Peer reviewed article

Factors influencing emergency delays in acute stroke management

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Summary

Objective: Early admission to hospital with minimum delay is a prerequisite for successful management of acute stroke. We sought to determine our local pre- and in-hospital factors influencing this delay.

Patients and methods: Time from onset of symptoms to admission (admission time) was prospectively documented during a 6-month period (December 2004 to May 2005) in patients consecutively admitted for an acute focal neurological deficit presented at arrival and of presumed vascular origin. Mode of transportation, patient's knowledge and correct recognition of stroke symptoms were assessed. Physicians contacted by the patients or their relatives were interviewed. The influence of referral patterns on in-hospital delays was further evaluated.

Results: Overall, 331 patients were included, 249 had an ischaemic and 37 a haemorrhagic stroke. Forty-five patients had a TIA with neurological symptoms subsiding within the first hours after admission. Median admission time was 3 hours 20 minutes. Transportation by ambulance significantly shortened admission delays in comparison with the patient's own means (HR 2.4, 95% CI 1.6–3.7). The only other factor associated with reduced delays was awareness of stroke (HR 1.9, 95% CI 1.3–2.9). Early in-hospital delays, specifically time to request CT-scan and time to call the neurologist, were shorter when the patient was referred by his family or to a lesser extent by an emergency physician than by the family physician ($p < 0.04$ and $p < 0.01$, respectively) and were shorter when he was transported by ambulance than by his own means ($p < 0.01$).

Conclusions: Transportation by ambulance and referral by the patient or family significantly improved admission delays and early in-hospital management. Correct recognition of stroke symptoms further contributed to significant shortening of admission time. Educational programmes should take these findings into account.

Key words: acute stroke; stroke delays; acute care; stroke management

Introduction

Recent studies have demonstrated that early management is critical for successful intervention in acute stroke. There is strong evidence that specific treatment such as thrombolysis increases the chances of a favourable outcome when administered within an appropriate time-window [1–3]. It is well known that the effect of thrombolytic therapy diminishes rapidly over time even within the 3-hour window, resulting in the concept of "time is brain" [4]. Despite the evidence, only a minority of patients benefit from this therapy [5]. Moreover, the most common reasons for not administering this treatment are overlong pre- and in-hospital delays [6].

The aim of our study was to determine the different factors in the pre- and in-hospital process that may affect early admission and management. Two main aspects were considered for the present study, the first evaluating the patient's characteristics, including risk factors, stroke knowledge and stroke recognition, the second focusing on the physician's attitude once he has been contacted by the patient or his family.

All patients presenting at the emergency department with an acute focal neurological deficit of presumed vascular origin were considered for the present study. Patients presenting haemorrhagic stroke or TIA were also included, since it is not possible to distinguish these events from acute ischaemic stroke at admission.

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Patients and methods

The University Hospital of Geneva acts as primary and tertiary care centre and teaching hospital. Each year 700 patients are admitted for stroke or TIA. The majority of patients come from the catchment area of Geneva and neighbouring communities, including small towns located near the French border. Patients may arrive at the hospital using their own means of transportation or by ambulance, which may be of a standard or an emergency medical type. In the latter there is a medical doctor on board. In Geneva, the emergency medical system is provided by the Emergency Medical Dispatch Center (EMDC) responding to a single local phone number (144) and two international numbers, 112 and 911. EMDC uses a local standardised protocol and can dispatch public or private ambulances with professional paramedics. Emergency physicians from the emergency department of the University Hospital can participate, if needed. Due to the heavy workload, response time is generally more than 60 minutes. Patients or their relatives can call private ward physicians for home visits but they are not expected to respond to vital emergencies (fig. 1). Stroke victims enter the hospital at the emergency department, where triage is performed by a triage nurse. Only the patients presenting with acute neurological symptoms of less than 6 hours' duration are managed immediately by emergency physicians and neurologists.

