</sup>, H Brown<sup>2</sup><sup>1</sup>Stroke Unit, Princess Alexandra Hospital, Brisbane, Australia<sup>2</sup>Department of Neurology, Princess Alexandra Hospital, Brisbane, Australia

We describe the case of a 58 year-old male who presented with facial droop and slurring of speech on a background of recent episodes of amaurosis fugax. Diffusion weighted Magnetic Resonance Imaging (MRI) confirmed acute right basal ganglia stroke. Further diagnostic work up including Chest X Ray showed left upper lobe abnormality. Carotid Ultrasonography showed very minor plaques bilaterally (<10% stenosis). Transthoracic echocardiogram (TTE) revealed large amount of transpulmonary shunting with agitated saline injection with no evident atrial septal defect or patent foramen ovale. There was no other structural heart disease. Given these results, Computerized tomography pulmonary angiogram was performed which showed an isolated complex pulmonary arteriovenous malformation (PAVM) in the left apex. Two shunt (venous admixture) studies showed a calculated shunt of 17% and 15.6%. Pulmo-

nary arteriography of the left main pulmonary artery confirmed complex AVM with multiple feeding arteries and a single draining vein. Amplatzer coils were percutaneously inserted. Post coiling shunt study showed calculated shunt of 2.9%. At the follow up, more than 12 months later, patient didn't have any further embolic events. In this case, a simple Chest X Ray helped with further evaluation and management. PAVMs should be considered in all patients with cryptogenic stroke and CXR should be performed in all patients.





Computerized tomography pulmonary angiogram showed tangle of abnormal vessels in the left upper lobe. Feeding artery from branches of left upper lobe pulmonary artery, with aneurysmal dilatation measuring 2.4cm. Drainage through the left superior pulmonary vein. No bronchial artery feeders identified.

### ESOC-0586

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Cerebral venous thrombosis in Behçet's disease and long-term follow-up of 21 cases

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**Introduction:** Behçet's disease (BD) is one of the most common causes of cerebral venous thrombosis (CVT) in the countries along the ancient Silk Route. We present a study showing clinical features and follow up results in patients with cerebral venous thrombosis due to Behçet's disease (CVTBD).

**Material and methods:** The files of CVTBD patients who had admitted to our clinic between January 2007 and November 2014 were reviewed. Onset ages of BD and NBD, functional system involvement, EDSS, neuroimaging findings and medications were recorded.

**Results:** Twenty-one patients with CVTBD were included to the study (female = 12; (57.1%), male = 9; (42.9%)). The mean age was  $47.0 \pm 12$  (range 27–69) years ( $48.0 \pm 14$  in male,  $46.25 \pm 10$  in female). Sixteen patients had only intracranial hypertension due to CVT. Five patients (23.8%) had parenchymal involvement beside CVT; they had parenchymal involvement signs in addition to intracranial hypertension signs. The course was monophasic except one patient (4.8%) who had parenchymal involvement had relapsing course. The median EDSS score was 0 (range 0–1) at the beginning and at the end of the study. Sixteen patients had a single sinus occlusion and 5 patients had multiple occlusions. The transverse sinus thrombosis was seen in 14 patients. All patients were treated with prednisolone. After the treatment, recanalization was seen in the occluded sinuses.

**Discussion:** Occlusion of a single sinus, especially transverse sinus, is more frequent than multiple sinus occlusions in patients with CVTBD in our study. Moreover, the prognosis is good after the treatment with steroid.

### ESOC-0587

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Etiologic subtypes of acute ischemic stroke with young patients

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**Introduction:** Stroke in people under 45 years of age is less frequent than in older population. The aim of this study was to determine the etiologic subtypes of ischemic stroke in the young patients in our acute stroke registry.

**Methods:** We reviewed the charts of 554 patients who were admitted with acute ischemic stroke between the dates January 2011 and August 2014. The patients under 45 years of age were included into the study. The demographic data, admission NIHSS scores and mRS scores in follow-up period were recorded. We determined etiologic stroke subtypes using the automated Causative Classification System (CCS).

**Results:** A total of 29 (5.2%) young patients with acute ischemic stroke (11 males [37.9%] and 18 females [62.1%]; mean age,  $38.1 \pm 6.24$  (25–45) years) were included. The mean NIHSS score was  $4.32 \pm 3.39$  at admission and it was significantly lower than in the elderly population ( $p = 0.027$ ). The rates of hypertension, diabetes, atrial fibrillation and coronary artery disease were significantly lower in the young patients compared to others ( $p < 0.05$ ). Otherwise, patent foramen ovale was significantly higher in the youngs ( $p < 0.001$ ). Etiologic stroke subtypes were large-artery atherosclerosis ( $n = 7$ , 24.1%), cardioaortic embolism ( $n = 9$ , 31%), small vessel disease ( $n = 2$ , 6.9%), other causes ( $n = 5$ , 17.2%) and undetermined causes ( $n = 6$ , 20.7%). The median mRS was 1 (0–4) in follow-up period and it was significantly lower than in the elderly ( $p = 0.002$ ).

**Conclusion:** In our registry, young patients with acute ischemic stroke was found 5.2%. Cardioaortic embolism was the most common cause of stroke in young patients.

### ESOC-0271

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Renal dysfunction: A new cause for stroke in young adults

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**Background:** In about 30% of young ischemic stroke patients no cause can be identified. In elderly patients renal dysfunction has been suggested as a possible contributing risk factor for stroke. Our objective is to investigate the influence of renal dysfunction on long-term incident vascular events after stroke in young adults aged 18 through 50 years.

**Methods:** This study is a prospective cohort study among 464 young stroke patients with an ischemic stroke or transient ischemic attack between January 1, 1980 and November 1, 2010. Estimated glomerular filtration rate (eGFR) was calculated from baseline creatinine levels using the chronic kidney disease epidemiology collaboration (CKD-EPI) equation and was divided in  $eGFR < 60$ ,  $60-120$  and  $>120$  ml/min/1.73 m<sup>2</sup>. Cox proportional hazard models were used to determine the effect of renal dysfunction on incident vascular events, adjusting for cardiovascular risk factors.

*Results:* eGFR < 60 ml/min/1.73 m<sup>2</sup> was associated with an increased risk of incident stroke (HR4.0 (95% CI:1.8–8.9)), but was not associated with an increased risk of other arterial events (cardial disease and/or peripheral artery disease) after adjustment for cardiovascular risk factors. eGFR >120 ml/min/1.73 m<sup>2</sup> was not associated with incident events.

*Conclusions:* Renal dysfunction is related to long-term stroke recurrence, but not to incident cardiovascular disease, on average almost 8 years after young stroke. Our findings might be a first step in the recognition of renal dysfunction as a new risk factor for the development of stroke at young age.

### ESOC-0433

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Stroke due to severe cardiomyopathy in bevacizumab treatment

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Cerebrovascular events complications of bevacizumab treatment include hemorrhagic and – more rarely – ischemic strokes.

We report on a 40 year old man with no previous vascular history who developed an acute right hemiparesis and aphasia (NIHSS = 8) due to ischemic stroke in the left MCA territory, with M2 occlusion. Time of onset was unknown and the patient did not undergo IV thrombolysis. He had a 2 year history of rectal cancer with hepatic and pulmonary metastases, treated with surgery completed by radio- and chemotherapy: FOLFIRI protocol (irinotecan, 5FU, folic acid) associated with bevacizumab (5 mg/kg) every 15 days since 18 months. Last dose of bevacizumab was given 10 days prior to stroke. Echocardiography performed six months earlier was normal. Routine lab tests and cardiac monitoring were normal, so was neck and intracranial CT-angiography except for persistence of the left M2 occlusion.

Transthoracic echocardiography revealed a very severe low flow dilated cardiomyopathy with an ejection fraction of 18% and multiple, voluminous and mobile thrombi in the left ventricle. Anticoagulation was started and the patient was referred to the oncology department one week later with NIHSS 3 and Rankin 2.

Although limited information is available on the effects of bevacizumab on the cerebral vasculature, distal arterial thrombi is the usual suspected mechanism of the ischemic strokes previously reported. Bevacizumab treatment otherwise increases the risk of developing high-grade cardiac heart failure in cancer patients and this could lead, in the most severe cases such as the present one, to stroke of cardioembolic origin.

### ESOC-0390

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Increasing stroke incidence in young adults in Denmark

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*Background:* Reports have indicated that stroke incidence in young adults may be increasing, however updated population-based data remain sparse. We studied the temporal trends (1994–2012) in incidence of stroke in Denmark among young adults aged 15 to 30 years.

*Methods:* We identified all individuals 15 to 30 years of age admitted to a hospital with a first-ever stroke in Denmark between 1994–2012 from the Danish Patient Registry, a national registry which holds information on all admissions to Danish hospitals. Incidence rates and corresponding 95% confidence intervals (95% CI) were estimated by the approximate 95% bootstrap method. The estimated annual percentage change (EAPC) was computed using Poisson regression. Possible non-linearities were tested by means of restricted cubic splines.

*Results:* We identified 3431 individuals with admitted with first-time stroke in the 18-year long study period. The age-standardized incidence rate of stroke increased from 11.97/100.000 person-years in 1994 to 16.77/100.000 person-years in 2012. This corresponded to an EAPC of 1.8% per year (CI: 1.1–2.6). The incidence rate of ischemic stroke increased from 1.92/100.000 person-years in 1994 to 4.42/100.000 person-years in 2012. The EAPC for ischemic stroke was 2.6% per year (CI: 0.6–4.6) between 1994–2006 and increased to 11.8% (CI 7.4;16.4) in the period between 2006–2012.

*Conclusion:* The incidence rate of first-time hospitalizations with stroke and in particular ischemic stroke in young Danish adults has increased substantially since the mid 1990's. The increase has been particularly strong in the most recent years.

### ESOC-0171

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### JAK2-V617F mutation as an underlying hypercoagulable state in a case of recurrent and therapy resistant venous and arterial thrombosis

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*Introduction:* Hypercoagulable states due to acquired or inherited abnormalities of coagulation are suspected in patients experiencing thrombotic events without obvious associated risk factors, at early age, positive family history and recurrent or multifocal events.

*Case presentation:* A 48-year-old Caucasian man with history of treatment-resistant recurrent venous and arterial thrombotic events (fibular vein thrombosis, pulmonary embolism, thrombotic ulnar artery occlusion) presented to our department with symptoms of a transient ischemic attack due to an unstable thrombus formation of the left internal carotid artery (ICA). Two hours after carotid-endarterectomy the patient

developed a thrombotic re-occlusion of the left ICA, which resulted in territorial middle cerebral artery infarction.

Evaluations of an underlying hypercoagulable state yielded negative results and no overt hematologic disease was present at that time. Within the next few months the patient presented to our department again with cerebral vein thrombosis and a Budd-Chiari syndrome. A positive test for the *JAK2-V617F* mutation and the subsequent bone marrow biopsy revealed an underlying myeloproliferative disorder (MPD) contributing to the prothrombotic state.

**Conclusion:** An acquired single gain-of-function point mutation (*V617F*) in the *JAK2*-gene is highly prevalent in polycythemia vera (95%) and essential thrombocythemia (50%). Major thrombotic events, especially splanchnic vein thrombosis also occur in *JAK2+* patients (27–44%) who otherwise have few or no clinical and laboratory features of MPD.

Subclinical MPD identified by molecular testing for the *JAK2-V617F* mutation might be an underrecognized prothrombotic state in patients with stroke and recurrent thrombotic events that strongly affects further diagnostic and therapeutic strategies.

### ESOC-0313

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Apixaban-associated interstitial lung disease

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**Background:** Post-marketing reports of interstitial lung disease (ILD) in users of dabigatran or rivaroxaban have been identified. However, association of apixaban, a factor Xa inhibitor, with ILD has not been clarified.

**Methods:** A single-center observational study on patients developing respiratory failure after initiation of apixaban medication was performed between February 2013 (sales release in Japan) and December 2014.

**Results:** Three patients (#1–3) were registered. All were Japanese men, high-aged (91, 87, 79 years old, respectively), and had renal dysfunction with a creatinine clearance around 35 ml/min. One had a history of ILD (#1) and another had emphysema (#3). One began to take apixaban as an initial anticoagulant for primary prevention (#1), and the other two changed from warfarin to apixaban for primary (#3) or secondary (#2) prevention. All developed acute respiratory failure 3 or 4 days after initiation of apixaban and ceased the medication soon. ILD was the final diagnosis for all. All underwent methylprednisolone pulse therapy and two received mechanical ventilation (#1, #3). One returned to normal within a week (#2), one repeated aspiration pneumonia and recovered (#3), and the other died of respiratory failure (#1).

**Discussion and conclusion:** Since ILD occurred soon after initiation of apixaban, there seems to be a strong association between ILD and apixaban for these three patients. In addition, all had multiple risk factors for ILD, including advanced age, renal dysfunction, and history of lung diseases. ILD is a possible early complication of apixaban for aged patients with multiple risk factors.

### ESOC-0676

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Neurofilament light chain serum levels in cervical artery dissection patients – An exploratory analysis

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**Background:** Cervical Artery Dissection (CeAD) is a major cause of stroke in young, otherwise healthy subjects. Serum neurofilament-light-chain (sNfL) levels are a marker of axonal injury. SNfL-levels correlate with clinical disease severity in several neurological disorders, but their importance in cerebrovascular disease remain unclear. In a proof-of-concept study we compared sNfL-levels with clinical features in patients with CeAD, which is a form of acute cerebrovascular disease with little confounding comorbidity.

**Methods:** This observational study included 49 consecutive non-traumatic CeAD-patients. SNfL-levels were measured by high-sensitivity electrochemiluminescence-immunoassay. Levels were compared with regard to (i) type of presenting symptoms: local symptoms alone (LS, n = 8), TIA, (n = 10), or ischemic stroke (n = 31); (ii) stroke severity at baseline quantified by NIHSS; and (iii) 3-month-outcome. Univariate and multivariate analyses adjusted for age, sex, NIHSS, and time to sNfL-measurement were done.

**Results:** CeAD-patients presenting with stroke had significantly higher sNfL-levels (median 108.9 pg/ml [Interquartile Range IQR 37.8–427.7]) than TIA patients (16.4 pg/ml [8.7–36.3], p = 0.009) or LS patients (23.4 pg/ml [17.8–30.8], p = 0.005) respectively. Among stroke patients, sNfL-levels were associated with NIHSS (r = 0.402, p = 0.025). SNfL-levels were associated with 3-month outcome (r = 0.403; p = 0.004). However this association was reduced to a non-significant trend after adjustment for age, sex, stroke severity, and time to sNfL-measurement (p = 0.096 (adjusted)).

**Conclusion:** In CeAD-patients, sNfL-levels differed with the type of presenting symptom. In stroke patients, sNfL concentrations reflected stroke severity as measured clinically. The prognostic meaning of sNfL in CeAD deserves further testing.

### ESOC-0680

#### 27. Rare Causes, Stroke in the Young, and Case Reports

##### Acute ischemic stroke as trigger of non-convulsive status epilepticus: A case series

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**Background:** Acute ischemic stroke (AIS) can trigger non-convulsive status epilepticus (NCSE). In this study, we sought to assess the frequency and clinical characteristics of patients with an acute ischemic stroke as cause of NCSE.

**Methods:** From January 2005 to December 2012, we prospectively registered all consecutive patients who had at least 1 EEG > 30 minutes or continuous video-EEG monitoring confirming status epilepticus. We

describe clinical and imaging characteristics of all NSCE patients who suffered AIS as detected on diffusion-weighted magnetic resonance imaging (MRI) as trigger of NCSE.

**Results:** Out of 335 consecutive patients with confirmed NCSE, we identified 9 patients (2.7%) who had both AIS and NCSE; four (44%) were women. The median age was 70 years (interquartile range: 67–82.5 years). Three patients (33%) presented with pure left-hemispheric ischemic lesions, 6 patients (66%) showed bilateral AIS. Ischemic lesions were located in the anterior circulation (n = 4, 44%), posterior circulation (n = 2, 22%), or both (n = 3, 33%). Prior to MRI, computed tomography (CT) was done in 8/9 patients (89%). On CT-scans, 2 patients (25%) had signs suggesting early cerebral ischemia, while in 6/8 such signs were absent. Median delay between symptom onset leading to admission and diffusion weighted-MRI was 3 days (interquartile range: 1.5–6.5 days).

**Conclusion:** Acute ischemic stroke is a rare but important cause of NCSE. On CT-scans culprit ischemic lesions can frequently be missed. MRI with diffusion weighted imaging should be performed shortly after NCSE-onset to identify its etiology.

## ESOC-0211

### 27. Rare Causes, Stroke in the Young, and Case Reports

#### Free-floating carotid thrombus causing embolic stroke – summary of 7 cases

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**Background:** Free-floating thrombus in the carotid artery (FFT-CA) is an uncommon cause of embolic stroke. The most common etiology is a complication of an unstable atheromatous plaque, but several other conditions can be responsible. The preferred diagnostic technique depends on local facilities. There is no guideline recommendation for the treatment of FFT. We retrospectively analyze the features of 7 patients with FFT in the last two years in our department.

**Method:** Patients with FFT were identified prospectively in our Neurosonology Laboratory during 2013 and 2014. Patient demographics, cardiovascular risk factors, clinical features, diagnostic modalities, treatment regimes, and outcomes were recorded.

**Results:** In the study period 6.396 duplex sonography examinations of extracranial arteries were performed and 7 cases were diagnosed with FFT-CA. CT angiograms confirmed the ultrasonic diagnosis in three of the 7 cases. One patient with transient neurological signs caused by significant internal carotid artery stenosis and FFT was treated with antiplatelet therapy and statin, followed by endarterectomy. Three patients with minor or moderate stroke without significant stenosis were anticoagulated. The outcomes were favorable in these 4 patients. Three patients were admitted with severe stroke. They were treated with low dose LMWH, antiplatelet drug and statin. These 3 patients died due to systemic complications.

**Conclusions:** These cases support the theory that plaque morphology may be more important in causing stroke than severity of stenosis. Medical and surgical management have been used and careful evaluation of risk-benefit can help in the final individual decision.

## Young Stroke Physicians: Research Design Workshop for Studies in Development

ESOC-0965

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Comparison of rehabilitation outcomes for persons after stroke in Latvia and Sweden: A PhD Project

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The ultimate goal of this project is to identify strengths and weaknesses of Latvian rehabilitation system to improve care for patients with stroke. The way towards this, will be by comparing outcomes for persons after stroke, in Latvia and Sweden, using the bio-psycho-social model of the World Health Organization.

