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Spontaneous coronary artery dissection: cases at the CHUV between 2012 and 2014

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Introduction

Spontaneous coronary artery dissection (SCAD) is a rare entity. It consists of the separation of the several layers of the coronary arteries, with or without an intimal flap[1–3]. In other words, at this time two physiopathological processes are identified: the first one is the rupture of the intimal and often the medial layers, as well as the engulfment of blood in that false lumen witch then compress the true lumen leading to a ischemia of the coronary artery's territory. The second one implies a probable rupture of the vasa vasorum, which leads to an intra-mural hematoma, without rupture of the coronary artery's layers. In that situation there is no communication between the true and the false lumen[1,2,4,5]. Some studies include SCAD patients with underlying artheromtous disease, but commonly SCAD is considered as a synonym for a non-atherosclerotic coronary arterie's dissection[1–4,6].

The prevalence of this pathology is not well known. The first studies covering a large population has shown a 0.1% to 1.1% cases in the angiographic series[1,7–12], but the latest studies tend to show a 4% rate of SCAD in case of patients presenting acute chest syndrome (ACS)[13]. Tree main hypothesises can explain this lack of diagnosis: first, the non-use of the angiographic exam especially on the young females presenting chest pain. Second the primary presentation as sudden cardiac death and finally, the lack of sensibility of angiography to detect SCAD[6]. We can see that with the upgrading of intra coronary arteries imaging, (as OCT or intravascular ultrasound), and the rising awareness amongst the cardiologists, the prevalence of SCAD seems to be rising[14]. Researches that include associated atherosclerotic coronary arteries disease with SCAD reveal a majority of male touched by this condition, but studies that only concern non-atheromatous SCAD have found a female predominance[2,11–13,15]. The reason why SCAD mostly happen to women is unclear, but the progesterone and oestrogen may be partially responsible for that[16]. It mainly affects young people (<50 years old) with an average age of 41 ± 10.6 for women and 45.4 ± 14.4 for men[5].

The prognoses of SCAD, once the acute event is resolved, appears to be good. However, this has not always been the case. In 1931, Pretty H. described the first case of SCAD on a necropsy. From that moment on, other necropsies have reported similar cases. The fact that the symptoms were only viewable on corpses allowed people to

think that the prognosis of this newly discovered pathology was dramatically bad. This idea changed in 1969 when the angiographic technique by Forker et al was able to describe the first case of SCAD on a living person. [17]. After that, some small cases series have often shown a good prognosis[7,10,18]. Nowadays, the lack of studies consisting of broad samples of patients on long-term follow up does not allow us to exactly know the prognosis of this entity. Clinical manifestations of SCAD range from light quickly resolving chest angina to sudden death. Frequently the initial presentation is an acute coronary syndrome (ACS), with ST-segment elevation (STEMI)[1,3–6].

The "gold-standard" exam used for the diagnosis of this condition is the coronary angiography (CAG).[1,3,6] Although the CAG is not as sensible as intra-coronary ultrasound (IVUS) or as optical coherence tomography (OCT) [9], it remains the main tool used for the evaluation of SCAD. To help improve the diagnosis of SCAD, Saw et al. proposed a CAG classification and a diagnosis algorithm[20].

There are no guidelines for the management of SCAD, the treatments are largely based on expert's opinion[1,3,4,6]. Several studies have found a better outcome thanks to a conservative treatment on patients without on-going ischemia or hemodynamic instability[21,22].

Some conditions associated with SCAD as pregnancy, fibromuscular dyplasia (FMD), connective tissue disorder (Marfan, Elder-dahnlos, Loeys-Dietz), or systemic inflammatory disease as systemic lupus erythematous[23–28] have been reported. Triggers have also often been reported, such as vomiting, coughing, intense exercise and cocaine abuse or dobutamine stress echocardiography [29–33].