Our prospective study included all consecutive patients from December 2004 to May 2005 presenting on admission an acute focal neurological deficit of presumed vascular origin. If ever the precise time of onset of symptoms was known, the various delays from onset of symptoms until arrival at the emergency department were evaluated prospectively. If the precise time of symptoms onset was unknown, we converted delay expressed in days into hours. This pertained to patients who arrived after the 24-hour window. For those patients who had symptoms on awakening, we considered time of awakening as the time of symptom onset.

Stroke was defined as a neurological deficit of abrupt onset usually lasting more than 24 hours with evidence of brain infarction (if ischaemic) or intracerebral haematoma (if haemorrhagic) on CT-scan or MRI. TIA was defined as a neurological deficit of abrupt onset generally lasting less than 1 hour and without any lesion on the neuroradiological workup [7]. During the first 48 h after admission a structured questionnaire was completed on patient's knowledge of stroke symptoms and their perception of stroke as a medical emergency. Awareness of stroke was considered as positive when the patient or, in case of aphasia, his relatives, correctly identified his symptoms as being those of a stroke. The questionnaire also documented the parameters as age, gender, living alone, cardiovascular risk factors (high blood pressure, hypercholesterolaemia, diabetes, tobacco, sedentary lifestyle, excess weight, positive family history) and history of TIA or stroke. Moreover, within the first 48 h after the patient's admission, a structured telephone interview was completed with the physician contacted initially by the patient or his family (family physician or private ward emergency). Data collected at the emergency department included time between admission, request of brain CT-scan and request for the neurologist's evaluation. The study was approved by the local ethics committee. Written informed consent was required.