Specific aims:

1. Study 1: To compare Latvian and Swedish in-patient rehabilitation systems and explore the impact of possible differences on functional independence for persons after stroke – comparative cohort study; data from retrospective chart reading and registry data;
2. Study 2: To investigate whether functional limitations in the post-acute phase of stroke (at the time of inpatient rehabilitation) have an influence on self-perceived level of disability in the chronic phase of stroke in a Latvian population living in the society (at home) – concurrent cohort study;
3. Study 3: To investigate whether personal factors, such as age, gender, place of residence and time since onset of stroke, can influence self-perceived functioning and predict barriers and facilitators perceived in dealing with environmental factors for persons in the chronic stage of stroke living in Sweden – cross-sectional study;
4. Study 4: To explore if personal factors identified as important in a Swedish population, are relevant for a Latvian population of stroke survivors – cross-sectional study.

ESOC-1576

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Neuropsychological computer training versus entertaining computer games in patients with post-stroke cognitive impairments: Randomized clinical study

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**Background:** Complex of computer neuropsychological programs, elaborated in the KSMU, has shown effectiveness for cognitive training in patients with vascular cognitive impairments in several pilot studies. Some studies have found that computer activity can influence mental ability positively in elderly.

**Aim:** comparing changes in cognitive status in patients with post-stroke VCI, who worked with neuropsychological computer programs, with those in a similar group of patients, who played entertaining games.

**Methods:** Patients after hemispheric stroke in recovery period with VCI without dementia (N=55, age 37–67) were randomized into three groups. All patients received conventional treatment. Patients in the intervention group had 10 daily training sessions with neuropsychological

computer programs of 40 min duration. Participants in the active control group played entertaining games keeping the identical regimen. The passive control group patients received standard treatment. Cognitive, neurological, affective and functional states were assessed before and after training period.

**Results:** After training course there were significant improvements in the intervention and the active control group on all cognitive scales (MMSE, MoCA, FAB, CDT, Shulte's test). Improvements of functional state were observed in the intervention group (IADL,  $p=0.008$ ). We found significant score increasing comparing cognitive states of patients from both training groups with the control group. But there were no differences on cognitive scales between the intervention and the active control groups.

**Conclusions:** Neuropsychological computer programs and entertaining computer games enhance cognitive status in patients with post-stroke VCI. But only neuropsychological computer training impacts functional state.

ESOC-1029

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Effect of RTMS on serum vascular endothelial growth factor (VEGF) in chronic stroke: Does that indicate neuroplasticity?

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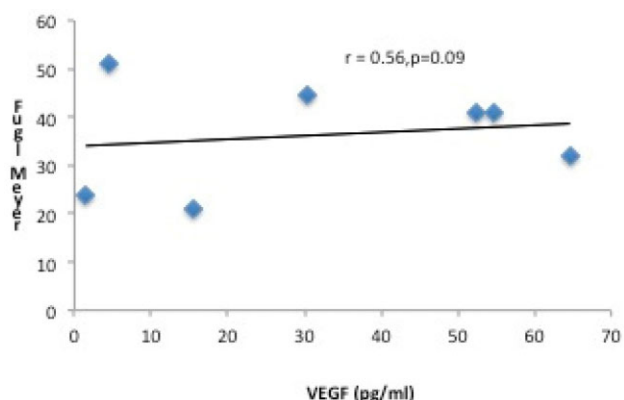
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**Background and purpose:** Repetitive transcranial magnetic stimulation (rTMS) has been known to stimulate neurotrophins like vascular endothelial growth factor (VEGF) aiding in neuroplasticity post stroke. The purpose of the study was to investigate the effect of rTMS with intensive physiotherapy on serum VEGF in chronic stroke patients with upper extremity motor deficits.

**Methods:** This ongoing randomized controlled trial recruited fifteen (n=15) chronic stroke patients from 3 to 18 months of index event with at least 10° of wrist extension, 10° of thumb abduction, Brunstorm stage 2–4; NIHSS 4–20. Patients were randomized to rTMS with intensive physiotherapy (n=7) and physiotherapy only (n=8). Serum venous sample for VEGF along with assessment with Fugl Meyer (FM), Barthel Index, modified Rankin Scale was done at baseline, 2 & 6 months. rTMS (1 Hz, 750 pulses with 110%RMT) was administered for 3 weeks (5 days/week). **Results:** Significant improvement was seen in patients treated with rTMS & physiotherapy on FM score (53.5 vs 42.7,  $p=0.001$ ) unlike modified Rankin scale (1.2 vs 1.8,  $p=0.3$ ) and Barthel Index (90.7 vs 83.7,  $p=0.34$ ) at 2 months. A high mean VEGF (1097.3 vs 803.5 pg/ml) with 35.4% increase after rTMS as compared to 24.4% in physiotherapy group alone. A weak positive correlation of VEGF with FM score ( $r=0.56$ ,  $p=0.09$ ) was observed in rTMS group (Fig. 1).

**Conclusion:** Increased serum VEGF after rTMS may help in neuroplasticity leading to significant improvement in upper extremity in chronic stroke. Future trials are needed to authenticate the results.





**Fig. 1** Correlation between serum VEGF and FM score in rTMS group (7 patients).

### ESOC-1351

#### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Evolution of resting-state network activity reflects functional recovery following acute lacunar stroke

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**Objective:** Individual prediction of functional recovery after acute stroke remains imprecise. Improving this could help with stratification for post-stroke recovery intervention trials. Resting-state fMRI (rs-fMRI) has been used in chronic stroke, but there is little understanding of its utility in acute stroke patients. The aim of this study was to evaluate the evolution of resting-state network (RSN) activity in the recovery from acute lacunar stroke.

**Methods:** Eleven consecutive patients with acute lacunar stroke (onset < 6 h) underwent rs-fMRI (TE 40 ms, TR 3000 ms, time of scan: 6 min) alongside clinical assessments (NIHSS, modified Rankin Scale (mRS)) at 4 time points: at presentation, 24 hours, 1 week, and 1 month. Functional connectivity within and between RSNs was evaluated and correlated with clinical changes. Validated statistical methods were used for each analysis; p values < 0.05 were considered significant.

**Results:** Median NIHSS at onset was 4 and at 1 month was 0. Median mRS at 3 months was 1. Significant dynamic changes were seen in the functional connectivity both within and between the motor, visual, and executive-control networks. Acute changes in intra-network connectivity were characterized by a higher variance affecting a more limited number of voxels when compared with week/month scans. Intra-network connectivity was significantly correlated with improvement in NIHSS (p = 0.04). **Conclusions:** The evolution of RSN activity closely tracked clinical changes with acute network disruption in the immediate aftermath of lacunar stroke and subsequent connectivity changes representing likely brain plasticity. Further work is ongoing to validate RSN as a prognostic measure.

### ESOC-1513

#### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Long-term stroke outcomes following inpatient rehabilitation

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**Background:** Many studies have been performed looking at outcomes after stroke but few have reported on whether patients get back to work. Other outcomes, for example the percentage of those with depression often have great variation within them depending on the study. Patients attending rehabilitation units following strokes often have more disabling symptoms and there has not been much work looking at this group particularly. We plan to clarify levels of residual disability in this patient cohort, as well as add to the literature describing the rates of getting back to work.

**Methods:** All patients who have previously had an inpatient stay on our rehabilitation ward will be given a questionnaire one year on in our outpatient clinic asking them specifically about symptoms including depression, bladder and bowel incontinence, place of living, mobility and continence of the bladder and bowels. We will conduct this over a year period in all of our clinics therefore hopefully recruiting approximately 40 patients. We will then look up their initial Barthel scores on arrival to the rehabilitation unit and their final scores on discharge.

**Hypothesis:** We anticipate that our initial Barthel scores will be lower than those published in other studies of all strokes but that they will have a greater subsequent improvement in those scores. One year on the percentage of those with motility and bladder and bowel problems will be slightly greater than the averages published due to the increased severity in this group.

### ESOC-0441

#### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Very early cognitive rehabilitation: A proposed algorithm to detect, assess and treat cognitive deficits in a stroke unit

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**Background:** Neuronal plasticity is a process that appears early after stroke. Early rehabilitation, by supporting motor learning and cognitive functions implied in learning processes, could enhance functional improvement early after stroke. A consistent and widely shared algorithm for early cognitive assessment and rehabilitation is needed.

**Aims:** we created and propose here an algorithm to detect, assess and treat cognitive impairment early after stroke. We first tested the feasibility in our comprehensive Stroke Center.

**Methods:** an interdisciplinary stroke and rehabilitation experts team produced the algorithm here presented. This algorithm is modulated taking into account the specificity of early stroke patients (level of cognitive functioning, behavioral disturbances, typical stroke side determined cognitive syndromes, individual cognitive profile) and the specificity of environment and setting in stroke units.

**Results:** In our Stroke Centre, during a period of 12 months, 113 patients have been studied and 25 started a very early cognitive rehabilitation. All patients were included in the algorithm in the first 2 weeks after stroke.

*Discussion:* Our preliminary experience showed that this tool is feasible and suitable for early stroke patients. It seems to be a promising tool to early detect cognitive deficit, in orienting cognitive rehabilitation and planning the post acute rehabilitation. All this points will be addressed in a prospective study planned to test the efficacy of this new rehabilitation strategy.

#### ESOC-1394

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Clot structure/function, hemostasis and hemorheology – Underlying causes for IV thrombolysis failure?

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*Introduction:* Extracerebral (ECA) or intracerebral artery (ICA) occlusions respond for majority of ischemic stroke (IS). Clot properties may differ depending on source, comorbidity and fibrinolytic ability of plasma which lead to different efficacy of intravenous thrombolysis (IVT). Rate of recanalization, neurological deficit and functional outcome in IS have been shown to be related to some hemostatic and hemorheological disturbances. The **aim of the planning study** is to evaluate the association between IVT efficacy with clot structure/function and blood properties which are the possible factors of IVT failure.

*Design:* prospective non-randomized clinical trial should include 200 patients with IS (eligible for IVT and with confirmed occlusion of ECA or ICA). Based on the IVT effect (recanalization or not) they might be selected for mechanical thrombectomy (MT). After that clot properties will be studied (histopathology method, scanning electron microscopy). All patients will undergo detailed neurological examination, standard neuroimaging (brain CT, CT-angiography and CT-perfusion), extended evaluation of blood properties at admission, after IVT, after MT (if done), at 1st, 7th, 21st and 90th day after admission. Blood properties evaluation is supposed to include detailed hemostatic, hematological and hemorheological analyses, platelet function, endothelial dysfunction, markers of inflammation and immune response, NET formation, recruitment and interactions between different leucocytes types, erythrocytes and platelets. That multidimensional study is able to be conducted on the multicenter basis with institutions collaboration.

#### ESOC-0682

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Evaluation of the efficacy of a simple educational strategy in reducing pre-hospital delay and improving prognosis in stroke patients

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*Background and purpose:* In recent years, the need for an early management of stroke patients has attracted increasing attention. A time-dependent effect has been observed with best prognosis in patients attended in the first 60 min ('the golden hour') after onset of symptoms. On the other hand, in the vast majority of studies evaluating pre-hospital delay, only 50–60% of patients arrive within the first 180 minutes, and a small proportion within the first 60 minutes. Global strategies and media campaigns (e.g. the FAST strategy) have only shown some effect on awareness of stroke in the short term. These global approaches are both expensive and ineffective in the long-term. Our aim is to evaluate a strategy targeting patients with risk factors, as most strokes happen in such patients (>90% in our series). The low cost of our strategy may allow its use as an everyday tool in primary care.

*Methods:* We want to evaluate the efficacy of a simple educational intervention (consisting of delivering a leaflet with graphic information on stroke symptoms and an advice to call the emergency services) for primary-care patients at risk of stroke in reducing the median pre-hospital delay after the onset of stroke symptoms. Our previous series will be used as a comparator. Secondary outcomes are a reduction of morbidity, dependence and mortality, and an increase in the use of the '112 Emergency Services' and in the rate of thrombolysis. No other interventions for patients or healthcare professionals will take place within the study period.

#### ESOC-1304

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Stroke team rhine main – A multicenter approach to structured, team-based management of acute ischemic stroke

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*Background:* The benefit of thrombolytic therapy for acute ischemic stroke is highly time-dependent. Endovascular stroke therapy has shown efficiency in experienced stroke centers and its wider implementation requires new forms of interdisciplinary organization. We implemented a new team-based stroke algorithm based on the principles of acute trauma life support (ATLS) in our hospital, bringing down our average DNT to 23 minutes and significantly reducing periprocedural delays in patients selected for endovascular stroke therapy.

*Aim of the project:* We plan to extend the STROKE TEAM algorithm to five participating Stroke Units of a regional stroke network in Hesse, Germany and evaluate its transferability to other hospital settings. End-points of a successful transfer will be a reduction of the DNT and an increase in staff satisfaction. Data on Patient safety will be reported, but our sample size will not permit meaningful statistical analysis.

*Project description:* In a first observation phase (3 months) DNT of patients receiving thrombolysis and data on staff satisfaction regarding the current state of acute stroke care will be collected at all participating hospitals.

In the following intervention phase we plan to communicate these findings to the participating hospitals, evaluate the individual stroke algorithms in group meetings, collect suggestions from the plenary for an individually tailored STROKE TEAM algorithm at each hospital and offer “train the trainer-workshops” including teaching materials for the simulator-based team trainings.

In the second observation phase (6 months) we will reevaluate DNT and staff satisfaction after the implementation of the STROKE TEAM algorithm.

### ESOC-0332

#### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development External validation of a score to predict the presence of asymptomatic carotid artery stenosis in people older than 59 years: A population study

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*Background:* Asymptomatic carotid artery stenosis (ACAS) is related to a higher risk of stroke. Because of the improvement in drug therapy, the annual rate of ipsilateral stroke associated with asymptomatic carotid stenosis has fallen from 2% to 4% to <1% in the past 20 years.

Population screening for ACAS are expensive and time consuming but could help to identify individuals at high risk of stroke who should be considered for best medical treatment.

*Aim:* We aim to determine the external validation of a prediction model (stroke 2014) for the identification of subgroups with relatively high prevalence of moderate or severe ACAS in the general population. Application of the prediction model may lead to a reduction in the number needed to screen for ACAS.

*Methods:* From the population registry of Citerna town, Umbria, Italy, we will include a random sample of inhabitants aged 60 years or more. We will include only participants without symptoms 6 months before the examination. Assuming a prevalence of moderate and severe ACAS (> 50%) around 10% (IC 7–13%) we will need a sample size of 276 individuals.

A trained neurologist will perform ultrasound examination of the carotid arteries. When both carotid arteries has a stenosis, we will register the most severe stenosis grade observed. An independent neurologist will calculate the score for each participant and will define the risk (from very low to high). We will calculate sensibility, specificity, PPV and NPV for each cut off.

### ESOC-0340

#### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development The influence of time of stroke onset on the utility of alberta stroke program early ct score

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*Background:* The efficacy of intravenous tissue plasminogen activator (tPA) diminishes in the setting of increased ischemic tissue burden, which can be assessed by the Alberta Stroke Program Early CT Score (ASPECTS). However, ASPECTS is dependent on the visibility of evolving ischemic changes on CT, and timing may critically impact on the reliability of ASPECTS. We hypothesize that the predictive capacity of ASPECTS on functional outcome is associated with time from acute ischemic stroke onset.

*Methods:* Acute ischemic stroke patients treated with tPA between 2007 and 2014 were included in a retrospective study. Patient demographics, vascular risk factors, baseline NIHSS, stroke subtype, time of onset and imaging and treatment, and 3 month mRS were collected. ASPECTS was assessed by 2 independent raters. We used generalized odds ratio analysis to assess onset time with the predictive capacity of ASPECTS.

*Results:* Three hundred and sixty-eighty patients were included. Median (IQR) age was 74 years (64–81), 167 (45.38%) were female and median (IQR) baseline NIHSS was 12 (6–18). Inter-rater agreeability was 0.59 (weighted kappa, 95% CI: 0.293–0.835). We categorized time from stroke onset to CT scan into quartiles: Q1 (11 to 100.5 minutes), Q2 (100.5 to 190 minutes), Q3 (190 to 279.5 minutes) and Q4 (279.5 to 369 minutes). There was significant association between a high ASPECTS (>7) and low mRS (<2) in Q3 (p = 0.02) and Q4 (p = 0.006), but not in Q1 and Q2.

*Conclusion:* We showed that ASPECTS beyond 190 minutes from stroke onset was significantly associated with mRS at 3 months.

### ESOC-1555

#### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Clinical and surgical features associated with stroke in patients undergoing coronary artery bypass grafting (CABG) surgery: A retrospective cohort study of 798 patients

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*Background and objective:* Postoperative stroke (POS) is one of the most feared complications of cardiac surgery due to its high morbidity and mortality consuming disproportionate amount of available resources. Our aim was to describe the major clinical and surgical features associated with stroke in patients undergoing CABG.

*Methods:* We reviewed all cases submitted to CABG surgery in our institution from January 2011 to June 2014. Their clinical and surgical characteristics were recorded. Mortality between patients with and without stroke was compared using Fisher's exact two-tailed test.

*Results:* Of 798 patients submitted to CABG surgery, only 1.62% (n = 12) experienced POS. The majority of patients were male (76%) with a mean age of 63,5 years old. One quarter of them presented with an asymptomatic carotid stenosis. All cases were ischemic stroke occurring predominantly during the first week (76%). One third awoke from anesthesia with

neurological deficit. The majority of POS after CABG surgery occur in the anterior circulation due to embolic mechanism. New onset postoperative atrial fibrillation (NOAF) was found in 23% of patients. POS usually needed vasoactive drugs (76%) and blood transfusion (61%) during surgery. Mechanical thrombectomy was performed in 15% of the POS. POS had a higher mortality rate (30% –  $p = 0.0002$ ) and a worse outcome after hospital discharge.

**Conclusions:** Stroke is a devastating postoperative complication of CABG surgery, however there are new opportunities to prevent and treat them. NOAF may increase the risk of stroke if they were not detected and rapidly treated.

## ESOC-1260

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Atrial strain plus NT-ProBNP for atrial fibrillation detection in ESUS stroke patients

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**Abstract:** Subclinical atrial fibrillation (AF) is the main cause of ESUS (embolic stroke of undetermined source). The left atria strain (LAS) is decreased in patients with AF. The level of N-terminal pro brain natriuretic peptide (NT-ProBNP) is a cardioembolic stroke marker. We studied the relationship between these surrogates to improve the AF detection in ESUS patients.

**Methods:** All patients with non-lacunar stroke in a 3 years period were included. Those with prosthetic heart valves of previous AF were excluded. ECG monitoring for AF detection was performed by 72 hours telemetry. The left atria deformability was analyzed by the percentage of LAS. Blood samples were drawn to measure the serum NT ProBNP concentration. The patients were classified in High-risk group for AF detection: (LAS < 25.83% & NT-ProBNP > 148 pg/ml) and Low-risk group (LAS < 25.83% & NT-ProBNP > 148 pg/ml).