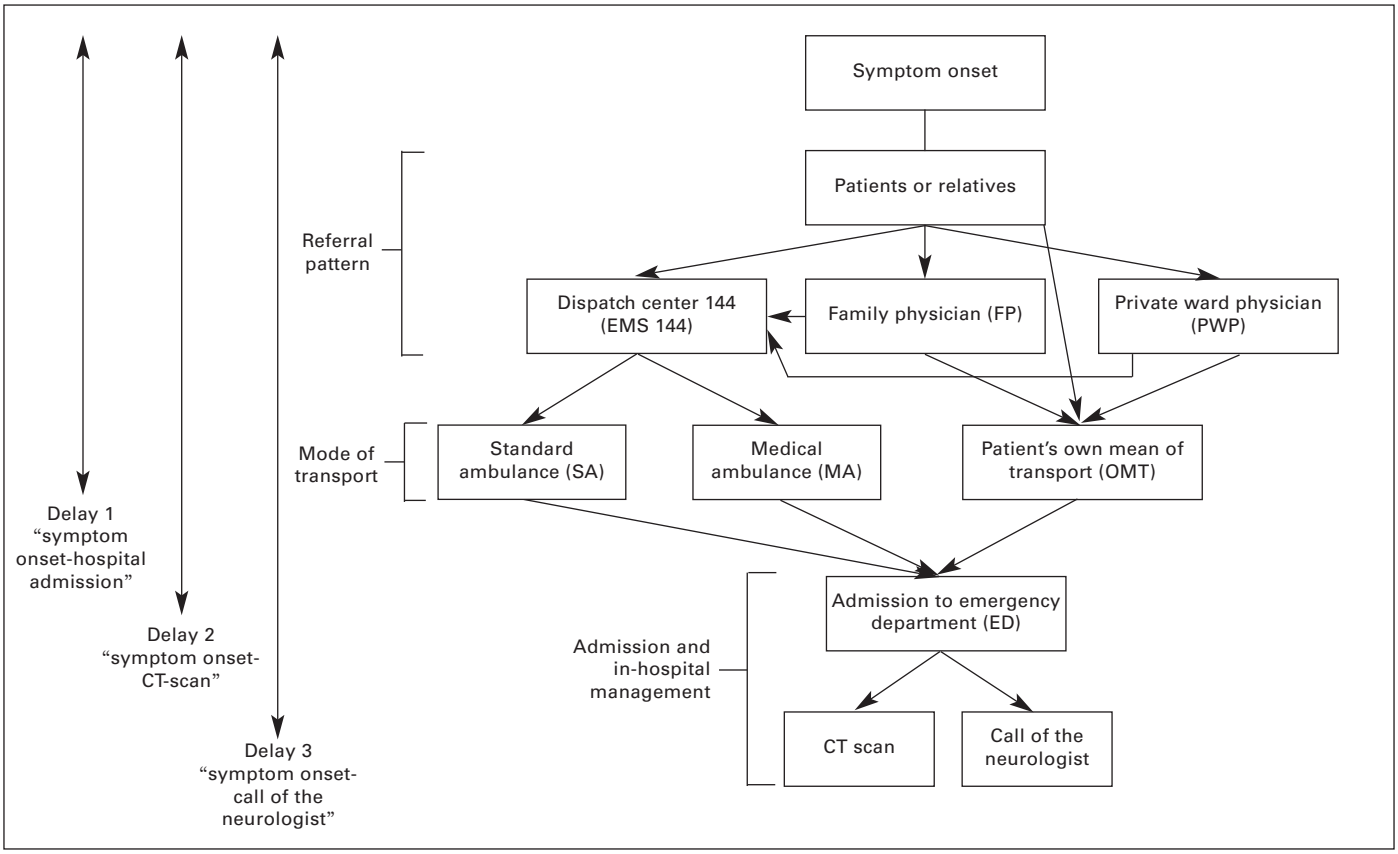

Figure 1

Diagram of pre- and early in-hospital delays according to the different pathways used from onset of symptoms until admission to the emergency department.

Statistics

The Mann-Whitney or Kruskal-Wallis tests were used for group comparison. Analysis of delays was performed using survival analysis. Kaplan-Meyer survival curves were compared using the log rank test. Simple and multiple Cox proportional hazard regression analyses were then applied to find independent factors associated with the different delays and used to compute hazard ratio (HR). Stepwise backward logistic regression analysis was used to test the association between independent factors and the use of the EMDC 144 system expressed as odds ratio (OR). Two-sided p levels <0.05 were considered significant. Analysis was performed using the STATA software, release 9.2.

Results

331 patients, 169 males and 162 females, were prospectively included in the study over a 6-month period. Their main characteristics are summarised in table 1. The median admission time of arrival at the emergency department was 3 hours 20 minutes. The proportion of patients arriving between 0 and 3 hours was 44.4% (n = 147), between 3 and 6 hours, 20% (n = 66).

Patient questionnaire

A total of 274 patients or relatives replied to the questionnaire in full. The early death of 38 patients meant that their questionnaires were only partially completed. The remaining 19 patients accepted inclusion in the protocol but refused participation during follow-up. However, they agreed to further research use of information initially provided.

The main findings on the patient's or his family's attitude at the very onset of symptoms and their knowledge of stroke were the following: 60

Table 1

Baseline characteristics of the study population (n = 331).

	N (%)
Age	72.4
Sex	169 M, 162 W
Home location	
Geneva city	297 (90%)
Neighbourhood including French cities close to Geneva	34 (10%)
Stroke (ischaemic)	249 (75%)
TIAs	45 (14%)
Intracerebral haemorrhage	37 (11%)
NIHSS at admission	9 (median)
Precise time of onset of symptoms:	
Yes	169 (51%)
No	162 (49%)
Symptoms at awakening	*56 (19%)*
Risk factors	
High blood pressure	124 (38%)
Hypercholesterolaemia	75 (29%)
Diabetes	38 (12%)
No physical activity	27 (15%)
Tobacco	72 (19%)
History of stroke/TIA	74 (22%)
Weight excess	52 (15%)
Positive family history	118 (36%)
Referral pattern (n = 331)	
Family physician (FP)	*41 (17%)
Emergency physician (PWP)	66 (20%)
Patient or family	140 (42.5%)
Other (referral from other hospitals, institutions)	84 (25.5%)

* 67 patients or families tried to contact their usual family physician, but 26 could not reach him.