**Results:** A total of 88 patients were included. The percentage of LAS and the value of NT-ProBNP showed an inverse correlation (Spearman's Rho –0.5) ( $p < 0.001$ ). The High-risk group showed higher percentage of AF detection (34.5% vs 8.5%) ( $p = 0.002$ ) and the Low-risk group had the most percentage of atherothrombotic strokes (35.5% vs 17.5%) ( $p = 0.059$ ) and stroke by PFO (19.4% vs 3.5%) ( $p = 0.014$ ). High-risk group was an independent predictor of AF when the age, (OR 0.18 [95% CI, 0.05–0.65];  $p = 0.008$ ), the CHADSVASC score (OR 0.13 [95% CI, 0.03–0.49];  $p = 0.002$ ) and the stroke etiology OR 0.15 [95% CI, 0.04–0.56];  $p = 0.005$ ) were considered.

**Conclusions:** The percentage of LAS and NT-ProBNP may help to classify the risk of AF detection in ESUS.

## ESOC-0979

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development RISCLON – Risk of recurrent stroke in Clopidogrel non-responders

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**Background:** Antiplatelet treatment with Clopidogrel is a cornerstone in secondary stroke prevention. Studies in patients with cardiovascular

disease indicate that some individuals (4–34%) have a poor response to Clopidogrel and have a higher risk of new cardiovascular events. This is never studied in ischemic stroke patients. We aim to evaluate if Clopidogrel non-responders have an increased risk of recurrent stroke.

**Method:** 196 patients with first-ever ischemic stroke on Clopidogrel 75 mg/day is tested for their Clopidogrel response (PRU, Platelet Reaction Units) using the VerifyNow P2Y12 assay (Accumetrics, California) 2–4 weeks after treatment initiation. Included patients must have stroke lesions on CTC/MRI, perfusion deficit or clinically high suspicion of stroke.

Follow-up every 3 months for 2 years in the outpatient clinic by a stroke physician to determine whether a new stroke has occurred. Both stroke physician and patients are blinded for the PRU result. At end of follow-up the PRU results are revealed and the number of non-responders (PRU > 208) with a recurrent stroke or TIA (Transient Ischemic Attack) is compared to those without.

**Progress:** 35% of patients have been enrolled.

## ESOC-1047

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development Tasdevil: Demographics and predictors of epilepsy following vascular insult, a longitudinal population-based study in northwestern Tasmania, Australia

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**Background:** Increasing data indicate epilepsy in the elderly is rising with substantial potential consequences, including injury and loss of independence. Although Cerebrovascular Disease (CVD) is the most common cause of seizures in this demographic, etiology remains largely unknown in the modern neuroimaging era. Epilepsy prevalence in Australia is an estimated 7.5 per 1000. However, there have been no community-based studies to determine epilepsy incidence outside the hospital setting in Australia, with CVD risk a potentially modifiable cause and consequence of epilepsy.

**Aims:** To evaluate association between CVD and development of epilepsy in elderly Tasmanians. Specifically:

- incidence of silent CVD in new-onset seizures
- incidence of post-stroke seizures,
- predictors of further seizure (i.e. potentially modifiable risk factors).

**Methods:** Design: component of a prospective, population-based study to determine seizure and epilepsy incidence, their associated risk factors and health service use over 5 years.

**Setting:** Northwest Tasmania (22,500 km<sup>2</sup>). Population 112,000, 18.2% ≥65 years.

**Case identification:** All patients presenting with stroke, seizure or their mimickers.

- Hot pursuit: hospital presentations, general practitioner visits, radiology and electroencephalogram (EEG) requests, general physician and neurologist referrals.
- Cold pursuit: emergency department attendances, hospital discharge lists.

**Primary outcomes:** Incidence of stroke, seizures and CVD risk factors. Risk of seizure (incidence and recurrence).

**Secondary outcomes:** Incidence of EEG and cerebral imaging abnormalities, anti-epileptic drug prescription patterns, hospital re-admission rates.

**Statistics:** Power of 80% to evaluate primary outcome, based on published Australian stroke rates and predicted rates of post-stroke seizure. Cox proportional hazard models for seizure risk analysis.

## ESOC-0996

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development

#### Novel oral anticoagulants in stroke patients (NOACISP) – A prospective registry

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**Background:** New direct oral anticoagulants (NOAC) are approved for prevention of stroke in patients with atrial fibrillation. These agents inhibit selected players in the coagulation cascade such as the direct thrombin inhibitor dabigatran or the factor Xa-inhibitors apixaban, rivaroxaban and edoxaban. Little is known how patients should be cared for if they have an acute ischemic stroke or an intracranial hemorrhage (ICH) while under NOAC treatment.

**Aim:** To systematically evaluate (i) current management strategies and (ii) 3-month outcome and complication of patients with either (a) acute ischemic stroke or (b) ICH occurring under NOAC treatment (i.e., last intake

**Design:** We set up a prospective, web-based multi-center registry. The following items are systematically ascertained: Demographic variables, stroke/ICH characteristics, routine laboratory tests including clotting tests/drug specific coagulation tests; type, agent, and dosage of anticoagulant, use and type of acute recanalization therapy or hemostatic therapies; 3-month functional outcome, presence or absence of ischemic/hemorrhagic complications. Patients taking vitamin K antagonists will serve as comparison group.

**Potential significance:** A multi-center cooperation with other stroke centers is intended. The present study will explore important aspects of current management of patients with ICH or acute ischemic stroke while under NOAC treatment. A special interest is focused on the use of acute recanalization therapies for acute ischemic stroke and hemostatic therapies in ICH.

## ESOC-0177

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development

#### Effects of mannitol on the clinical outcomes in acute intracerebral hemorrhage: Analysis in INTERACT2

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<sup>8</sup>Servicio de Neurología Departamento de Medicina, Clínica Alemana, Universidad del Desarrollo, Santiago, Chile

**Background:** Mannitol is frequently used in the management of acute stroke without clear supporting evidence of benefit. We aimed to

determine whether mannitol improved clinical outcomes independent of other factors among participants of INTERACT2.

**Methods:** INTERACT2 was an open, blinded endpoint, randomized controlled trial of 2839 patients with spontaneous intracerebral hemorrhage (ICH) (<6 hrs) and elevated systolic blood pressure (SBP, 150–220 mmHg) allocated to intensive (target SBP < 140 mmHg within 1 hr) or guideline-recommended (target SBP < 180 mmHg) BP lowering treatment. Multivariable and propensity score (PS) analyses were used to assess the relationship of mannitol use (<7 days) and 90-day clinical outcomes (death or major disability, mRS scores 3–6).

**Results:** There was no significant difference in death or major disability between mannitol and non-mannitol users (multivariable adjusted odds ratio [OR] 0.89, 95% CI 0.73–1.08;  $p = 0.22$  and PS analyses OR 0.86, 95% CI 0.72–1.04;  $p = 0.12$ ). However, mannitol significantly reduced the risk of death at 90 days (multivariable adjusted OR = 0.78, 95% CI 0.59–1.03;  $p = 0.08$  and PS analyses OR = 0.71, 95% CI: 0.54–0.95;  $p = 0.02$ ).

**Conclusions:** Mannitol appears to improve the chances of survival but not in overall better functional outcome in ICH.

## ESOC-0507

### 28. Young Stroke Physicians: Research Design Workshop for Studies in Development

#### Development and evaluation of a complex intervention for post-stroke fatigue

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**Introduction:** Post-stroke fatigue (PSF) is common and distressing but there is no effective treatment. PSF is associated with psycho-behavioral factors and complex interventions targeting these factors are effective in treating fatigue in other conditions. This study aims to develop and evaluate the feasibility of an intervention for PSF.

**Methods:** Based on a comprehensive literature review, the views of service users, and expert input from stroke physicians, clinical psychologists and a psychotherapist, a psychological therapy was developed. This is a complex intervention which comprises an educational approach to reassure patients that PSF is often reversible, and a behavioral approach to encourage patients to achieve a balance between daily activities, rest and sleep. The intervention is being tested in a feasibility study, which is delivered by a clinical psychologist through six face-to-face sessions and one telephone session. Feasibility outcomes include recruitment rate, completion rate, and participants' feedback.

**Results:** We sent out 120 invitation letters and 12 people consented to participate. Eight of the enrolled participants completed the treatment and another four participants withdrew for reasons not directly relevant to the intervention (Fig. 1). All eight participants reported their fatigue 'improved' following the intervention and rated this intervention 'helpful' in reducing their fatigue. Further feedback will be obtained from a focus group with all participants.

**Conclusion:** This intervention is acceptable to stroke survivors. In the next phase, we will adapt it for delivery by stroke nurses and test it in a randomized controlled trial to obtain further evidence on feasibility and efficacy.

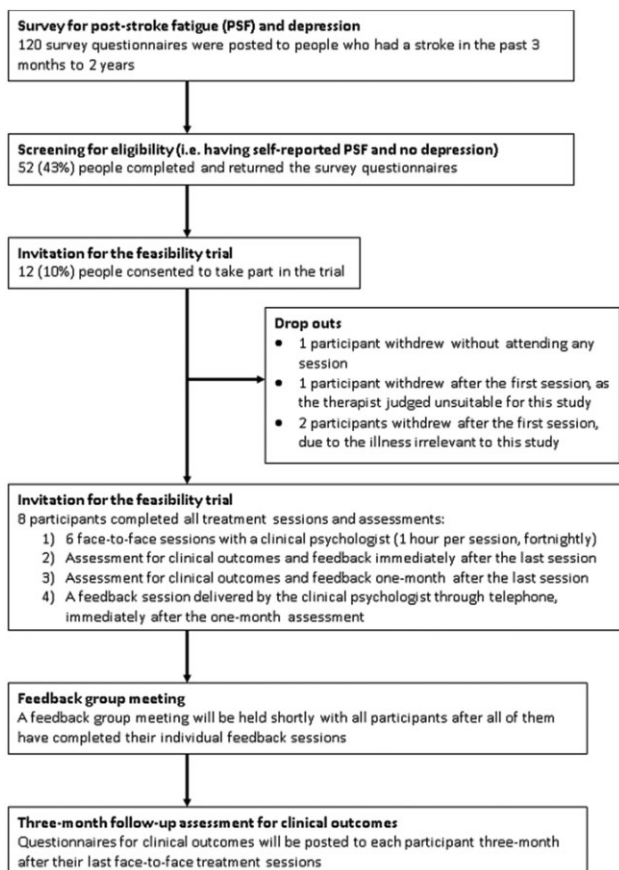


Fig. 1

**ESOC-0261**  
**28. Young Stroke Physicians: Research Design Workshop for Studies in Development**  
**Magnetic resonance vessel wall imaging in young stroke**

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*Background:* Current stroke analysis in young stroke patients often fails to determine the exact cause. Magnetic Resonance – Vessel Wall Imaging (MR-VWI) of intracranial vessels, being a step beyond imaging luminal stenosis, may detect and characterize vessel wall alterations as a cause of young stroke. The presence of vessel wall abnormalities in young stroke may point to causes of stroke with possibly more often rare causes of stroke in this population (intracranial dissections, vasculitis, vasoconstriction). As a result, individual treatment or on the other hand further diagnostic efforts can be adjusted.

*Objective:*

1) To study vessel wall alterations of intracranial vessels in young stroke patients with a cryptogenic stroke,

2) To study the presence of contrast-enhancement in vessel walls as a sign of inflammation

*Methods:* We will perform a prospective study in 50 patients with ischemic stroke, aged between 18–50 years and 25 age matched controls. We will exclude patients with known cardiovascular risk factors, known coagulation disorders, known carotid stenosis or a suspected cardiogenic cause. We will use high resolution VWI in combination with a standard young stroke MR protocol (MRA, DWI, FLAIR). The presence of vessel wall abnormalities will be assessed in patients and controls.

**ESOC-0334**

**29. Ongoing Trials**

**The REstart or STop Antithrombotics Randomised Trial (RESTART): baseline characteristics of the first 100 participants**

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*Background:* In high-income countries, 40% of adults with spontaneous intracerebral haemorrhage (ICH) are prescribed an antithrombotic drug before ICH onset. In previous observational studies, adults with antithrombotic-associated ICH were mean age 75 years, 56% male, 40% had lobar ICH, 73% had hypertension, and 3% had a prior history of ICH; antithrombotic drugs before ICH included antiplatelet drugs (59%), anti-coagulants (35%), or both (6%).

*Methods:* The REstart or STop Antithrombotics Randomised Trial (www.RESTARTtrial.org, ISRCTN71907627) aims to recruit >720 adult survivors of antithrombotic-associated ICH to test whether starting antiplatelet drugs causes a beneficial net reduction of all serious vascular events over two years compared with avoiding antiplatelet drugs. We performed descriptive analyses of trial participants to assess generalisability.

*Results:* At randomisation, the first 100 participants were mean age 76 years, 61% male, and 50% had lobar ICH. Co-morbidities before randomisation included hypertension (83%), ICH (6%), ischaemic heart disease (54%), atrial fibrillation/flutter (36%), ischaemic stroke (25%), and transient ischaemic attack (17%). Before ICH onset, participants had taken aspirin (57%), clopidogrel (20%), dipyridamole (6%), warfarin (30%) or rivaroxaban (2%). Median delay from ICH onset to randomisation was 56 days (inter-quartile range 21–98). These characteristics were similar in the 60 participants in the brain magnetic resonance imaging sub-study.

*Conclusion:* The characteristics of the first 100 participants in RESTART are similar to the characteristics of adults with antithrombotic-associated ICH in previous observational studies, suggesting there is no evidence of selection bias and that, if maintained, the trial findings should be generalisable.

## ESOC-1599

## 29. Ongoing Trials

**Combined lysis of thrombus with ultrasound and systemic tissue plasminogen activator for emergent revascularization in acute ischemic stroke (CLOTBUSTER)**

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<sup>7</sup>Biostatistics, University of Alabama Birmingham, Birmingham, USA

*Background:* Continuous exposure of intracranial arterial occlusions to pulsed wave ultrasound enhances tPA-induced recanalization.

*Hypothesis:* Sonothrombolysis improves functional outcomes of stroke patients receiving tPA therapy.

*Objectives:* Assess efficacy of combined treatment with a novel transcranial ultrasound device and systemic tPA (Target) compared to systemic tPA alone (Control) in subjects with acute ischemic stroke.

*Methods:* Subjects with acute ischemic stroke, pre-morbid mRS of 0–1 and NIHSS  $\geq 10$  will be randomized (1:1) to the Target and Control groups. Active and sham ultrasound will be delivered via the Clotbust ER device for 2 hours with the first hour overlapping with IV-tPA administration. Subjects are followed for adverse events through day 7 or hospital discharge, whichever is first and return for 90-day mRS evaluation. Primary endpoint analysis of 90-day mRS will be assessed utilizing ordinal logistic regression. A total of 824 patients will be enrolled with interim analyses at  $\frac{1}{3}$  and  $\frac{2}{3}$  of enrollment.

*Current Status:* As of February 18, 2015 CLOTBUSTER is ongoing with 639 of 824 planned subjects enrolled to date. The DSMB recommended continuation of the trial as planned without modification after the first interim analysis. The second interim analysis is planned for the end of March, 2015. Enrollment is expected to complete by the end of June 2015 with follow up of the last patient projected at the end of the third quarter of 2015.

*Conclusions:* CLOTBUSTER enrollment is projected to continue into the third quarter of 2015.

Sponsored by Cerevast Therapeutics Inc. ClinicalTrials.gov Trial Registry ID: NCT01098981.

## ESOC-1376

## 29. Ongoing Trials

**Life after stroke – the LAST study**

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<sup>4</sup>Department of Medicine, Trondheim University Hospital, Trondheim, Norway

*Purpose:* The primary aim of the LAST study is to assess the effect of a long term follow-up program on motor function after stroke.

*Methods:* This is a prospective, multi-site randomised controlled trial, with blinded assessment 18 months after inclusion. A total of 390 informed consenting patients will be recruited and randomised to a control group or to an intervention group. The recruitment will be conducted at the outpatient clinic at the participating hospitals, 10 to 16 weeks after onset of stroke. Patients will be stratified according to stroke severity, age above 80 and recruitment site. Every month, patients randomised to the intervention group will be encouraged by a physiotherapist to do 30 minutes of daily physical activity and 60 minutes of motor training every week. The control group will receive standard care according to the Norwegian guidelines. All patients will be followed for 18 consecutive months. The primary outcome is motor function (Motor Assessment Scale) at 18 months follow-up. Secondary outcomes are; dependency, balance, endurance, health related quality of life, fatigue, anxiety and depression, cognitive function, burden on caregivers and health costs.

*Results/Discussion:* The recruitment was ended by June 2014. A total, 384 patients were included. Out of these, 279 (73%) were <80 years and 305 (79%) suffered from mild/moderate stroke. So far, 188 patients have completed the intervention. The drop-out rate is 17% which is in accordance with the power calculation. The intervention will be concluded by the end of 2015.

## ESOC-1601

## 29. Ongoing Trials

**Lumina-study: Gadolinium-enhanced aneurysm wall imaging of non-ruptured intracranial aneurysms**

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*Background:* Current models to assess the rupture risk of intracranial aneurysms are inaccurate and fail to identify small aneurysms with a high risk of rupture. Therefore, new risk factors for aneurysm rupture need to be identified. Inflammation may be a key modulator in aneurysm rupture. Gadolinium-enhanced magnetic resonance imaging (MRI) with vessel wall imaging (VWI) can identify sites of inflammation in other vasculopathies such as vasculitis and intracranial atherosclerosis. Recent studies suggest that contrast enhancement of the aneurysm wall is associated with aneurysm growth or rupture.

*Design:* Prospective single center cross-sectional study.

*Objectives:* To assess the prevalence of contrast enhancement of the aneurysm wall and its predictors in patients with small unruptured intracranial aneurysms.

*Population:* 80 patients  $\geq 18$  years with  $\geq 1$  small unruptured intracranial aneurysm(s).

*Outcome:* Contrast enhancement of the aneurysm wall on 3 Tesla MRI with VWI.

*Statistical analyses:* We will assess the proportion and corresponding 95% confidence interval (CI) of aneurysms with contrast enhancement. With univariable and multivariable conditional logistic regression analysis we will calculate odds ratios and 95%CI for the association between contrast enhancement and the use of anti-inflammatory drugs, aneurysm size, hypertension, and tobacco use.

*Yield:* This study gives insight in the prevalence of contrast enhancement and its predictors in patients with small unruptured intracranial aneurysms. The results of this study will be used to design a prospective multicenter cohort study to investigate whether contrast enhancement of the aneurysm wall predicts aneurysm growth in small aneurysms that are left untreated.

*Status:* 38 patients have been included.

## ESOC-1613

## 29. Ongoing Trials

## Patch: platelet transfusion in cerebral haemorrhage

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**Background:** Haematoma volume is one of the most important outcome predictors in intracerebral hemorrhage (ICH). Several studies showed that haematoma volume increases during the first 6 hours after onset of ICH. Reduction of this haematoma growth provides a promising target to improve outcome. Patients using antiplatelet treatment (APT) are at risk for haematoma growth. In these patients platelet transfusion (PT) is the best way to restore coagulation.

**Objective:** The objective is to investigate whether platelet transfusion within 6 hours after onset of ICH can improve functional outcome by limiting haematoma growth in ICH patients using APT.

**Study Design:** PROBE: Prospective, randomised, open treatment, blind end-point evaluation study

**Study Population:** Patients with spontaneous ICH using APT (aspirin, dipyridamole and / or clopidogrel) at time of haemorrhage. For full inclusion and exclusion criteria please visit [www.strokeamc.nl](http://www.strokeamc.nl).

**Intervention:** Patients are randomised to receive either 1) single platelet transfusion (1 or 2 units) or 2) standard care without platelet transfusion

**Outcome:** Primary endpoint is poor functional outcome (modified Rankin Scale score 4–6) three months after ICH.

Secondary endpoints are safety of platelet transfusion and haematoma growth within 24 hours on CT imaging.

**Trial Progress:** 162 patients of the targeted 190 patients have been included. The trial is including in 36 centres in the Netherlands, 13 centres in Scotland, and 11 centres in France.

**Contact:** Please visit [www.strokeamc.nl](http://www.strokeamc.nl). Study nurse Nadine Fleitour: [n.m.fleitour@amc.uva.nl](mailto:n.m.fleitour@amc.uva.nl), +315664564 or PhD student Irem Baharoglu: [m.i.baharoglu@amc.uva.nl](mailto:m.i.baharoglu@amc.uva.nl)

## ESOC-1619

## 29. Ongoing Trials

## ARTSS-2: A pilot, phase IIb, randomised, multi-center trial of argatroban in combination with recombinant tissue plasminogen activator for acute stroke

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**Trial Registry Numbers:** NCT01464788; ISRCTN51505768

**Background:** Recombinant tissue plasminogen activator (rt-PA), fails to reperfuse most large thrombi strokes. In our Phase IIa low-dose safety study (n = 65), the two drugs appear safe when delivered concomitantly and recanalization rates were greater than with historical controls. This study will provide evidence-based data needed to design a definitive trial.

**Objectives:** Estimate overall benefit among stroke patients treated with rt-PA who are randomised to also receive either low-dose Argatroban,

high-dose Argatroban, or neither; Verify the safety of low-dose Argatroban and rt-PA and test the safety of high-dose combination treatment; Assess rates of early recanalization.

**Study Population:** 105 total ischaemic stroke patients treated with IV-rt-PA; age ≥ 18 years; proximal intracranial artery occlusion (imaged by TCD or CTA), or NIHSS ≥ 10.

**Intervention:** Patients are randomized 1:1:1:

1) Low-dose Argatroban 1.0 µg/kg/min 48-hr infusion, preceded by a 100 µg/kg bolus. Titrated to 1.75 times baseline aPTT + IV-rt-PA;

2) High-dose Argatroban 3.0 µg/kg/min 48-hr infusion, preceded by a 100 µg/kg bolus. Titrated to 2.25 times baseline aPTT + IV-rt-PA;

3) Intravenous-rt-PA alone.

**Outcome Measures:** Excellent functional outcome (0–1 mRS) at Day 90 as assessed by blinded personnel; Safety as measured by the incidence of symptomatic intracranial haemorrhage; Rates of arterial recanalisation; NIHSS improvement at 2/24/48 hours, day 7 and day 90; Quality of Life and Cost Utility Analysis.

**Trial Status:** Ongoing. 89 of 105 patients enrolled. Mean age: 69.3 ± 14.8 and median (range) NIHSS: 14.5 (2–33).

**Trial Sponsors:** NIH; The University of Texas Health Science Center-Houston

## ESOC-1032

## 29. Ongoing Trials

## Rapid intervention with glyceryl trinitrate in hypertensive stroke Trial-2 (RIGHT-2)

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**Rationale:** High blood pressure (BP) is common in acute stroke and is associated with poor outcome. Previous hospital-based trials testing the effects of BP lowering on functional outcome have been inconclusive. The PIL-FAST and RIGHT pilot trials confirmed the feasibility of performing single centre UK ambulance-based stroke trials. In both RIGHT and in a subgroup of patients recruited within 6 hours into the large ENOS trial, transdermal glyceryl trinitrate (GTN), a nitric oxide donor, lowered BP and reduced death or disability. Based on these results, RIGHT-2 aims to test the safety and efficacy of transdermal GTN in the pre-hospital setting.

**Methods:** Paramedics from 5 UK ambulance services serving 30 comprehensive or primary stroke care centres will screen, consent, randomise and treat 850 patients presenting within 4 hours of FAST-positive stroke and with systolic BP >120 mmHg. Treatment will comprise GTN or similar sham patch, and will be continued in hospital for 3 days. The primary outcome will be the modified Rankin Scale at day 90. Secondary outcomes include vascular events, disability, quality of life, mood and cognition. Neuroimaging and biomarkers will examine potential mechanisms of action. Recruitment will commence in quarter 1/2 2015.



*Funding:* British Heart Foundation

*Contact Information:*

*Website:* <http://www.right2-trial.org>

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*Telephone:* +44 115 823 1770

## ESOC-1181

### 29. Ongoing Trials

#### Triple Antiplatelets for Reducing Dependency after Ischaemic Stroke (TARDIS). A randomised controlled trial

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*Rationale:* The risk of recurrence is greatest immediately after stroke or TIA. Existing prevention strategies (antithrombotic, lipid/blood pressure lowering, endarterectomy) reduce, not abolish, further events. Dual antiplatelet therapy – aspirin & clopidogrel (AC) for ischaemic heart disease, aspirin & dipyridamole (AD) for stroke, is superior to aspirin monotherapy. We hypothesise that triple antiplatelet therapy (ACD) will be superior to current guideline therapy (AD or C) in patients at high-risk of recurrence, providing bleeding does not become excessive.

*Design:* TARDIS is a multicentre, parallel-group, prospective, randomised, open-label, blinded-endpoint, controlled trial. In the start-up (3 years) phase, we assessed the safety, tolerability and feasibility of intensive antiplatelet therapy (ACD) versus guideline therapy given for 1 month in 902 patients with acute stroke/TIA. The main 5 year phase will assess the safety and efficacy of intensive or guideline therapy in up to 4,100 patients. The primary outcome is ordinal stroke severity (fatal/severe non-fatal/mild/TIA/none) at 90 days. Secondary outcomes include death, myocardial infarction (MI), vascular events, function, bleeding, serious adverse events; sub-studies will assess cerebral emboli and platelet function.

*Trial status:* The main phase of the trial commenced on 1<sup>st</sup> October, 2012, and will run for 5 years. As of 8<sup>th</sup> January, 2285 patients have been recruited from 102 centres (UK, Denmark, Georgia, New Zealand).

*Funding:* The National Institute of Health Research, Health and Technology Assessment Programme

*Contact Information:*

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ISRCTN47823388

## ESOC-0887

### 29. Ongoing Trials

#### Tenecteplase versus alteplase for stroke thrombolysis evaluation trial

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In phase II studies, tenecteplase has been shown to result in more complete reperfusion. We have now begun a phase III trial compare Tenecteplase with Alteplase in acute ischemic stroke with onset <4.5 hours in patients clinically eligible for intravenous alteplase who fulfil additional imaging criteria.

*Design:* Multicentre, prospective, randomised, open-label, blinded endpoint (PROBE) phase III study. Patients will be randomised 1:1 to standard dose intravenous alteplase (0.9 mg/kg) or tenecteplase (0.25 mg/kg as a single bolus). There will be two randomisation strata: first, randomisation will be stratified by the presence or absence of internal carotid artery occlusion (ICAO) on baseline CT or MR angiography; second, randomisation will be stratified by size of infarct core (above or below 25 mL) on baseline CTP or diffusion-weighted MRI (DWI). Patients with ICAO will be capped at a maximum of 25% of the sample size.

*Population Studied:* Patients aged ≥ 18 years presenting with acute hemispheric ischemic stroke within 4.5 hours of stroke onset who are clinically eligible for IV alteplase. Multimodal CT or MRI including perfusion imaging must be performed before randomization.

*Primary Outcome:* Modified Rankin Scale (mRS) 0–1 at 3 months (no disability).

*Secondary Outcomes:* Reperfusion at 24 hours post stroke  
Early clinical improvement (reduction in acute – 24 hour NIHSS score)  
Modified Rankin Scale 0–2 at 3 months

Recanalisation at 24 hours post stroke.

*Trial Status:* Commenced August 2014 with 6 centres now open in Australia and a further 17 sites planned to open across Taiwan, Canada and Europe.

## ESOC-1596

### 29. Ongoing Trials

#### Robot Assisted Training for the Upper Limb after Stroke (RATULS)

**H. Bosomworth**<sup>1</sup>, L. Shaw<sup>1</sup>, H. Rodgers<sup>1</sup>

<sup>1</sup>Stroke Research Group, Newcastle University, Newcastle upon Tyne, United Kingdom

*Introduction* Loss of the ability to use the arm is a common and distressing consequence of stroke. Currently it is unclear how best to provide

therapy to improve arm recovery and function. Research suggests that robot-assisted training may be beneficial but this is not yet proven and further research is needed.

*Methods:*

*Study design:* A pragmatic multicentre randomised controlled trial, cost analysis and process evaluation.

*Study setting:* Four study centres, each consisting of a hub hospital with an InMotion robotic gym system and adjacent primary and secondary care spoke sites.

*Study participants:* Adults with acute or chronic first ever stroke (1 week to 5 years post stroke) causing moderate to severe upper limb functional limitation.

*Study treatments:* There are three randomisation groups:

- i. Robot assisted training using the InMotion robotic gym system delivered for 45 minutes, three times per week for 12 weeks.
- ii. Enhanced upper limb therapy delivered for 45 minutes, three times per week for 12 weeks.
- iii. Usual NHS care.

*Randomisation:* Central independent web based service.

*Primary outcome:* Upper limb function measured by the Action Research Arm Test at 3 months.

*Secondary outcomes:* Upper limb impairment, activities of daily living, quality of life, resource use and adverse events measured at 3 and 6 months.

*Blinding:* Outcomes assessments by blinded assessor.

*Parallel process evaluation:* Semi-structured interviews with a sub-sample of participants and staff.

*Sample size:* 720 participants.

*Current study progress:* RATULS opened to recruitment in April 2014. Current recruitment (16.02.2015) is 146 participants.

## ESOC-1600

### 29. Ongoing Trials

#### The NIH strokeNet: Maximizing efficiencies for conducting high quality clinical trials in stroke prevention, treatment and recovery

J. Broderick<sup>1</sup>, Y. Palesch<sup>2</sup>, W. Zhao<sup>2</sup>,

for the NIH StrokeNet Investigators

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<sup>2</sup>Public Health Sciences, Medical University of South Carolina, Charleston, USA

*Background:* The 2012 Stroke Progress Review Group and National Institute of Neurological Disorders and Stroke (NINDS) identified the need for a multi-center stroke trial network that would provide a robust, standardized, and accessible infrastructure to facilitate rapid development and implementation of NINDS-funded stroke trials in stroke prevention, treatment, and recovery.

*Objective:* The network is designed to increase efficiency of stroke trials by facilitating patient recruitment and retention, supporting novel methodologies, and streamlining approaches to develop stroke therapies.

*Design:* In 2013, NINDS awarded 25 Regional Coordinating Centers, a National Coordinating Center at the University of Cincinnati, and a National Data Management Center at the Medical University of South Carolina, to form the NIH StrokeNet. Efficiencies of the network include master trial agreements, central IRB, central pharmacy and investigational product distribution, common data elements, standard operating procedures, web-based Clinical Trial Management System, and statistical expertise. The StrokeNet will collaborate with other consortia and includes a training program for stroke research.

Investigators should contact NINDS to determine whether a proposal is appropriate for the network. Concepts approved by NINDS are referred to StrokeNet to assess feasibility. If feasible, Investigators may submit a grant

application in response to one of the StrokeNet Funding Opportunity Announcements for review by NINDS.

*Funding:* NINDS Award Number U01NS086872 and NS087748. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. NCC PI: J. Broderick, MD, University of Cincinnati. Contact: J. Spilker, RN, Administrative Director. judith.spilker@uc.edu (513) 558-5430

## ESOC-0693

### 29. Ongoing Trials

#### Prehospital stroke study at the universitair ziekenhuis brussel: Preliminary data on 24/7 in-ambulance telemedicine for emergency stroke care

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In-ambulance telemedicine for stroke (telestroke) is a promising concept. Real-time bidirectional audiovisual communication between a patient in a moving ambulance and a remote stroke expert can facilitate specialized care at a very early stage. We have developed several prototypes for in-ambulance telemedicine and we have created a telemedicine platform encompassing standardized assessment of stroke severity using the Unassisted TeleStroke Scale (UTSS), clinical decision support software for stroke physicians and reporting functionality for the in-hospital team awaiting the patient. Feasibility studies using this system in healthy volunteers and in patients during paramedic emergency missions have shown that this approach is safe, feasible and well-accepted by all stakeholders.

We have completed a pilot study on 24/7 in-ambulance telestroke support, confirming the safety, feasibility and reliability of this concept. We present a video fragment of an in-ambulance teleconsultation from this trial. Already during patient evacuation to the ambulance, vital data was exchanged between the general practitioner present at the location and the remote stroke physician. During emergency transportation to the hospital, the teleconsultant examined the patient, alarmed the in-hospital team and communicated critical information to the in-hospital team (patient identification and date of birth, vital parameters, glycaemia, time of symptom onset, stroke severity based on the UTSS, Glasgow Coma Scale score, medical history, concomitant medication, suspected diagnosis, checklist for treatment with intravenous thrombolysis, family contact information, premorbid modified Rankin Scale score).

A single-center randomized clinical trial evaluating the efficacy, safety, feasibility, reliability, and cost-effectiveness of in-ambulance telestroke is currently ongoing.

## ESOC-1245

## 29. Ongoing Trials

**Stroke: An evaluation of thrombectomy in the ageing brain – [including] where IV thrombolysis fails or is contraindicated (STABILISE)**E. Cora<sup>1</sup>, P. White<sup>1</sup>, G. Ford<sup>2</sup><sup>1</sup>*Institute of Neuroscience, Newcastle University, Newcastle upon Tyne, United Kingdom*<sup>2</sup>*Academic Health Science Network, University of Oxford, Oxford, United Kingdom*

**Introduction:** Patients with acute ischaemic stroke (AIS) due to a large vessel occlusion (LVO) have very poor outcomes. Only one randomised controlled trial (RCT), MR CLEAN, has evaluated the efficacy of thrombectomy in a heterogeneous population. Published thrombectomy studies typically exclude patients  $\geq 75$  years or patients with a contraindication to intravenous thrombolysis (IVT).

Thrombectomy devices have limitations because they were initially designed as stents for intracranial aneurysm coiling. Although modified for endovascular acute stroke treatment, they have limitations especially for accessing distal and tortuous vessels. Longer clots are more common in patients not responding to IVT.

STABILISE evaluates a new thrombectomy device (ERIC™) designed with features allowing longer clot retrieval and access to distal and tortuous vessels.

**Method:** Multicentre, prospective, phase II, single blinded RCT comparing the ERIC™ device with standard thrombectomy devices in female and male patients  $\geq 50$  years with AIS due to a LVO. Patients will be randomised in a 2:1 ratio to the ERIC device preferentially or to a standard thrombectomy device. A total of 120 patients will be enrolled over a period of 2 years.

The feasibility, safety and technical efficacy of the ERIC™ device will be assessed in a truly heterogeneous population. Early MRI after thrombectomy will be used as biomarker of clinical outcome. The trial is currently open to enrolment at the Royal Victoria Infirmary in Newcastle and the early progress results will be presented. The final trial results will be used to devise a definitive phase III clinical trial of the ERIC™ device.

## ESOC-1620

## 29. Ongoing Trials

**Practise trial: Penumbra and recanalisation acute computed tomography in ischaemic stroke evaluation**S. El Tawil<sup>1</sup>, J. Wardlaw<sup>2</sup>, L. Kalra<sup>3</sup>, I. Ford<sup>4</sup>, K. Muir<sup>1</sup><sup>1</sup>*Institute of Neuroscience and Psychology, University of Glasgow, Glasgow, United Kingdom*<sup>2</sup>*Clinical Neurosciences, University of Edinburgh, Edinburgh, United Kingdom*<sup>3</sup>*Clinical Neurosciences, King's College London, London, United Kingdom*<sup>4</sup>*Robertson Centre of Biostatistics, University of Glasgow, Glasgow, United Kingdom*

**Background:** IV rtPA is used in less than half of patients with acute ischaemic stroke eligible for thrombolysis. The use of multimodal imaging, such as CTP and CTA provide additional information on tissue viability, brain perfusion and vascular anatomy that might be helpful in patient stratification for therapy. It is currently unknown whether these additional benefits will outweigh the disadvantages of additional resource utilisation, radiation and contrast exposure, and treatment delay associated with their use.

**Aim:** To evaluate the utility of additional multimodal CT imaging in acute ischaemic stroke patients clinically eligible for IV rtPA, compared to NCCT. The primary endpoint is the proportion of patients treated with IV

rtPA in the 2 groups. Secondary end-points include diagnostic accuracy and clinical outcomes at 3 months.

**Methods:** The study is a prospective, multicentre RCT. Patients eligible for rt-PA will be randomised to NCCT alone or CT+CTP+CTA. The decision on IV rtPA based on allocated imaging will be documented. Total imaging time in both arms, and time to initiation of treatment delivery in those treated with IV rtPA, will be recorded. Follow up will include brain imaging at 24 h to document infarct size, presence of oedema and the presence of intra-cerebral haemorrhage. Clinical evaluations will include NIHSS score at baseline, 24 hours and 7 days, and mRS at day 90 to define functional outcomes.

**Progress:** The first centre was opened for patient recruitment, with seven other centres to be opened in March and April of 2015.

## ESOC-1154

## 29. Ongoing Trials

**On the road towards prehospital stroke diagnosis using microwave technology**J. Karlsson<sup>1</sup>, Z. Fekete<sup>2</sup>, B. Cederin<sup>3</sup>, E. Bertholds<sup>3</sup>, S. Candefjord<sup>4</sup>, A. Fhager<sup>4</sup>, T. McKelvey<sup>4</sup>, M. Persson<sup>4</sup>, M. Elam<sup>5</sup><sup>1</sup>*Stroke Unit, Sahlgrenska Univ Hospital, Gothenburg, Sweden*<sup>2</sup>*Stroke Unit, County Hospital of Borås, Borås, Sweden*<sup>3</sup>*Stroke Unit, County Hospital of Skövde, Skövde, Sweden*<sup>4</sup>*Signals & Systems, Chalmers Univ of Technology, Gothenburg, Sweden*<sup>5</sup>*Clin Neurophysiology, Inst of Neuroscience & Physiology, Gothenburg, Sweden*

In 2014 we reported “proof-of-principle” results showing that microwave-based brain measurements on patients hospitalized for stroke were capable of differentiating hemorrhagic (HS) from ischemic strokes (IS) (Persson et al, 2014). From start, one major aim of this project has been to develop a system suitable for prehospital use. This calls for a small, low weight, user-friendly and mechanically robust instrument. Here we present early data from an ongoing study using a recently developed device, which is battery-powered and weighs less than 6 kg.