Table 2

Prediction of patient's cardiovascular risk factors, previous history of stroke/TIA and stroke knowledge on admission delays (n = 274).

	Hazard ratio	P value	95% CI
Male gender	1.14	0.332	0.88 to 1.48
Living alone	1.02	0.881	0.77 to 1.36
Age at onset of symptoms	1.00	0.760	0.99 to 1.01
High blood pressure	1.30	0.066	0.98 to 1.72
Hypercholesterolaemia	0.84	0.223	0.63 to 1.11
Diabetes	0.66	0.014	0.47 to 0.92
No physical activity	0.68	0.012	0.50 to 0.92
Tobacco	0.91	0.570	0.67 to 1.25
Previous history of stroke or TIA	1.07	0.669	0.79 to 1.44
Weight excess	1.73	0.007	1.16 to 2.58
Family history	0.99	0.965	0.72 to 1.37
Patient/family already heard about stroke	1.21	0.325	0.83 to 1.77
Most frequent symptoms associated with stroke:			
a) weakness and/or numbness of the face, arm or leg	1.13	0.4	0.84 to 1.5
b) difficulty in speaking	1.16	0.2	0.88 to 1.53
c) visual problems involving one or both eyes	0.90	0.54	0.63 to 1.3
d) chest pain	1.15	0.66	0.6 to 2.1
e) dizziness	0.89	0.42	0.66 to 1.19
f) unusual, intense headache	1.00	0.98	0.73 to 1.36
Correct recognition of the symptoms (awareness of stroke)	1.9	0.003	1.34 to 2.34

For 57 patients the questionnaire data was incomplete because of early death (n = 38); the remaining 19 patients accepted inclusion in the protocol but later refused to answer the questionnaire. Acceptance was however given for use of the initially provided information for research purposes.

Figure 2

Flow-chart of the process between onset of symptoms and study inclusion.