After ethical/regulatory review, stroke alert chain patients hospitalized at three stroke units in the West Sweden region are recruited. Currently 23 patients, whereof 13 diagnosed with HS and 10 with IS, have been included. The classification algorithm was trained on measurements from patients with confirmed diagnosis, using a leave-one-out procedure with Monte Carlo-based bootstrap step (Persson et al, 2014). The classification accuracy was evaluated using the area under receiver operating characteristic curve (AUC). For selected parameter settings an AUC of  $0.96 \pm 0.02$  within ten nearby frequency intervals around 0.45–1.50 GHz was obtained. These parameter settings as well as the high AUC value needs to be confirmed on larger patient populations.

Compared to our previous studies on stroke patients, using two consecutive generations of microwave devices, preliminary findings with the present 4<sup>th</sup> generation device show higher sensitivity and specificity, probably due to an improved antenna positioning system. We are presently planning prehospital trials with this device.

Persson, Fhager, Trefna, Yu, McKelvey, Pegenius, Karlsson & Elam (2014) IEEE TBME 61(11)2806–2817

## ESOC-0100

## 29. Ongoing Trials

**Targeting sedentary behaviour and sitting time in stroke survivors. A new paradigm for addressing recurrent stroke risk**C. English<sup>1</sup>, G. Healy<sup>2</sup>, A. Coates<sup>1</sup>, T. Olds<sup>1</sup>, J. Bernhardt<sup>3</sup><sup>1</sup>Alliance for Research in Exercise Nutrition and Activity, University of South Australia, Adelaide, Australia<sup>2</sup>School of Population Health, University of Queensland, Brisbane, Australia<sup>3</sup>Stroke Division, Florey Institute of Neuroscience and Mental Health, Melbourne, Australia

High levels of sitting time can have serious health consequences, including increased risk of cardiovascular disease. Targeting sitting reduction in stroke survivors may reduce recurrent stroke risk. Our research program, comprising to date an observational study and pilot randomized controlled trial (RCT), investigates sitting time in people living in the community after disabling stroke. All studies use objective measures of sitting time (activPAL3 activity monitor) and activity (Actigraph GT3X+). In our observational study (n = 63), stroke survivors spent, on average, 2.7 (95% confidence interval [CI] 1.6 to 3.7) hours more each day sitting down, 156 (95% CI 105.5 to 205.6) minutes less in light intensity physical activity and 33 (95% CI 22.7 to 43.6) minutes less in activity of at least moderate intensity compared to healthy age-matched controls. In the pilot RCT to investigate the safety and feasibility of reducing sitting time in people with stroke, 35 participants were randomly allocated to receive a series of counselling sessions based on a message to either 'sit less move more' (intervention group) or 'calcium for bone health' (control group). To date, sitting time data are available for n = 21. Intervention participants (n = 11) reduced their daily sitting time by 63 (95% CI 27 to 100) minutes. Control participants (n10) showed smaller sitting time reductions (53 minutes, 95% CI 3 to 104 minutes). These data show that changes in sitting time are safe and feasible in this population. Preliminary work on markers of recurrent stroke risk indicates positive effects on blood pressure and glucose metabolism.

## ESOC-0469

## 29. Ongoing Trials

**Platelet-oriented inhibition in new TIA and minor ischemic stroke (POINT) trial**M. Farrant<sup>1</sup>, J.D. Easton<sup>1</sup>, A. Kim<sup>1</sup>, S.C. Johnston<sup>2</sup><sup>1</sup>Neurology, University of California San Francisco, San Francisco, USA<sup>2</sup>Neurology, University of Texas Austin, Austin, USA

*Platelet-Oriented Inhibition in New TIA and minor ischemic stroke* is a prospective, randomized, double-blind, multicenter trial with the primary null hypothesis that, in patients with TIA or minor ischemic stroke treated with aspirin 50–325 mg/day, there is no difference in survival free of ischemic stroke, myocardial infarction, and ischemic vascular death at 90 days in those treated with clopidogrel (600 mg loading dose then 75 mg/day) compared to placebo when therapy is initiated within 12 hours of the time last known free of new ischemic symptoms.

Subjects are 18 years of age or older with high-risk TIA (ABCD<sup>2</sup> score  $\geq 4$ ) or minor ischemic stroke (NIHSS  $\leq 3$ ) followed for 90 days from randomization. 5,840 patients will be recruited; international sites joined the POINT trial in August of 2013.

*Principal Investigator:* S. Claiborne Johnston, MD, PhD, University of Texas, Austin

*Co-Principal Investigators:* J. Donald Easton, MD, University of California, San Francisco

Anthony S. Kim, MD, MAS, University of California, San Francisco

*Contact:* Mary Farrant, MBA, BSN, RN, University of California, San Francisco; Director, POINT Trial Clinical Coordinating Center (CCC), San Francisco, California, United States, 94158; Phone 1-415-502-7304; Email: mary.farrant@ucsfmedctr.org

*Planned Number of Centers:* 350; Present Number: 245

*Planned Number of Subjects:* 5,840; Present Number: 2,522

*Sponsor:* University of California, San Francisco (UCSF); National Institute of Neurological Disorders and Stroke (NINDS)

*Collaborators:* Neurological Emergencies Treatment Trials Network (NETT); Medical University of South Carolina (MUSC); POINT Clinical Research Collaboration EMMES Corporation

*Dates of Study:* October 2009–September 2016

*ClinicalTrials.gov Identifier:* NCT00991029; <http://clinicaltrials.gov/ct2/show/NCT00991029?term=POINT&rank=1>

## ESOC-0960

## 29. Ongoing Trials

**Assessment of therapy fidelity processes in the very early rehabilitation in speech (VERSE) clinical trial**E. Godecke<sup>1</sup>, E. Armstrong<sup>1</sup>, S. Middleton<sup>2</sup>, T. Rai<sup>3</sup>, D. Cadilhac<sup>4</sup>, N. Ciccone<sup>1</sup>, A. Whitworth<sup>5</sup>, M. Rose<sup>6</sup>, G.J. Hankey<sup>7</sup>, A. Holland<sup>8</sup>, J. Bernhardt<sup>9</sup><sup>1</sup>Psychology and Social Science, Edith Cowan University, Perth, Australia<sup>2</sup>Faculty of Health Sciences, St Vincent's & Mater Health and Australian Catholic University, Sydney, Australia<sup>3</sup>School of Mathematical Sciences, University of Technology Sydney, Sydney, Australia<sup>4</sup>Stroke and Ageing Research Group, Monash University, Melbourne, Australia<sup>5</sup>School of Psychology and Speech Pathology, Curtin University of Technology, Perth, Australia<sup>6</sup>Human Communication Sciences, La Trobe University, Melbourne, Australia<sup>7</sup>School of Medicine and Pharmacology, University of Western Australia, Perth, Australia<sup>8</sup>Speech Language and Hearing Sciences, University of Arizona, Arizona, USA<sup>9</sup>Stroke, The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia

*Background:* The benefits of intensive, standardised aphasia therapy after stroke are unclear. VERSE is a randomised, open-label, blinded endpoint evaluation trial designed to test whether two forms of daily, prescribed aphasia therapy for 20 sessions, beginning within 14 days of acute stroke, is more effective than usual care in promoting recovery from post-stroke aphasia in 246 eligible patients. Efficacy is determined by between group differences in the Aphasia Quotient of the Western Aphasia Battery at 3 months.

This substudy will describe the process of evaluating therapy fidelity in the three-arm trial: usual care (UC); usual care-plus (UC-Plus); or VERSE therapy. UC therapy is usual ward-based therapy; UC-Plus is usual ward-based therapy but provided daily, and VERSE therapy is a prescribed aphasia therapy provided daily.

*Methods:* All speech pathology services are being documented in the REDCap™ online database system. The primary outcome is adherence to the prescribed amount of therapy time. Secondary outcomes include adherence measures of therapy task, task instructions, cueing and production of verbal output as contracted to the intervention protocol for UC-Plus and VERSE therapy. An independent evaluator will assess therapy fidelity from 4–5 video-recorded sessions (per participant) in UC-Plus and VERSE groups. UC sessions will be video-recorded and evaluated as completed. Logistic regression will be used to compare group differences.

*Results:* This trial is currently running in 10 centres as of 9<sup>th</sup> January 2015.

*Discussion:* This methodological process will produce data that will enable the active ingredients of very early aphasia therapy to be determined.

## ESOC-1472

### 29. Ongoing Trials

#### Mistie III: Update on the international trial of minimally invasive surgery plus RT-PA for spontaneous intracerebral haemorrhage

**B.A. Gregson**<sup>1</sup>, A.D. Mendelow<sup>1</sup>, K. Lane<sup>2</sup>, N. McBee<sup>2</sup>, R. Thompson<sup>3</sup>, M. Zuccarello<sup>4</sup>, I. Awad<sup>5</sup>, K. Lees<sup>6</sup>, J. Dawson<sup>6</sup>, C. Anderson<sup>7</sup>, D. Hanley<sup>2</sup>

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<sup>6</sup>Department of Cardiovascular & Medical Sciences, University of Glasgow, Glasgow, United Kingdom

<sup>7</sup>Department of Neurology, University of Sydney, Sydney, Australia

*Background and Aims:* Pilot studies of minimally invasive surgery (MIS) for spontaneous supratentorial intracerebral haemorrhage (ICH) have suggested that when combined with recombinant tissue plasminogen activator (rt-PA) applied directly to the clot improved recovery is seen. MISTIE III aims to establish whether MIS plus rt-PA in selected patients with ICH improves outcome compared with conventional medical management.

*Design:* MISTIE III is an international multicentre randomised open label trial coordinated by the BIOS group at Johns Hopkins University and funded by US NIH. It will recruit 500 patients and will evaluate primary outcome by a 12% increase in modified Rankin Scale score (mRS) of 0–3 at 180 days compared to medical management.

*Patients and methods:* Patients must have a stable ICH of >30 ml with a GCS ≤ 14 or an NIHSS ≥ 6, and SBP <180 for six hours prior to randomisation. Randomisation should occur within 72 hours of the diagnostic CT. Outcome will be measured at 30, 180 and 365 days using video recorded mRS assessment. Patients randomised to surgery will have a CT to confirm correct location of the drainage catheter prior to dosing and 1 mg of rt-PA will be administered every 8 hours for up to 9 doses. All patients will have daily CT scans during the acute period to monitor for rebleeding.

*Progress:* To date 102 patients have been recruited in the US and Israel. About 30 sites have been recruited in UK, Germany, Hungary, and Spain. Patient recruitment opened in Europe in December 2014.

## ESOC-1512

### 29. Ongoing Trials

#### Higher stroke risk patients with previous symptoms and cerebral infarction in the ACST-2 trial

**A. Halliday**<sup>1</sup>, G. ACST-2 Collaborators<sup>1</sup>

<sup>1</sup>Nuffield Department of Surgery, University of Oxford, Oxford, United Kingdom

The Asymptomatic Carotid Surgery Trial-2, ACST-2, is an international randomised trial comparing surgery with stenting for treatment of tight carotid stenosis. Patients entered have not had recent ipsilateral symp-

toms, but are thought to require intervention to prevent stroke. They should be on appropriate drug treatments with a life expectancy of at least 5 years. Over 1700 patients of a planned 3600 have been recruited. Patient medicines are recorded by the participating physician at entry and at one month after treatment and are reported by patients themselves at yearly follow up. Early hazards of intervention (30-day stroke, myocardial infarction and death rates) and long-term risk of stroke will be compared between treatment groups using Kaplan Meier analyses. Interim Results Participants' mean age is 72 years and median stenosis of the artery being treated is 80%. Many patients (43%) had previous symptoms or cerebral infarction prior to trial entry. The early (30-day) risk of serious complications, disabling stroke and death for both patient groups is 1.0%. Patients have now been followed for up to 6 years. Almost all (98%) are taking antithrombotic (platelet or anticoagulant) treatment, 85% are on statins (type and dose recorded) and over 80% are on blood pressure lowering treatments. Conclusions Almost half of patients being recruited to ACST-2 for stroke prevention interventions have had symptoms or evidence of previous cerebral infarction (43%). Their long-term risk of stroke is significantly higher than for others with no history or evidence of previous cerebral ischaemia. The early risk of serious hazards from trial interventions is low and we continue to monitor stroke prevention drug therapy yearly. ACST-2 is not a trial confined to low risk patients who have never had stroke or TIA and we continue to recruit patients thought to require intervention because of significant future risk of stroke from their severe carotid stenosis.

## ESOC-0576

### 29. Ongoing Trials

#### Prevention of cerebral ischaemia in stent treatment for carotid artery stenosis – design of a randomised trial of optimised antiplatelet therapy with outcome assessment on MRI (PRECISE-MRI)

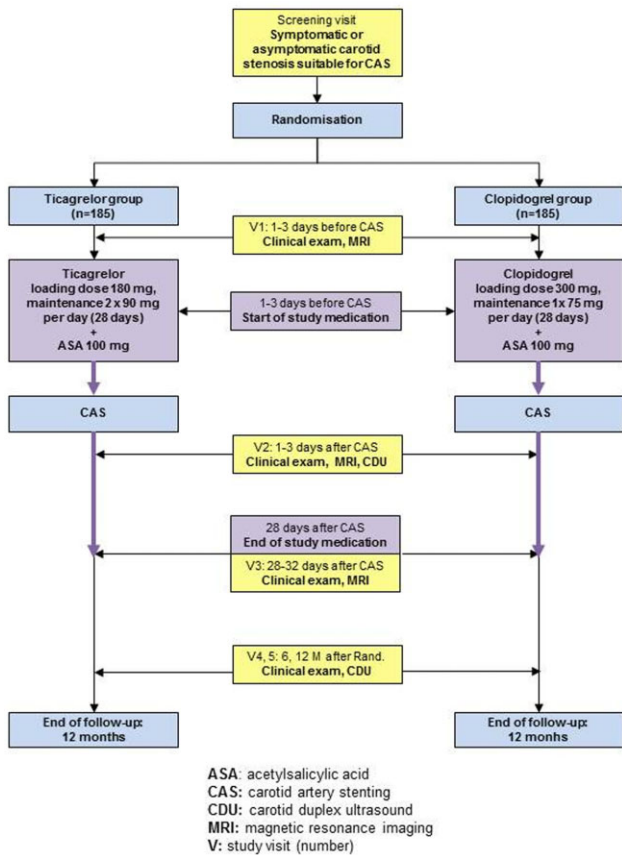
**L. Hert**<sup>1</sup>, P. Lyrer<sup>1</sup>, L. Bonati<sup>1</sup>

<sup>1</sup>Neurology, University Hospital Basel, Basel, Switzerland

*Background and Aim:* Carotid artery stenting (CAS) prevents stroke in patients with carotid artery stenosis but carries a risk of peri-procedural stroke. Ticagrelor is a novel reversible inhibitor of the platelet adenosine diphosphate receptor P2Y<sub>12</sub> which was superior to clopidogrel as add-on to aspirin in preventing stent thrombosis, cardiovascular outcome events, and death in patients undergoing coronary artery stenting, without causing an increase in major bleeding events. The primary aim is to test the hypothesis that ticagrelor is superior to clopidogrel as add-on to aspirin in preventing peri-procedural ischaemic brain lesions occurring during CAS without increasing the risk for intracerebral haemorrhage.

*Study Design:* Randomised placebo controlled double-blind trial. 370 patients with symptomatic or asymptomatic carotid stenosis undergoing CAS according to local and national guidelines will be randomly assigned to ticagrelor (180 mg loading dose prior to the procedure followed by 90 mg twice daily) or clopidogrel (300 mg loading dose followed by 75 mg once daily). All patients will receive 100 mg aspirin per day throughout the study period. Dual antiplatelet therapy (study drug plus aspirin) will be continued for 28 days after stent placement. Brain MRI including diffusion-weighted and susceptibility-weighted imaging will be performed 1–3 days before CAS; 1–3 days after CAS; and 28–32 days after CAS. The primary composite imaging study endpoint is the presence of at least one new ischaemic or haemorrhagic brain lesion on the MRI scan done 1–3 days or 28–32 days after CAS, which had not been present on the MRI before the procedure.

**PREvention of Cerebral Ischaemia in Stent treatment for carotid artery stenosis – A randomised trial of optimised antiplatelet therapy with outcome assessment on MRI (PRECISE-MRI)**



**ESOC-0526**

**29. Ongoing Trials**

**Telstar – treatment of electroencephalographic status epilepticus after cardiopulmonary resuscitation**

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<sup>5</sup>clinical neurophysiology, Academic Medical Center, Amsterdam, Netherlands

**Background:** Electrographic status epilepticus is observed in 9–35% of patients with postanoxic encephalopathy after cardiac arrest and is associated with poor outcome. It is unclear whether these EEG patterns represent a condition to be treated with antiepileptic drugs to improve outcome, or severe ischemic damage, in which treatment is futile. We study the effect of early treatment with antiepileptic drugs on neurological outcome.

**Design:** Multicenter clinical trial with randomised treatment allocation, open label treatment, blinded endpoint evaluation (PROBE design).

**Population:** Adult patients with postanoxic encephalopathy after cardiac arrest, admitted to an intensive care unit, with electrographic status epilepticus on continuous EEG.

**Intervention:** Treatment of electrographic status epilepticus is based on recommendations for treatment of status epilepticus and consists of step-wise treatment up to thiopental, if necessary. The objective is to suppress all epileptiform activity in the EEG during at least 24 hours. If the status returns after 2 x 24 hours, it will be considered refractory. In the control group, electrographic status epilepticus will be left untreated.

**Endpoints:** The primary outcome measure is neurological outcome defined as the score on the Cerebral Performance Category (CPC) at 3 months, dichotomised as good (CPC 1–2 = no or moderate neurological disability) or poor (CPC 3–5 = severe disability, coma, or death).

**Sample size:** The projected sample size is 172, based on a presumed reduction of poor outcome of 7%.

**Trial status:** Inclusion started March 1, 2014. Interested centres are invited to participate.

clinicaltrials.gov, identifier NCT02056236

**ESOC-1612**

**29. Ongoing Trials**

**REstart or Stop Antithrombotics Randomised Trial (RESTART)**

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<sup>1</sup>Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom

**Question:** For adults surviving spontaneous (non-traumatic) intracerebral haemorrhage (ICH) who had taken an antithrombotic (i.e. anticoagulant or antiplatelet) drug for the prevention of vaso-occlusive disease before the ICH, does a policy of starting antiplatelets result in a beneficial net reduction of all serious vascular events compared with a policy of avoiding antiplatelets?

**Design:** Investigator-led, multicentre, open, randomised, parallel group, assessor-masked.

**Eligibility:** Adults with spontaneous primary or secondary ICH who had taken antithrombotic drugs for the prevention of vaso-occlusive disease before ICH onset. Brain magnetic resonance imaging (MRI) performed after ICH but before randomisation (if in MRI sub-study).

**Randomisation:** Central, web-based system using a minimisation algorithm, with 1:1 treatment allocation to which central research staff are masked.

**Interventions:** Avoid versus start antiplatelet drugs (aspirin, clopidogrel or dipyridamole; chosen at investigator's discretion).

**Primary outcome:** recurrent symptomatic ICH.

**Secondary outcomes:** symptomatic haemorrhagic and vaso-occlusive events; symptomatic stroke of uncertain type; other fatal events; modified Rankin Scale score; adherence to antiplatelets.

**Power:** Given the annual recurrence rate of ICH may be 1.8–7.4% and there may be a 1–4-fold relative increase in this risk on antiplatelet therapy, 720 participants will have 90% power to detect a doubling of an annual ICH rate of 4.5% or 93% power to detect a quadrupling of an annual rate of 1% over two years at the 5% level. This trial will also provide adequately precise estimates of the rates of all serious vascular events to inform the design of a trial with the power to assess net clinical benefit.

## ESOC-1102

## 29. Ongoing Trials

**Reversal of neurological deficit in acute stroke with signal-of-efficacy trial of auto-BPAP to limit damage from suspected sleep apnea (REVERSE-STEAL):****A multicenter randomized trial update**

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**Background:** With evidence emerging, treatment with non-invasive ventilation in patients with acute ischemic stroke (AIS) and sleep apnea has been recently added as Class IIb recommendation to the updated AHA/ASA stroke guidelines. However, most evidence originated from sub-acute and rehabilitation phases of stroke and efficacy data for non-invasive ventilation in the acute phase is lacking.

**Methods:** We conduct a multicenter randomized controlled third-rater blinded parallel-group trial. AIS patients with symptomatic proximal arterial obstruction and clinically suspected sleep apnea are randomized to standard stroke care alone or standard stroke care plus auto-titrating bilevel positive airway pressure (auto-BPAP). Auto-BPAP is initiated within 24 hours from stroke onset and performed for a maximum of 48 hours during diurnal and nocturnal sleep. Patients undergo cardiorespiratory polygraphy between days 3 and 5 to assess sleep apnea. Primary endpoint is any early neurological improvement on the NIHSS score at 72 hours. Safety, tolerability, short-term and 3-months functional outcomes are assessed as secondary endpoints by un-blinded and blinded observers.

**Results:** To date, sixteen AIS patients have been enrolled: 69% men, 68 ± 8 years, median NIHSS 12 (IQR 5–18) points. Thirteen (81%) patients had symptomatic M1- or M2- MCA-occlusions, 2 (13%) PCA- and 1 (6%) ICA-occlusions. Mean apnea-hypopnea-index was 12.8 ± 11.5/h suggestive of sleep apnea in 11/16 (69%) patients.

**Discussion:** We expect that this study will further define the clinical potential of early treatment with non-invasive ventilation in the acute phase of ischemic stroke. The study will provide data to power a subsequent phase III trial.

## ESOC-0028

## 29. Ongoing Trials

**Thrombolysis for acute wake-up and unclear-onset stroke trial with alteplase at 0.6 mg/kg (THAWS). Protocol and update**

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**Purpose:** Stroke patients with unclear-onset time have a potential to recover with intravenous thrombolysis. MRI findings with positive DWI and negative FLAIR (negative FLAIR pattern) can identify ischemic stroke patients within 4.5 h from symptom onset. We aim to test the efficacy and safety of intravenous thrombolysis with alteplase at 0.6 mg/kg (officially approved dosage in Japan) in ischemic stroke patients with unclear-onset time and a negative FLAIR pattern.

**Design:** The THAWS (ClinicalTrials.gov identifier: NCT02002325) is an investigator initiated, multicenter (35 hospitals in Japan), prospective, randomized, open label, blinded-endpoint assessment clinical trial. Trial protocol was published in *International Journal of Stroke* (2014;9:1117–1124). Patients with unclear-onset time will be evaluated with a multimodal MRI. Three hundred patients with a negative FLAIR pattern will be randomized 1:1 to either intravenous thrombolysis with alteplase (n = 150) or standard treatment (n = 150) within 4.5 h after symptom recognition. We generally follow the trial design of the WAKE-UP (ClinicalTrials.gov Identifier: NCT01525290). Intracranial hemorrhage will be assessed on follow-up MRI after 22–36 h. Primary outcome will be assessed at 90 days.

**Study outcomes:** The primary efficacy endpoint is favorable outcome defined by 90-day mRS 0–1. The safety outcome measures are 24-h symptomatic intracranial hemorrhage, serious bleeding during study period and 90-day mortality.

**Update:** Patient enrollment was started in May 2014. Initial safety assessment was approved from the Ministry of Health, Labour and Welfare in Oct 2014.

**Discussion:** This trial may help determine whether low-dose alteplase should be recommended for ischemic stroke patients with unclear-onset time using MRI-based selection.

## ESOC-0328

## 29. Ongoing Trials

**TALOS: A multicenter, randomized, double-blind, placebo-controlled trial to test the effects of citalopram in patients with acute stroke – ongoing trial**

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**Rationale:** Selective Serotonin Reuptake Inhibitors (SSRI) are effective in the treatment of post-stroke depression and may have potential neuroprotective and vascular effects. A possible neuroprotective effect was sug-

gested to be the mechanism of an enhanced motor recovery with early prescription of fluoxetine post stroke (Chollet et al., *Lancet*, 2011). Human studies have shown a 80–90% decrease in platelet serotonin after treatment with SSRI, and this potentially results in platelet inhibition. SSRI treatment may thus protect against ischemic vascular events as shown in registry data on ischemic stroke patients (Mortensen et al., *Stroke*, 2013).

Prospective studies are needed to determine the effects of SSRI treatment after acute ischemic stroke.

**Aims and design:** TALOS is an ongoing investigator-initiated, national multicenter randomized- and placebo-controlled, double-blind trial testing citalopram in acute ischemic stroke. We hypothesize that citalopram treatment initiated in the acute phase after ischemic stroke will improve outcome assessed by the modified Rankin Score (mRS) and reduce the risk of vascular death, TIA/stroke or myocardial infarction during 6 months of follow-up.

**Study population planned:** 600 patients

**Inclusion period:** August 2013 – August 2015 (ongoing)

**Study outcomes:** There are two *co-primary* effect variables

1. Functional status at 6-months, (mRS), and
2. Vascular death, TIA/stroke or myocardial infarction

**Secondary effect variables include**

- Single primary outcomes
- Performance in activities of daily living (*Barthel Index*)
- Cognitive impairment (*Mini Mental State Examination*)
- Prevention of Post-stroke depression

**Discussion:** SSRI treatment may be neuroprotective and prevent new vascular events, well tolerated and overall beneficial in the wake of stroke.

## ESOC-1610

### 29. Ongoing Trials

#### The Norwegian Sonothrombolysis in Acute Stroke Study (NOR-SASS)

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**Background:** Sonothrombolysis augments intravenous thrombolysis by promoting fluid motion around the thrombus, weakening fibrin cross-links and increasing tPA concentration within the thrombus. Contrast enhanced sonothrombolysis (CEST), adding iv gaseous microspheres (Sonovue), may potentiate the effect of ultrasound. When exposed to ultrasound, microspheres oscillate, expand and collapse, agitate surrounding fluid, erode thrombus surface and increase the surface area for thrombolytic action. As yet, there are no randomized studies of CEST in ischemic stroke patients without arterial occlusion, patients treated with iv tenecteplase or patients ineligible for iv thrombolysis.

**Methods:** Unselected patients  $\geq 18$  years with acute ischaemic stroke without visible arterial occlusion on admission CTA are randomized 1:1 within  $<4\frac{1}{2}$ h to CEST (2 MHz TCD for 60 min + 10 ml Sonovue) or placebo in a single center PROBE (Prospective Randomised Open-label Blinded Endpoint) trial. Both patients receiving either alteplase or tenecteplase (NOR-SASS A+B) and patients ineligible for iv thrombolysis (NOR-SASS C) are included. Primary endpoints are early clinical outcome at 24 h and functional handicap at 90 days.

**Results:** Approximately 200 patients have been included so far. To date, data and safety committee has not found any safety issues and the study is still recruiting patients (18 February 2015).

**Discussion:** If a positive effect can be proven, CEST may become a therapeutic option for a broader acute ischemic stroke population, including patients without arterial occlusion, patients treated with tenecteplase and patients ineligible for iv thrombolysis.

## ESOC-1606

### 29. Ongoing Trials

#### The Norwegian Tenecteplase Stroke Trial (NOR-TEST): Randomised controlled trial of tenecteplase vs. alteplase in acute ischaemic stroke

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**Background:** Alteplase is the only approved thrombolytic agent for acute ischaemic stroke. Tenecteplase may be more effective and less harmful than alteplase, but large randomised controlled phase 3 trials are lacking. The Norwegian Tenecteplase Stroke Trial (NOR-TEST) aims to compare efficacy and safety of tenecteplase vs. alteplase.

**Methods/Design:** NOR-TEST is a multi-centre PROBE (prospective randomised, open-label, blinded endpoint) trial designed to establish superiority of tenecteplase 0.4 mg/kg (single bolus) as compared with alteplase 0.9 mg/kg (10% bolus + 90% infusion/60 minutes) for consecutively admitted patients with acute ischaemic stroke eligible for thrombolytic therapy, i.e. patients a) admitted  $<4\frac{1}{2}$  hours after symptoms onset; b) admitted  $<4\frac{1}{2}$  hours after awakening with stroke symptoms c) receiving bridging therapy before embolectomy.

Randomisation tenecteplase:alteplase is 1:1. The primary study endpoint is favourable functional outcome defined as modified Rankin Scale 0–1 at 90 days. Secondary study endpoints are: 1) haemorrhagic transformation (haemorrhagic infarct/haematoma); 2) symptomatic cerebral haemorrhage on CT 24–48 hours; 3) major neurological improvement at 24 hours; 4) recanalisation at 24–36 hours; 5) death.

**Results:** To date, data and safety monitoring committee has not found any safety issue and the study is still recruiting patients. Approximately 400 patients have been so far included (1<sup>st</sup> March 2015).

**Discussion:** NOR-TEST may establish a novel approach to acute ischaemic stroke treatment. A positive result will lead to a more effective, safer and easier treatment for all acute ischaemic stroke patients.

NOR-TEST is registered with EudraCT No 2011-005793-33 and in ClinicalTrials.gov (NCT01949948).

## ESOC-1608

### 29. Ongoing Trials

#### Fluoxetine Or Control Under Supervision (FOCUS)

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f. FOCUS Trial Collaborators<sup>1</sup>

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**Introduction:** Recent small trials suggest that selective serotonin reuptake inhibitors improve neurological and overall recovery after stroke. Our aims are to determine whether fluoxetine 20 mg daily for 6 months, started at 2–15 days after stroke onset in patients with persisting neurological deficits, reduces dependency at 6 months and whether any benefits persist to 12 months.

**Methods:** This UK wide, multicentre, randomised placebo-controlled trial aims to recruit 3000 patients. Eligible patients providing informed consent are randomised by a central web-based system. Patients' progress in-hospital and early adherence are collected by local follow-up at hospital discharge (for inpatients) and central follow-up at one month (for outpatients). Other secondary outcomes (survival, health related quality of life, mood, fatigue, Stroke Impact Scale, new clinical diagnosis of depression and resource use) are collected at 6 and 12 months via postal, or telephone questionnaires to patients and general practitioners. Based on a sample size for a binary outcome, a trial of 3000 (1500 per group) will provide greater than 90% power ( $\alpha = 0.05$ ) to detect a 5.5% absolute increase in proportion of patients with a modified Rankin score of 0–2 (i.e. independent) (odds ratio = 1.30). Using an ordinal sample size method, we will detect a common odds ratio of 1.23. We have harmonised



assessments with the Australian AFFINITY (Assessment of fluoxetine in stroke recovery) and Swedish EFFECTS (Efficacy of Fluoxetine – a randomised Controlled Trial in Stroke) trial.

**Conclusion:** FOCUS will show whether fluoxetine improves overall recovery in a broad range of stroke patients.

## ESOC-0410

### 29. Ongoing Trials

#### Pragmatic Ischaemic Stroke Thrombectomy Evaluation: PISTE

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Intravenous thrombolytic treatment (IVT) within 4.5 hours of onset improves the probability of recovery to independence after acute ischaemic stroke, but is much less effective in patients with large artery occlusion (LAO). Outcomes in this group of patients (up to two thirds of those eligible for IVT) remain particularly poor, with high mortality (around 25%) and likelihood of disability (>45%). Since recanalisation of the occluded artery is strongly associated with the likelihood of good recovery, treatment that can more effectively open the occluded artery may benefit this group.

Devices for endovascular mechanical thrombectomy are known to increase recanalisation rates. Recent clinical trials indicate superiority of endovascular thrombectomy over medical treatment alone in the setting of persistent LAO despite IVT and have demonstrated encouraging safety data with their use. However, the effect of endovascular treatment as adjunctive care in all LAO patients when initiated as early as possible after starting IVT remains to be fully determined.

PISTE is a pragmatic RCT comparing standard IV thrombolysis (rtPA) with IV lysis and additional mechanical thrombectomy in patients with ischaemic stroke eligible for thrombolysis who have a relevant anterior circulation large vessel occlusion. Any approved device can be used.

The full scale trial follows on from the nearly completed pilot phase. It involves the hyperacute stroke research centre network and other UK/Norwegian centres with neurointerventional expertise in stroke.

## ESOC-0527

### 29. Ongoing Trials

#### Head Position in Stroke Trial (HeadPoST): Challenges of setting up of a large international stroke nursing care trial

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**Background:** There is insufficient evidence to recommend a specific head position in patients with acute ischemic stroke (AIS) or intracerebral hemorrhage (ICH). Potential benefits of lying flat in AIS and conversely sitting up in ICH may be offset by increased risk of aspiration pneumonia and cardiac-respiratory failure.

**Aims:** To compare the effects of lying flat (0°) with sitting-up (≥30°) head position applied in the first 24 hours of admission for patients presenting with acute stroke on poor outcome (death or disability) at 90 days. Key secondary aim is to determine if sitting up is superior to lying flat in acute ICH.

**Methods:** A multicenter, prospective, cluster randomized, crossover, blinded outcome assessed, clinical trial through a 140 hospitals in Australia, China, Taiwan, Mongolia, Chile, Brazil, and United Kingdom. Key aspects of the study to avoid bias include consecutive recruitment (selection bias), thorough preparation and training of site staff (compliance and overcome local barriers) and central blinded outcome assessment (observer bias). Sample size is calculated on each hospital recruiting 140 consecutive patients. Funded by the National Health and Medical Research Council (NHMRC) of Australia.

**Results:** Set-up of the study was performed during 2014 in 7 countries and more than 100 hospitals, addressing compliance and other key aspects of consecutive recruitment, thorough training and overcoming local barriers. Patient recruitment will occur during 2015–2016.

**Conclusions:** Cooperation, training and communications are essential to setting up and conducting the study. Given uncertainty over benefits/risks, reliable randomized evidence is required to standardize clinical and nursing practice.

## ESOC-1168

## 29. Ongoing Trials

**Establishment of a research and training network for aphasia after stroke**M. Ali<sup>1</sup>, K. VandenBerg<sup>1</sup>, A. Bowen<sup>2</sup>,M. Brady On behalf of the Collaboration of Aphasia Trialists<sup>1</sup><sup>1</sup>NMAHP Research Unit, Glasgow Caledonian University, Glasgow, United Kingdom<sup>2</sup>School of Psychological Sciences, Manchester University, Manchester, United Kingdom

**Introduction:** Aphasia research faces methodological and infrastructural challenges, often remaining language, region, and discipline-specific, limiting the efficiency, strength, and broader relevance of individual research. Funded by the European Cooperation in Science and Technology (COST), the Collaboration of Aphasia Trialists (CATs) enhances knowledge, skills and methodology in aphasia research on an international level.

**Methods:** We established a memorandum of understanding; two individuals represent each participating country on a management committee. We established working groups to investigate (i) assessment and outcome measures for aphasia research, (ii) prognosis and predictors of recovery, (iii) effectiveness of interventions, and (iv) societal impact and re-integration. We collated aphasia trial datasets to facilitate novel exploratory and secondary analyses to address gaps in knowledge and inform trial design. We facilitated knowledge exchange across our network through training visits at participating institutions within CATs.

**Results:** Our network includes >85 multidisciplinary members, across 22 European countries, Australia, New Zealand and South Africa. Our active research programmes include systematic reviews, meta-analyses, improvements in the quality of aphasia research methodology and reporting and translation of language assessment tools across multiple languages. We have also facilitated 8 research training visits across the collaboration, developed and informed international aphasia research grant applications and established annual training schools for early stage aphasia researchers.

**Conclusions:** Expansion and integration of trial networks is essential to facilitate research translation. CATs facilitates high-quality, synergistic international research, dissemination and training opportunities. We welcome additional participation in this Collaboration by the aphasia research community. Information can be found at [www.aphasiatrials.org](http://www.aphasiatrials.org)

## ESOC-0730

## 29. Ongoing Trials

**Head Position in Stroke Trial (HeadPoST) pilot phase**V. Olavarria<sup>1</sup>, P.M. Lavados<sup>1</sup>, P.M. Muñoz-Venturelli<sup>1</sup>, S. Gaete<sup>2</sup>, S. Martins<sup>3</sup>, H. Arima<sup>4</sup>, S. Heiritier<sup>4</sup>, C.S. Anderson<sup>4</sup>, A.M. Brunser<sup>1</sup><sup>1</sup>Internal Medicine, Clínica Alemana Universidad del Desarrollo Instituto de Neurociencias, Santiago, Chile<sup>2</sup>Internal Medicine, Hospital Dr. Lautaro Navarro Avaria, Punta Arenas, Chile<sup>3</sup>Neurology, Hospital de Clinicas de Porto Alegre, Porto Alegre, Brazil<sup>4</sup>Neurology, The George Institute for Global Health University of Sydney, Sydney, Australia

**Background:** Controversy exists over the optimal head position in acute ischemic stroke (AIS) patients in the first 24–48 hours. Interventions that augment cerebral blood flow (CBF) could be beneficial. The simplest way to do this could be to place the head in “lying flat” rather than “sitting up” position. Potential benefits may be offset by an increased risk of pneumonia or cardiac failure. **Aims:** HeadPoST Pilot will determine the safety, feasibility and potential efficacy of the “lying flat” compared to the standard “sitting up” head position in AIS patients. **Methods:** Cluster randomized, open, blinded endpoint assessment, active-comparative international clinical trial. Patient are included if within 12 hours from

symptom onset, anterior circulation infarction, NIHSS > 1 and adequate sonographic window. Main efficacy outcome is mean CBF velocity in the “lying flat” compared to the “sitting up” head position assessed by Transcranial Doppler (TCD) to the middle cerebral arteries. Secondary objectives are safety and neurological status at 7 days and disability at 90 days. A sample size of 32 clusters (mean 3 patients) was calculated to detect an 8.3 cm/s increase in CBF velocity (IC 95% 4.82 a 12.03) with 90% power, 5% significance. **Results:** The study has included 76 patients (16 clusters) as of January 2015 in 3 centres. No safety concerns have been raised by the DSMB. **Conclusions:** This pilot phase is recruiting on schedule. The lying flat head position is a potential low cost, widely applicable, nursing intervention to increase CBF in AIS and may improve clinical outcomes.