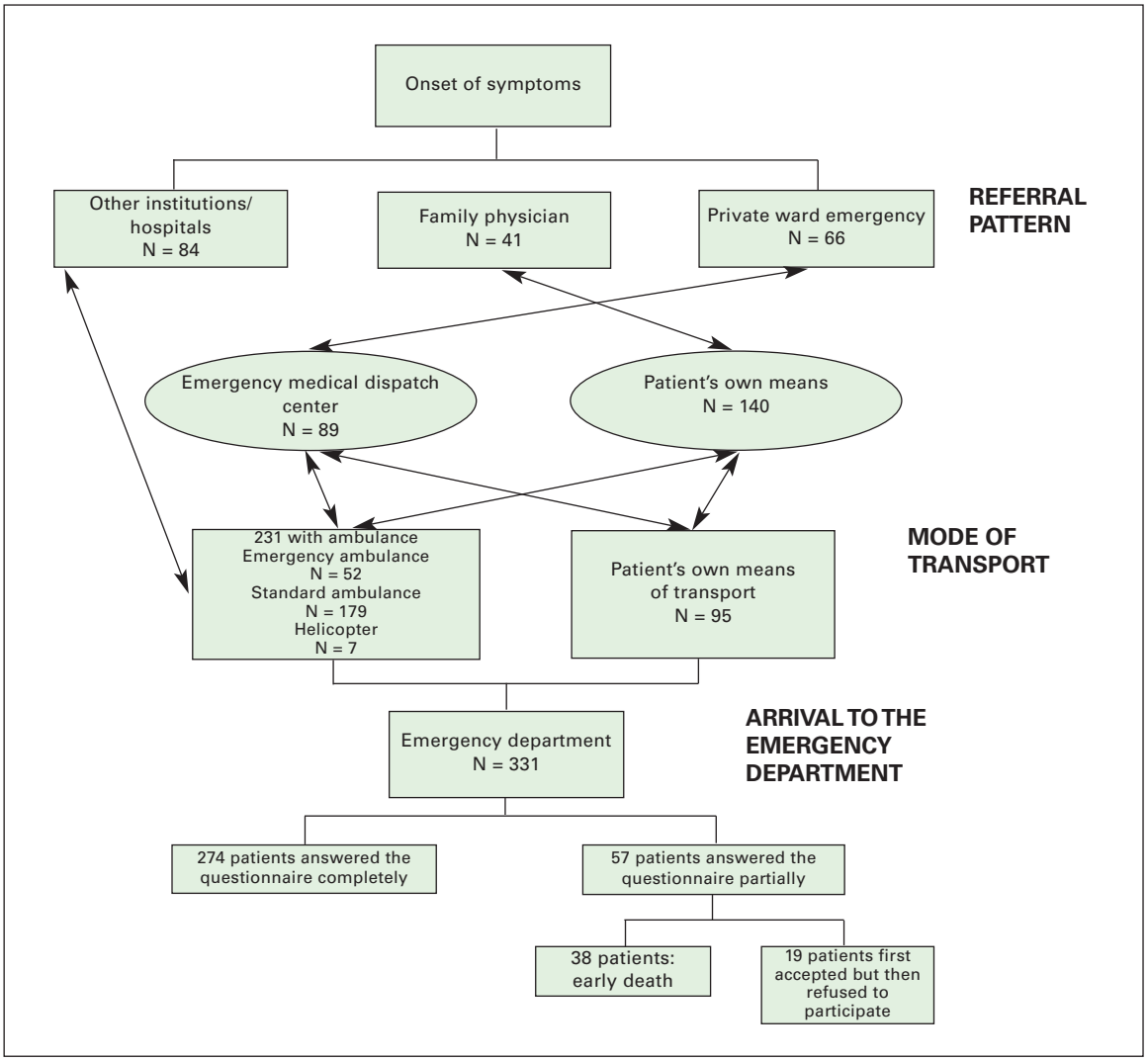

Table 3

Prediction of use of the Emergency Medical Dispatch Center (EMDC) and delays between onset of symptoms and call to the EMDC (n = 89).

Prediction of use EMDC	Odds ratio	P value	95% CI
Age	1.03	0.059	1.00 to 1.06
Gender	1.01	0.9	0.5 to 1.9
Living alone	0.56	0.14	0.26 to 1.23
CV risk factors			
High blood pressure	1.58	0.2	0.7 to 3.2
Cholesterol	0.63	0.2	0.31 to 1.28
Diabetes	1.01	0.9	0.44 to 2.3
No physical activity	1.56	0.2	0.72 to 3.39
Tobacco	0.78	0.5	0.35 to 1.71
History stroke/TIA	1.07	0.85	0.52 to 2.2
Severity of symptoms			
NIHSS >5	2.9	0.002	1.5 to 1.7
Family physician	0.34	0.003	0.16 to 0.7
Private ward physician	3.2	0.009	1.3 to 7.7
	Hazard ratio	**P value**	**95% CI**
Delay between onset symptoms and call EMDC			
Family physician	0.34	0.003	0.16 to 0.7
Private ward emergency	0.43	0.001	0.28 to 0.66

patients or family members (21%) adopted the "wait and see" attitude, 89 (32%) called the EMDC 144, 67 (24%) contacted the family physician and 58 (21%) the private ward physician. Overall, 233 patients or family members (85%) had already heard of stroke; 168 (61%) identified weakness and/or numbness of the face, arm or leg as the most frequent symptoms of stroke, 134 (49%) difficulty in speaking, 44 (16%) visual problems involving one or both eyes, 75 (27%) dizziness, 60 (22%) unusually intense headache and 13 (4.7%) chest pain. Ninety-five patients or family members (35%) correctly recognised the symptoms. Only 21 patients (7.6%) knew about a specific stroke treatment but as many as 164 (60%) considered that it was urgent to go to hospital immediately.

Physician's questionnaire

Of the 107 physicians contacted (family physicians and private ward physicians), 83 answered the phone interview. Of these, 27 (33%) considered stroke an emergency even if the delay for thrombolysis was over, 18 (21%) recommended immediate transfer of the patient to hospital for potential thrombolysis, but only 9 (11%) organised this transport themselves; 11 (13%) thought the symptoms were not severe enough to justify a transfer to hospital and 52 (63%) visited the patient at home. It should be mentioned here that 23 patients (28%) refused to go to hospital.

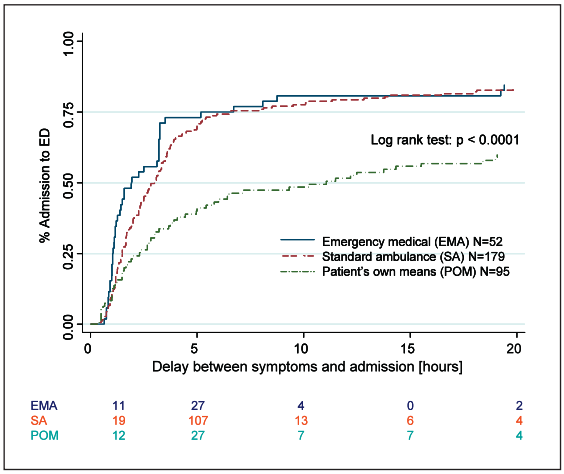

Figure 3

Kaplan-Meyer curves of admission delays between first symptoms and admission to the emergency department (ED): differences between the kinds of transportation (computed on the full data set, but focused on the first 24 hours). Absolute number of patients is shown below the x-axis.

Delays and mode of transportation

Analysing the admission time for the whole group of 331 patients, we observed that transportation by an emergency medical ambulance (n = 53) or by a standard ambulance (n = 179) was 2.4 (95% CI 1.6 to 3.7) and 1.8 (95% CI 1.6 to 3.7) times, respectively, more rapid than transportation by the patient's own means (n = 97), (p <0.001; 95% CI 1.6 to 3.7 and 1.3 to 2.4) (fig. 2).

Delays and stroke knowledge

Neither the presence of cardiovascular risk factors, including a history of previous stroke or TIA, nor a knowledge of stroke shortened the admission time (table 2). The only factor associated with reduction of admission time was awareness of stroke (HR 1.9, 95% CI 1.3 to 2.9, p = 0.003).

Delays and call to the Emergency Medical Dispatch Centre (EMDC)

Of the 231 patients (70%) transported by ambulance, 89 (38%) called EMDC 144. The main factors predicting the call to the EMDC and the factors associated with the delays between the onset of symptoms and this call are summarised in table 3.

In-hospital delays and mode of referral

The arrival was pre-announced for 159 patients (48%), for 89 (57%) via EMDC 144. Time to request of CT-scan and time to calling the emergency neurologist were shorter when the patient was referred by his family than by the FP (147 vs 197 minutes [p <0.04] and –7.3(*) vs 36 minutes [p <0.01], respectively) and when transported by ambulance than by his own means (134 vs 215 min [p <0.04] and –2.4(*) vs 26 min [p <0.01], respectively).

(*) Observing the negative times means that request of CT-scan and call to the neurologist were done before the patient arrived at the emergency department (an average of 7.3 and 2.4 minutes, respectively) (fig. 3).