## ESOC-1284

## 29. Ongoing Trials

**A randomized controlled trial of nature-based post-stroke fatigue rehabilitation (“the nature stroke study”) (NASTRU): study design and progress report**A. Pálsdóttir<sup>1</sup>, G. Andersson<sup>2</sup>, P. Grahn<sup>1</sup>, B. Norrving<sup>3</sup>, S. Kyrö Wissler<sup>1</sup>, I.F. Petersson<sup>4</sup>, H. Pessah-Rasmussen<sup>5</sup><sup>1</sup>Dept. Work Science Business Economics and Environmental Psychology (AEM), Swedish University of Agricultural Sciences (SLU), Alnarp, Sweden<sup>2</sup>VO Neurology and Rehabilitation Medicine, Skånes University Hospital, Malmö, Sweden<sup>3</sup>Dept. of clinical sciences Neurology & VO Neurology and rehabilitation medicine Skånes University Hospital, Lunds University, Lund, Sweden<sup>4</sup>Orthopaedics Dept. of clinical sciences & Epidemiology and Register Centre South Skåne, Lunds University, Lund, Sweden<sup>5</sup>Department of Neurology and Rehabilitation medicine Skåne University Hospital Dept health science, Lund University, Lund, Sweden

Fatigue is common after stroke and contributes to disability, impaired quality of life, and reduced work ability. Currently, there is no evidence-based intervention for post-stroke fatigue but idiopathic chronic fatigue and burnt-out syndromes may benefit from nature-based rehabilitation. The aim of NASTRU was to examine whether ten weeks of nature-based rehabilitation, as add-on to standard management, could influence post-stroke fatigue (primary outcome), depression, work ability or functional outcome (secondary outcomes), compared to controls.

Inclusion criteria were patients with stroke living in the catchment area of the Skåne University Hospital, 50–80 years old, independent in ADL, and reporting fatigue at 3 months (sub-acute subgroup) or >one year (chronic sub-group) after the index stroke. Patients randomized to the intervention underwent a rehabilitation program in groups up to 8 patients in an especially designed garden at the Swedish University of Agricultural Sciences, Alnarp. The intervention was grounded in environmental psychology and occupational therapy, supported by a multimodal rehabilitation team that utilized the garden/nature for sensory stimulation, body awareness, meaningful occupations and nature experiences.

The enrollment of 101 patients (51 intervention; 50 control) was completed on August 2014. Follow-up is on-going, with assessments by examiner blinded to treatment group, at end of intervention period, 8 months, and 14 months after randomization. A parallel study with qualitative in-depth interviews in a subset of patients, who were randomized to the intervention group, as well as the staff, is also on going.

## ESOC-1605

## 29. Ongoing Trials

**An audit of prevalence of obstructive sleep apnoea in a cohort of patients attending tia clinics within william harvey hospital**A. Saxena<sup>1</sup>, D. Hargroves<sup>2</sup><sup>1</sup>*School of Medicine, King's College London, London, United Kingdom*<sup>2</sup>*Stroke Medicine, William Harvey Hospital, Ashford, United Kingdom*

**Introduction:** An on-going audit to assess prevalence of obstructive sleep apnoea (OSA) in a cohort of patients attending TIA clinics at William Harvey Hospital (WHH) with complaints of both transient focal neurological symptoms and disturbed sleep.

**Method:** An on-going case review of patients seen in the TIA clinics at WHH and referred to overnight sleep studies if they have evidence of increased day time sleepiness and/or nocturnal sympathetic over-activity. Information recorded included results categorized by AHI.

**Results:** 460 patients have been referred to sleep studies.

Based on their sleep study results:

- 117 (25.4%) had mild OSA
- 68 (14.8%) had moderate OSA,
- 32 (7.0%) had severe OSA,
- 22 (4.8%) required a repeat study,
- 221 (48%) had no significant OSA
- Therefore, 217 out of 460 patients (47.2%) were diagnosed with OSA.

**Discussion:** The prevalence of OSA in the cohort of TIA and stroke patients at William Harvey Hospital was 47.2% compared to the average prevalence of 2–9% in the general population. Therefore, the study demonstrates the positive correlation between neurovascular diseases and OSA similar to emerging evidence. The clinical importance is physicians in neurovascular clinics should use the screening questions and Epworth sleeping scale in order to identify and manage OSA earlier. The benefits of treating OSA are improved blood pressure control, decreased cardiovascular morbidity and mortality, reduced healthcare costs and improvement in clinical symptoms. Furthermore, treating OSA in patients with known cardiovascular disease can decrease risk of further events and increase time to such events.

## ESOC-0639

## 29. Ongoing Trials

**Optimising the analysis of cognition collaboration (OA-Cog)**P. Scutt<sup>1</sup>, P.M.W. Bath<sup>1</sup>, A.A. Montgomery<sup>2</sup><sup>1</sup>*Stroke Division of Clinical Neuroscience, University of Nottingham, Nottingham, United Kingdom*<sup>2</sup>*Nottingham Clinical Trials Unit, University of Nottingham, Nottingham, United Kingdom*

**Rationale:** Over 800,000 people suffer with dementia in the UK. The evidence base for the treatment of cognitive decline and dementia is small. One reason for this may be that the measures used to assess cognition in clinical trials are not sensitive to change and/or the analyses used are suboptimal. OA-Cog aims to identify the most efficient cognitive measurement and analysis technique for cognition data and dementia in randomised controlled trials.

**Design:** Chief investigators of randomised controlled trials with cognitive outcome assessments are asked to share individual patient data from their trials. Variables requested include baseline prognostic factors, treatment group, cognitive measures (e.g. Mini Mental State Examination (MMSE), Alzheimer's Disease Assessment Scale cognitive sub-score (ADAS-cog)) and other outcome measures (e.g. death, dementia).

Data are then analysed using various endpoints (e.g. mean MMSE score at end of trial, MMSE score as a gradient over time) and statistical methods (e.g. Wilcoxon rank-sum test, repeated measures ANOVA) in order to identify which is the most efficient.

**Trial Status:** As of 15<sup>th</sup> December 2014, data from 28 clinical trials, with a total of 82,668 patients, have been shared. The OA-Cog project is currently seeking further clinical trial data.

## ESOC-1403

## 29. Ongoing Trials

**Navigate ESUS: Multicenter, randomized, double-blind, phase III study of prevention of recurrent stroke and systemic embolism in patients with recent embolic stroke of undetermined source**R. Veltkamp<sup>1</sup>, A. Dávalos<sup>2</sup>, D. Toni<sup>3</sup>, L. Cunha<sup>4</sup>, R. Brouns<sup>5</sup>, K. Muir<sup>6</sup>, H. Mundl<sup>7</sup>, S.D. Berkowitz<sup>8</sup>, A. Shoamanesh<sup>9</sup>, S.J. Connolly<sup>10</sup><sup>1</sup>*Medicine (Division of Brain Sciences), Imperial College London, London, United Kingdom*<sup>2</sup>*Neurosciences, Autonomous University of Barcelona, Barcelona, Spain*<sup>3</sup>*Neurology and Psychiatry, Sapienza University of Rome, Rome, Italy*<sup>4</sup>*Neurology, Coimbra University, Coimbra, Portugal*<sup>5</sup>*Neurology, Vrije Universiteit Brussel, Brussels, Belgium*<sup>6</sup>*Neurology, University of Glasgow, Glasgow, United Kingdom*<sup>7</sup>*Global Clinical Development (Cardiovascular – Thrombosis), Bayer Healthcare, Wuppertal, Germany*<sup>8</sup>*Global Clinical Development (Cardiovascular – Thrombosis), Bayer Healthcare, Whippany, USA*<sup>9</sup>*Medicine (Division of Neurology), Population Health Research Institute – McMaster University, Hamilton, Canada*<sup>10</sup>*Medicine (Division of Cardiology), Population Health Research Institute – McMaster University, Hamilton, Canada*

**Rationale:** Embolic stroke of undetermined source (ESUS) has been defined as a non-lacunar infarction without proximal arterial stenosis or identified high risk source of cardioembolism. The risk of recurrent stroke in older ESUS patients is substantial despite current standard of care.

**Objective:** To determine whether rivaroxaban is superior to aspirin for reducing the risk of recurrent stroke and systemic embolism after recent ESUS.

**Design:** Multicenter, multinational, double-blind, double-dummy, active-controlled randomized clinical trial.

**Population:** Seven thousand patients aged ≥18 years randomized within 6 months of their qualifying stroke. Main eligibility criteria are outlined in the Table.

**Table. Main Eligibility Criteria**

Inclusion criteria	Definition
Embolic stroke of undetermined source	Non-lacunar ischemic stroke visualized by neuroimaging Absence of relevant extracranial arterial occlusion/atherosclerotic stenosis ≥50% No history/evidence of atrial fibrillation after at least 24 hours of cardiac monitoring Absence of intracardiac thrombus Absence of other specific cause of stroke
<b>Exclusion criteria</b>	Specific contraindications to aspirin or rivaroxaban Indication for chronic anticoagulation or antiplatelet therapy GFR

*Intervention:* Rivaroxaban 15 mg daily or aspirin 100 mg daily (1:1 blinded randomization).

*Primary outcome:* Time to recurrent stroke or systemic embolism.

*Secondary outcomes:* Time to the composite of cardiovascular death, recurrent stroke, systemic embolism, and myocardial infarction, the individual components of the composite, and all-cause mortality. The primary safety outcome is major bleeding (ISTH criteria).

*Statistical analysis:* The primary efficacy intention-to-treat analyses will compare rivaroxaban to aspirin using an age-stratified log-rank test.

*Current Status:* First participant randomized in December, 2014. Target of 400 recruitment sites in 27 countries.

## ESOC-1597

### 29. Ongoing Trials

#### Interference of blood pressure control within 24 h in acute ischemic stroke. Systematic review and meta-analysis. Protocol

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*Introduction:* Review the evidence on how acute variation in blood pressure (BP) during first 24 hours of acute ischemic stroke (AIS) can influence outcome.

*Methods:* Searched the Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library 2015, Issue 12); MEDLINE (1954 to feb 2015); EMBASE (1980 to feb 2015); CINAHL (1982 to feb 2015), database of Research in Stroke (DORIS) (2008 to 2013), Latin American and Caribbean Health Sciences Literature (LILACS) (1982 to feb 2015) and reference lists of articles. We contacted researchers in the field. We also searched Dissertation Abstracts International via Dissertation Express, and the meta-Register of Controlled Trials. In an effort to identify further published, unpublished, ongoing trials and SCOPUS.

*Objectives:* Primary: Death or dependency at the end of scheduled follow-up. Dependency is defined as being severely dependent on others in activities of daily living, or being significantly disabled; this corresponds to a Barthel Index score or a modified Rankin Scale grade 3 to 6 at three months follow-up.

*Secondary:* 1. Standardized non-disease-specific instrument for describing and valuating health-related quality of life. EQ-5D (EuroQol) questionnaire. 2. The NIH Stroke Scale measure of neurologic deficit; the Barthel Index measure of activities of daily living; the Modified Rankin Scale measure of the degree of disability or dependence in daily activities 90 days follow-up. 3. Average time of hospital discharge. 4. Time to discharge from the Neuro ICU or Neurocritical Care Unit. 5. Assessment of systolic and diastolic blood pressure control. 6. Causality assessment of adverse events following blood pressure reduction within 24 h of AIS.

## ESOC-0995

### 29. Ongoing Trials

#### TICH-2 Trial – tranexamic acid for intracerebral haemorrhage 2

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*Rationale:* To assess in a pragmatic phase III prospective double blind randomised placebo-controlled trial whether tranexamic acid is safe and

reduces death or dependency after primary intracerebral haemorrhage (PICH). The results will determine whether tranexamic acid should be used to treat PICH, which currently has no proven therapy.

*Design:* Patients will be randomised (1:1) to receive either tranexamic acid or placebo (0.9 % saline) within 8 hours of acute primary intracerebral haemorrhagic stroke.

Randomisation will be computerised and minimised on key prognostics age; sex; time since onset; systolic blood pressure; stroke severity (NIHSS); presence of intraventricular haemorrhage and known history of antiplatelet treatment. Patients randomised to placebo will receive intravenous normal saline. Patients, investigators and outcome assessors will be blind to treatment allocation. The primary outcome is death or dependency (modified Rankin Scale, mRS) and telephone follow-up is at day 90.

*Trial status:* The start-up phase of the trial commenced on 1 March 2013 and ran for 1 year and the main phase commenced 1<sup>st</sup> April 2014. The recruitment target was 300 participants in the start-up phase and 2,000 in the main phase. As at 6<sup>th</sup> January, 2015 754 patients have been recruited from 78 centres (UK, Georgia, Italy). The objective is to have 80 UK centres and 40 international centres.

*Funding:* The National Institute of Health Research, Health and Technology Assessment Programme

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## ESOC-1001

### 29. Ongoing Trials

#### A European, multicentre, phase III, clinical trial of hypothermia for acute ischaemic stroke: EuroHYP-1

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*Background:* Cooling is a promising neuroprotective intervention in experimental ischaemic stroke; cooling to 35°C reduced infarct size by about one third. Cooling awake ischaemic stroke patients to 35°C has been shown feasible and safe, but whether this is safe and effective has not been tested in a large clinical trial.<sup>2</sup>

*Aims:* To determine whether systemic cooling to target temperature of 34 to 35°C, started within 6 hours of symptom onset and maintained for 24 hours, improves functional outcome at 3 months in patients with acute ischaemic stroke.

*Methods:* Open, randomised, phase III, multicentre, international clinical trial with masked outcome assessment testing the safety and efficacy of therapeutic cooling in 1500 awake adult patients with acute ischaemic stroke. Cooling will be initiated within 6 hours of symptom onset with an intravenous infusion of 20 ml/kg cooled normal saline (4°C) over 30 to 60 minutes, followed by either surface or endovascular cooling to 34 to 35°C, maintained for 24 hours. Shivering and discomfort will be prevented and treated with anti-shivering drugs. All patients will receive best medical treatment, including alteplase, if indicated. The primary outcome is centrally adjudicated modified Rankin Scale (mRS) at 90 days (shift analysis). A trial with 750 patients per arm has 90% power to detect a 7% absolute improvement in the mRS at the 5% significance level.

*Conclusion:* EuroHYP-1 is ongoing, and funded by the European Commission within the 7th Framework Programme (FP7/2007–2013) grant agreement number 278709.

## ESOC-1088

## 29. Ongoing Trials

**A multicentre, randomized, double-blind, placebo-controlled trial to test efficacy and safety of MRI-based thrombolysis in wake-up stroke (WAKE-UP)**

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**Background:** In about 20% of acute ischemic stroke patients symptoms occur during sleep. These patients are generally excluded from intravenous thrombolysis. Recently, it was shown that MRI can identify patients within the time-window for thrombolysis ( $\leq 4.5$  h from symptom onset) by a mismatch between the acute ischemic lesion visible on diffusion weighted imaging (DWI) but not visible on fluid-attenuated inversion recovery (FLAIR) imaging. WAKE-UP (Efficacy and safety of MRI-based thrombolysis in wake-up stroke: a randomised, double-blind, placebo-controlled trial) aims to test the efficacy and safety of MRI-guided thrombolysis with tissue plasminogen activator (rtPA) in ischemic stroke patients with unknown time of symptom onset.

**Methods:** WAKE-UP is an investigator initiated, European, multicentre, randomized, double-blind, placebo-controlled clinical trial. Patients with unknown time of symptom onset who otherwise comply with clinical inclusion and exclusion criteria for thrombolysis will be studied by MRI. Patients with MRI findings of a DWI-FLAIR-mismatch will be randomised to either treatment with rtPA or placebo. The primary efficacy endpoint will be favourable outcome as defined by modified Rankin Scale 0–1 at day 90. The primary safety outcome measures will be mortality and death or dependency as defined by modified Rankin Scale 4–6 at 90 days. WAKE-UP is registered with the EU Clinical Trials Register (EudraCT No. 2011-005906-32) and ClinicalTrials.gov (ClinicalTrials.gov Identifier NCT01525290).

**Results:** The trial has started in October 2012 and is currently recruiting patients in 6 European countries. A first interim safety analysis was performed after 100 patients had completed the trial. No safety concerns have been raised as of yet. An update on the number of active sites and enrollment status will be given.

**Conclusion:** WAKE-UP is an innovative clinical trial applying novel MRI criteria to identify stroke patients with unknown time of symptom onset likely to benefit from thrombolysis based on the estimation of lesion age.

## ESOC-1592

## 29. Ongoing Trials

**APACHE-AF: Apixaban versus antiplatelet drugs or no antithrombotic treatment after anticoagulation-associated intracerebral haemorrhage in patients with atrial fibrillation. A randomized phase II clinical trial**

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**Background:** There is a lack of evidence on the optimal prevention of ischaemic stroke in patients with atrial fibrillation and a recent intracerebral haemorrhage (ICH) during treatment with oral anticoagulation. These patients are currently treated with vitamin K antagonists, antiplatelet drugs, or no antithrombotic treatment, depending on personal and institutional preferences. Treatment with a direct oral anticoagulant like apixaban might be an attractive alternative in terms of a low risk of recurrent ICH, while at the same time being effective for the prevention of ischaemic stroke.

**Objective:** To obtain reliable estimates of the rates of vascular death or non-fatal stroke in patients with atrial fibrillation and a recent anticoagulation-associated ICH who are treated with apixaban versus those who are treated with antiplatelet drugs or no antithrombotic drug at all.

**Study design:** Multi-centre, phase II, randomised, open-label clinical trial with blinded outcome assessment.

**Study population:** 100 adults with a history of atrial fibrillation and a ICH during treatment with oral anticoagulation in whom clinical equipoise exists on the optimal stroke prevention therapy.