Discussion

This study analysed the different factors which influence the time intervals from stroke onset to hospital admission and the beginning of in-hospital management. A total of 147 patients (44.4%) arrived within 3 hours and an additional 66 (20%) within 3–6 hours, figures similar to arrival times observed in other studies [8–13]. In our group the main factors associated positively with shorter pre- and in-hospital delays were use of an ambulance and awareness of stroke [14–17]. Transportation was one of the most important factors in early acute stroke patient's admission [17–20]. Several studies have shown that transportation by ambulance and in particular using an EMDC system increased the number of acute stroke patients arriving within appropriate delays for thrombolysis [20]. In our study, two thirds of the patients used an ambulance and among them 39% used the EMDC 144 system. It should be noted that this proportion of patients varies widely across individual studies, a factor which may have been influenced by the presence of concomitant educational programmes. For instance, coincidentally with the start of the study by Barsan et al., educational and promotional programmes stressing the signs and symptoms of stroke and the need to call the number 911 were presented to physicians, paramedical staff and public with a subsequent increase in emergency telephone system use from 39% in the first quartile of the study to 60% in the fourth quartile [20]. On the other hand, in a more recent French study published by Derex and colleagues, not performed within the setting of an educational programme, only 35% of stroke patients used the emergency telephone system [12]. In our study 27% of patients primarily contacted their FP, a proportion similar to that observed in other recent trials [8, 12] and a factor in delayed admission. Patients who did not initially contact their FP were more likely to use the EMDC 144 system and ambulance transportation [9, 20–22].

As reported by others [8, 12], the presence of cardiovascular risk factors or a past history of stroke or TIA had no influence on admission time. Possible explanations for these results may be incomplete education after the first cerebrovascular event and, in particular, lack of information regarding the existence of a specific treatment in the very early phase. In fact, only 7.5% of our patients knew of the existence of a specific early treatment. In contrast, knowledge of stroke symptoms was