**Intervention:** Patients will be randomized to apixaban 5 mg twice daily or to avoiding anticoagulation. Patients will be randomized between 7–90 days after the index haemorrhage.

**Primary outcome:** Vascular death or non-fatal stroke.

**Sample size:** Ten primary outcome events in 100 patient-years of follow up will yield a 95% confidence interval of 4.9 to 17.6.

**Funding:** The Netherlands Organisation for Health Research and Development, Dutch Heart Foundation.

**Status:** Recruitment started, first patients randomised.

**Registration:** NTR4526

**Trial website:** <http://www.apache-af.com>

## ESOC-1210

## 29. Ongoing Trials

## The optimising the analysis of vascular prevention trials project (OA-PREVENTION)

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**Rationale:** Due to major advances being made in primary and secondary vascular prevention and the risk of recurrence of vascular events falling, vascular prevention trials are increasing in size. Since the number of trials has also increased, it is increasingly difficult to recruit patients into new trials. Therefore new strategies are needed to reduce trial sample sizes and to amplify the potential to demonstrate benefit. OA-Prevention aims to identify the most efficient type of outcome measure and analysis technique for vascular prevention data in randomised controlled trials.

**Methods:** Prevention trials typically count outcomes as dichotomous events although this is inefficient statistically and gives no indication on the severity of recurrent events. Vascular events could therefore be poly-chotomised with ordering determined by severity. It is planned to test this concept by using data from vascular prevention trials.

**Design:** Chief investigators of randomised controlled trials in vascular prevention are asked to share individual patient data from their trials. Requested data includes baseline prognostic factors, treatment group and vascular event outcome data (including information on severity).

**Status:** As of 8<sup>th</sup> January 2015, data from 17 clinical trials (7 primary prevention, 9 secondary and 1 acute) with a total of 91,721 participants have been shared with the collaboration. The OA-Prevention project is currently seeking further clinical trial data.

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## ESOC-1617

## 29. Ongoing Trials

## The thrombolysis in uncontrolled hypertension (TRUTH) study: An observational study on treatment strategy of elevated blood pressure in stroke patients eligible for IVT

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Intravenous thrombolysis (IVT) with recombinant tissue plasminogen activator is an effective treatment in acute ischemic stroke. However, IVT is contraindicated when blood pressure (BP) is above 185/110 mm Hg. In

Dutch clinical practice, two distinct strategies are used in this situation. The *active* strategy comprises lowering BP with antihypertensive agents below these thresholds to allow start of IVT. In the *conservative* strategy, IVT is administered only when BP drops spontaneously below protocolled thresholds.

We hypothesize that the active strategy leads to a better functional outcome three months after acute ischemic stroke. Secondary hypotheses are that this effect occurs despite increasing the number of sICHs, and could be attributable to a higher rate of IVT treatments and a shorter door-to-needle time.

The TRUTH is a prospective, observational, cluster-based, parallel group follow-up study; in which participating centers continue their current local treatment guidelines. Outcomes of patients admitted to centers with an active will be compared to those admitted to centers with a conservative strategy.

Our sample size estimate of 1235 was based on an ordinal analysis of the modified Rankin Scale, with corrections for expected imbalance in group size and clustering effects.

The TRUTH is the first large prospective study specifically studying IVT-candidates with elevated BP, and has the potential to change clinical practice and optimize acute stroke care in these patients.

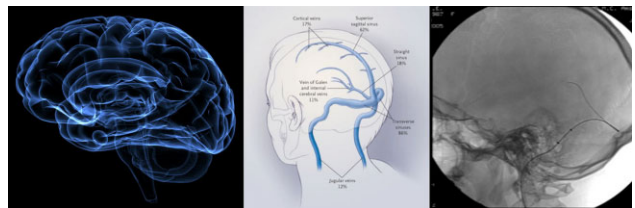
**Study proceedings as of March 3rd, 2015:**

Approval medical ethical committee	September 2014
Start date	January 2015
Estimated end date	December 2018
Centers participating	11
Centers starting up	15

## ESOC-1611

## 29. Ongoing Trials

## Thrombolysis or anticoagulation for cerebral venous thrombosis (TO-ACT trial)

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**Background:** Endovascular thrombolysis (ET), with or without mechanical clot removal, may be beneficial for a subgroup of patients with cerebral venous sinus thrombosis (CVT), who have a poor prognosis despite treatment with heparin. Published experience with ET is promising, but only based on uncontrolled studies.

**Objective:** The objective of the TO-ACT trial is to determine if ET improves the functional outcome of patients with CVT.

*Methods:* Multi-centre, prospective, randomized, open-label, blinded endpoint (PROBE) trial. Patients are eligible if they have a radiologically proven CVT, a high probability of poor outcome (defined by presence of one or more of the following risk factors: mental status disorder, coma, intracranial hemorrhagic lesion, or thrombosis of the deep cerebral venous system) and if the responsible physician is uncertain whether ET or standard anticoagulant treatment is better. 164 patients will be included.

*Intervention:* Patients are randomized to receive either ET or standard treatment (therapeutic doses of heparin). ET consists of local application of rt-PA or urokinase within the thrombosed sinuses, mechanical thrombectomy, or a combination of both.

*Outcomes:* The primary endpoint is the modified Rankin score (mRS) at 12 months. Secondary outcomes are 6 months mRS, mortality and recanalization rate. Principal safety outcomes are major intra- and extracranial hemorrhagic complications.

*Further information:* The first patient was randomized in September 2011. Currently, 50 patients are included by a total of 13 hospitals in four countries. Investigators who are interested in participation can contact us at [j.coutinho@amc.uva.nl](mailto:j.coutinho@amc.uva.nl)

## Late-breaking abstracts

### ESOC-1603

#### 30. Late-breaking abstracts

##### Epidemiology of childhood stroke

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The purpose of this study is to report on our experience of epidemiological data of childhood stroke. 32 patients under the age of 15 years were investigated. 18 (56.25%) of these patients were males and 14 (43.75%) were females. Diagnoses of stroke were confirmed by MRI/MRA scan. The most – 12 (37.5%) childhood stroke cases were obtained in patients aged 6–24 months, 5 (15.62%) patients were in the age group of 2–5 years, 9 (28.13%) were aged 5–10 years and 6 (18.75%) – above 10 years of age. AIS was reported in 21 (65.62%) patients, among which 12 (37.5%) were males; followed by hemorrhagic stroke in 7 (21.88%) patients and CSVT in 4 (12.5%) cases. Focal signs occurred in all cases of AIS, in 3 of hemorrhagic stroke cases and in 2 patients with CSVT. Risk factors were identified in 11 (34.37%) children.

Age	AIS n = 21 n (%)	CSVT n = 4 n (%)	Hemorrhage n = 7 n (%)
6–24 months	9 (28.12%)	1 (3.12%)	2 (6.25%)
2–5 years	4 (12.5%)	1 (3.12%)	0 (0%)
5–10 years	5 (15.62%)	2 (6.25%)	2 (6.25%)
>10 years	3 (9.37%)	0 (0%)	3 (9.37%)

	Males (n = 18) N (%)	Females (n = 14) N (%)	Total (n = 32) N (%)
AIS	12 (37.5%)	9 (28.12%)	21 (65.62%)
CSVT	3 (9.37%)	1 (3.12%)	4 (12.5%)
Hemorrhagic	3 (9.37%)	4 (12.5%)	7 (21.87%)
Other			

Risk factors	N, %
Factor VIII deficiency	2 (6.25%)
Encephalitis	2 (6.25%)
Moya moya disease	1 (3.12%)
ALL	2 (6.25%)
Bacterial meningitis	1 (3.12%)
AVM	1 (3.12%)
Head trauma	1 (3.12%)
Hypertension	1 (3.12%)

### ESOC-1607

#### 30. Late-breaking abstracts

##### Where time is not of the essence – stroke treatment and care in an Ebola treatment centre

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Stroke care has advanced in the western world by leaps and bounds over the past century. Recently, in West Africa, declining Ebola mortality rates in the Ebola epidemic have raised questions and issues about standards of care and in terms of non-Ebola disease management. Patients now may present with Ebola disease manifestations but then acquire new diagnoses which require treatment and possible interventions.

Neurological sequelae of Ebola are known but not well described in the literature. They include encephalitis, meningitis, and stroke. No studies are available that differentiate between the different neurological diagnoses as there is no imaging support and limited laboratory access; diagnosis is clinical.

Through a case discussion we explore the difficulties and challenges of providing a low resource post-stroke care in an Ebola Treatment Centre. The patient was Ebola positive on PCR testing, suffered a stroke which left her with a right sided hemi-paresis, and then consequently cleared the virus from her system. Providing stroke care not only in a low resource environment but while also wearing full Personal Protective Equipment (PPE), in tropical heat with limited patient time is explored and documented for the first time in the literature.

### ESOC-1621

#### 30. Late-breaking abstracts

##### Experience in mechanical thrombectomy in acute ischemic stroke: How close are the results of the real clinical practice to those obtained in the last trials?

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**Background:** In the last weeks two important trials on endovascular treatment for ischemic stroke have been published, showing that early thrombectomy with the stent retriever in selected patients can improve their functional outcome. Mechanical thrombectomy for acute treatment of ischemic stroke was established at the University Hospital of Cruces in October 2012. We below show our experience and results with this technique.

**Methods:** Since endovascular treatment was implemented in our hospital, we have treated 181 patients with acute ischaemic stroke. We selected patients with a carotid territory stroke of less than 6 hours from onset, with a previous mRs ≤ 2, that present an arterial stop in the angio-CT, ASPECT score >7 in the CT-scan and a favorable perfusion study. Those patients eligible for r-TPA received treatment before endovascular procedure.

**Results:** This group of 181 patients has a mean age of 70.9 (± 12.83, 27–91), there are 97 males and 87 females, with a previous mRs of 0 in 84.21%, 1 in 4.09% and 2 in 8.18%. The mean NIHSS at admission was 15.7 (± 6.37, 3–28). 34.16% of patients received previous treatment with



r-TPA. Complete recanalization (TICI 2b, 3) was obtained in 91.16%. Mean NIHSS at discharge was 3.8. Symptomatic cerebral hemorrhage occurred in 4.97% patients. 64.23% of patients are independent (mRS  $\leq$  2) at 90 days.

**Conclusions:** Mechanical thrombectomy is a safe and efficient therapy in acute stroke when it is performed in experienced centres under strict selection criteria. A proper stroke treatment strategy is needed in our country in the pursuit of equity.

## ESOC-1593

### 30. Late-breaking abstracts

#### Epidermal growth factor and growth hormone-releasing peptide-6: Combined therapeutic approach in experimental stroke

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Stroke is the world's second leading cause of mortality, with a high incidence of disability in survivors. Promising preclinical studies on neuroprotection have failed in stroke trials. Combined therapy is a compelling promissory strategy, as it simultaneously targets different nodes of the complex ischemic cascade. The aim of this work is to evaluate the possible neuroprotective effects of the combined therapy of Epidermal Growth Factor (EGF) and Growth Hormone-Releasing Peptide-6 (GHRP6) in focal brain ischemia experimental stroke. The neuroprotective effect of the EGF+GHRP6-combined therapy, which has been previously assessed in global brain ischemia experimental models, were compared with one of the most relevant strategies to reach neuroprotection: Hypothermia.

The brain focal ischemia model were generated using one intracerebral administration of endothelin-1 in rats. Two hours after reperfusion EGF, GHRP6 or EGF+GHRP6 were intraperitoneally administered. Clinical manifestations were registered daily. Three days after reperfusion, animals were anesthetized and perfused with saline. Infarct volume was analyzed with TTC staining.

EGF+GHRP6 co-administration reduced clinical manifestations, and infarct size. Additionally animals treated with EGF+GHRP6 had a neurological grade and infarct volume, similar to those that were treated with hypothermia.

Thus EGF and GHRP6 co-administration had an impact in both clinical and pathological outcomes, showing the promising therapeutic potential of this combined treatment approach for stroke patients.

## ESOC-1609

### 30. Late-breaking abstracts

#### Randomized clinical trial of the effectiveness of nutritional assessment in adult patients with prior stroke

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**Background:** Chronic noncommunicable diseases (NCDs) account for about 60% of global mortality Stroke becomes more important as it is the

leading cause of disability and the second cause of mortality worldwide, with 6.15 million deaths worldwide. Hypertension is a major risk for stroke, several studies have shown that various nutritional aspects are associated with the risk of stroke, reducing it.

**Objectives:** To evaluate the effectiveness of nutritional counseling with a DASH-style in improving the control of stroke risk factors compared to the usual diet in adult patients with a history of stroke.

**Patients and Methods:** Patients with previous stroke were randomized to receive nutritional guidance with a DASH diet (intervention group GI), or follow usual diet (control group GII). Clinical and biographical characteristics were evaluated and visits were conducted anthropometric and blood pressure measurements, biochemical tests, and 24-hour recall of food intake. Patient follow-up was three months (December/2014 to February/2015).

**Results:** This study evaluated 43 patients (21 GI and GII 22) with a mean age of 58 years. There were no significant differences between groups. There is a tendency for reduction of diastolic blood pressure with increasing calcium intake ( $p < 0.05$ ) and an increase of the same with increased sodium intake ( $p < 0.0055$ ) in both groups.

**Conclusions:** The results of the research were negative, showing no differences between groups. Possibly the low compliance of patients influence the results and therefore a greater number of people in groups and longer follow-up may bring us a more accurate perception of this relationship.

## ESOC-1595

### 30. Late-breaking abstracts

#### Clinical significance of biochemical markers in the recovery period of ischemic stroke in children

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The causes and risk factors of stroke in children differ significantly from those of adults: infections, cardiac arrhythmias, heart diseases, prothrombotic mutations, migraine, etc. Biochemical markers, well studied in adults, are unknown for paediatric neurology: nitric oxide, endothelin-1, von Willebrand factor, homocysteine.

**Methods:** 50 children from 10 months to 17 years after ischemic stroke and control group of 50 healthy children, comparable by gender and age, underwent clinical assessment of neurologic deficit by the scale PSALM (Pediatric Stroke Activity Limitation Measure). Blood levels of von Willebrand factor (vWF), homocysteine, nitric oxide, endothelin-1 were evaluated in all children.

**Results:** Significant increase in levels of vWF ( $p = 0.005$ ), endothelin-1 ( $p < 0.001$ ) and homocysteine ( $p = 0.02$ ), as well as the reduction of nitrogen oxide ( $p < 0.001$ ) were found in children after ischemic stroke compared to the control group. In a stroke group strong positive correlation ( $r = 0.63$ ;  $p < 0.001$ ) between vWF and PSALM score, as well as a moderate negative correlation ( $r = -0.48$ ;  $p < 0.001$ ) between ratio NO / endothelin-1 and PSALM score were observed.

Based on this independent correlations, with the linear regression analysis we have calculated the mathematical model, predicting the outcome of ischemic stroke in children on the base of vWF, nitric oxide and endothelin-1 blood levels.

**Conclusion:** Changing of vWF, nitric oxide and endothelin-1 blood levels can be considered not only as a risk factor of ischemic stroke, but also as an outcome measure.

## ESOC-1615

## 30. Late-breaking abstracts

**Poor leptomeningeal collateral status is associated with abysmal outcome in consecutive patients with acute MCA occlusion**

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**Background:** Poor collateral blood flow through leptomeningeal vessels is likely a pivotal factor in the outcome of stroke patients, but the effect lacks to be documented in unselected and consecutive stroke patients.

**Method:** We included 185 consecutive patients with middle cerebral artery occlusion (MCA) undergoing thrombolysis (and endovascular treatment – EVT) from May 2009 to February 2014. All patients received acute CT-angiography followed by intravenous thrombolysis treatment (and transfer for EVT). Poor collateral status was defined as contrast filling of only distal superficial vessels in the ischemic area. Modified Rankin Scale (mRS) was assessed after 3 months. Mortality-status was followed for one year after stroke.

**Results:** Patients underwent CTA with a median delay of 87 minutes (70–117 minutes). Median (IQR) NIHSS on admission was 15 (9.5–19). All patients underwent intravenous thrombolysis, and 56 (30%) underwent additional EVT. Median (IQR) 3 months outcome in patients with poor collaterals was 4 (3–6) compared to 2 (1–4) in the remaining population ( $p < 0.0001$ ). Patients with poor collaterals were less prone to good 3 months outcome (mRS 0–2) (OR 0.31 CI: 0.12–0.80) after adjustment for age, time-to-scan, EVT, NIHSS, and thrombus burden. During the first year after stroke, patients with poor collaterals suffered a cumulative mortality of 41.9% compared to 18.3% of the remaining population ( $p = 0.001$ ). Adjusted for age, time-to-scan, EVT, NIHSS, and thrombus burden, poor collateral status was associated with mortality during the first year (HR 2.1 CI: 1.01–4.15).

**Conclusion:** Poor collateral status predicts poor long-term outcome after stroke in consecutively treated stroke patients.

## ESOC-1587

## 30. Late-breaking abstracts

**EuroSCORE risk model as predictor of mace after carotid artery stenting and carotid endarterectomy in patients with carotid stenosis and concomitant coronary artery disease**

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**Purpose:** To study outcomes of carotid artery stenting (CAS) and carotid endarterectomy (CEA) in patients with carotid stenosis and multivessel coronary disease according to EuroSCORE risk model.

**Methods:** We reviewed 312 patients who were treated for carotid stenosis (142 carotid artery stentings and 170 carotid endarterectomies).

**Results:** Depending on comorbidities all patient were divided in two groups: EuroSCORE  $\leq 5$  ( $n = 181$ ) and EuroSCORE  $> 5$  ( $n = 131$ ). In EuroSCORE  $\leq 5$  group CAS was performed in 75 patients, CEA – in 106 patients. The 30-days stroke rate did not differ between CAS and CEA. The 1-year freedom from stroke were 93.4% in CAS subgroup and 94.3% in CEA subgroup ( $p > 0.05$ ). There was no difference in the all-cause death rate (stroke-related, coronary, other) at 1-year follow-up. In EuroSCORE  $> 5$  group CAS was performed in 73 patients, CEA – in 58 patients. There was no difference in the incidence of 30-days stroke between CAS and CEA. The 1-year freedom from stroke were 93.2% in CAS subgroup and 94.9% in CEA subgroup ( $p > 0.05$ ). The all-cause death rate among CAS patients was lower (1.4%) compared to CEA patients (12%,  $p = 0.044$ ).

**Conclusion:** In the low-risk patients (EuroSCORE  $\leq 5$ ) the incidence of neurological complications and all-cause death rate did not differ between CAS and CEA subgroups. In high-risk patients (EuroSCORE  $> 5$ ) there was no significant difference in the incidence between subgroups, but patients after CEA are at higher risk for any-cause related death.