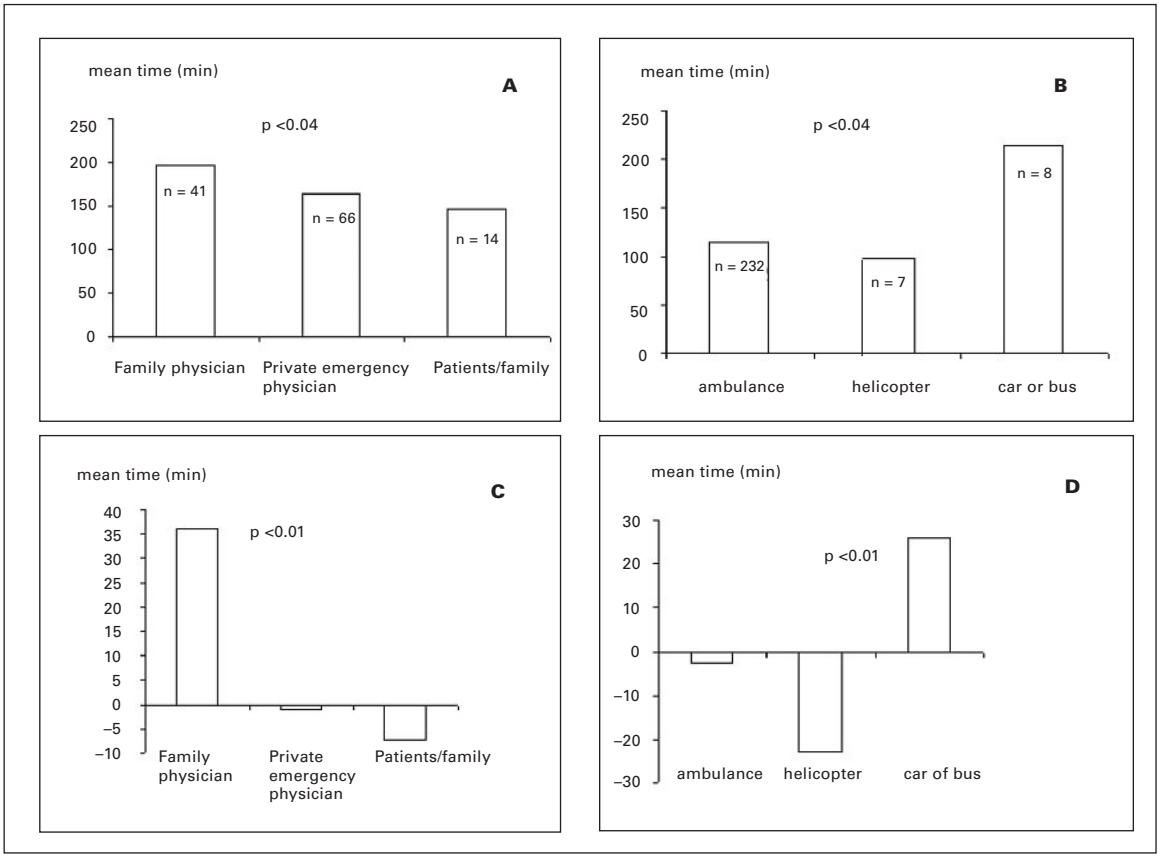

Figure 4

In-hospital delays between arrival at ED and request for CT-scan (A and B) and call to neurologist (C and D) according to referral patterns (A and C) and mode of transport (B and D). Negative values of mean time indicate that the neurologist was contacted from the ambulance before the arrival at admission. P values were calculated as comparisons among the different groups.

good in more than 50% of the patients and 60% of them were aware of the importance of urgent hospital admission. Despite this good stroke knowledge, only one third of our patients were able to recognise their own symptoms correctly. Most other studies also fail to demonstrate an impact of stroke knowledge on admission delays [23, 24]. However, this gap between theoretical stroke knowledge and practical inability to recognise the symptoms has not been reported previously. As awareness of stroke was a significant factor associated with shorter admission time in our study, we believe that educational programmes should not only focus on stroke knowledge but also on patients' ability to correctly identify their own symptoms. We also observed that stroke awareness further predicted the time between onset of symptoms and call to EMDC 144. This particular aspect has been emphasised by various authors. Feldman et al. showed that the median delay to the first contact with a physician was 1 hour when stroke symptoms were recognised by the patient or his family, as compared to 7 hours when the symptoms were not recognised [25]. Rossnagel and colleagues also demonstrated that one of the factors most strongly associated with a shorter out-of-hospital interval was recognition of the symptoms as an emergency [19]. Similarly, in a questionnaire performed on 150 patients, Barr and co-workers established that time delay was shorter if the patients regarded their symptoms as serious [26].

Once the patient has been admitted management could still be delayed "waiting for the physician" [27–29]. One way to overcome this obstacle was to pre-announce the patient, which in fact happened in almost 50% of patients in our study. Mode of transportation and referral pattern could positively influence in-hospital delays, in particular the time to request of brain CT-scan and time to call the neurologist. This time was significantly shorter when the patient or his family acted on their own instead of contacting either their family physician or the private ward physician (fig. 2). It is noteworthy that nearly two thirds of the patients used the EMDC 144 system on their own initiative. Our findings highlighted the importance of future educational programmes, which should also be orientated towards physicians in order to reduce the number of "intermediate stages" which may occur between onset of symptoms and hospital arrival. In fact, only one third of the physicians considered stroke an emergency once the 3-hour window was over, and accordingly almost two thirds of them visited the patient at home instead of organising immediate transfer to hospital.

Furthermore, the results of a recent Swiss study suggested that there was much potential for reduction of stroke costs by improving early admission for stroke treatment and thereby increasing the chances of earlier patient independence [30].

Our study had the following limitations associated with its observational design: potential recalling bias in the absence of a family member (or witness of the event) and in some cases uncertainty regarding the time of the call to the family physician or private emergency physician. We

considered, however, that this was still the best way to assess the time of symptoms onset as compared to the time of call to the emergency number.

In summary, the main factors associated with shorter pre- and early in-hospital delays were the use of an ambulance and awareness and recognition of stroke symptoms. The delays were clearly increased when the patients contacted their family physicians. Our findings underline the need to further educate the population as well as the different stakeholders in stroke care provision. As awareness of stroke was a significant factor associated with a shorter admission time, we believe that educational programmes should not only focus on stroke knowledge but also on patients' ability to identify their symptoms correctly.

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