FMD in particular seems to have a strong link with SCAD. Lately, Prasad et al. studied 115 cases of confirmed SCAD, searching for exctracoronary vascular abnormalities, which they found in 66% of the patients. The FMD was the most frequent, with a rate of 45%[34].

Eleid et al. showed an anatomical risk factor for SCAD by putting forward large prevalence of coronary artery tortuosity in patients having experienced SCAD than in normal population (78% vs 17%). Moreover, they found a correlation between the degree of tortuosity and the risk of recurrent SCAD[35].

Recently Chou et al. published a cases serie of 9 SCAD misdiagnose as Takotsubo syndrome. Both pathologies have the same presentation and are way more frequent in women population. Through this article, they highlight the fact that angiographer should

become more aware of the diffent angiographic SCAD presentation (→ pas clair), and also that SCAD must be part of the differential diagnosis when it comes to ACS in young people[36].

In this study, we report twelve cases of identified SCAD, which were observed between 2012 and 2014 in the French-speaking part of Switzerland. This is a monocentric study, covering about one million people. The first objective is to see if the general repartition and presentation matches the ones described in the current literature.

Methodology

The protocol of our study was validated by the Swiss ethical commission. We used the keywords "Coronary spontaneous dissection" and "Acute coronary syndrome" to identify in the Centre Universitaire Hospitalier Vaudois (CHUV) CAG's database all patients suspicious of SCAD. We found 19 patients between 2012 and 2014. Then, two experts read all the medical records available for the selected patients, including the CAG images, and dismissed 7 of them. We ended with 12 confirmed SCAD cases.
We looked through the medical records for the needed data, and in the meantime we emailed the 12 patients in order to obtain their consent to contact their general practitioner (GP) and/or cardiologist. We obtained 10 consents, 2 of the 12 candidate didn't responded. Once the consents were obtained, we contacted the patient's GP/cardiologist to have some more information about the follow up since SCAD.
We noticed that 7 patients had a cardiac MRI from three weeks to 4 month after the SCAD. To examine closely the area touched by the necrosis process, we asked a radiologist from the CHUV to have a look at the images and to measure the fibrosis process. The expert excluded 1 out 7 patients, because of the images' bad quality.
We also wanted to test the tortuosity of the coronary arteries as defined in the studie of Eleid et al. which was:

- severe tortuosity ≥ 2 consecutives curves of >180° in a coronary artery of more than 2mm diameter
- tortuosity ≥ 3 consecutives curves between 90° and 180° in a coronary artery of more than 2mm diameter

- mild tortuosity ≥ 3 consecutive curves between 45° and 90° in a coronary artery of more than 2mm diameter or ≥ 3 consecutive curves between 90° and 180° in a coronary artery of less than 2mm diameter.

We looked at the 3 mains coronary arteries of each patient in order to score the tortuosity. We gave 3 points to severe tortuosity, 2 points to tortuosity, 1 point to mild tortuosity and 0 point to no tortuosity. We summed the points for each main artery, ranging them from 0 to 9.[35]

Results

11 out 12 patients were female (91.7%). The mean body mass index (BMI) was 24.9 ± 4.3. 4 out 11 (36.4%) women were postmenopausal, and only 1 who, strictly speaking, was in peripartum period. 7 out 12 (58.4%) patients had 1 or more cardiovascular risk factors (CVRF), including AHT, cigarette's smoking, familial history of cardiovascular events. None of them have had a SCAD before. Amongst the 12 patients, 4 were transferred to a peripheral hospital to pursue their stay, while the 8 remaining returned home. The average hospital stay was 6.6 ± 3.7 days for the 8 patients who finally went back home. 6 patients had a cardiac MRI to evaluate the sequellae fibrosis on the myocardium. The percentage of fibrosis of the myocardium's total volume was 13.5 ± 7.6%.

Presentation of the sample

Number of patients	12
Mean age ± SD	49.6 ± 12.8
Female gender	11 (91.7%)
Mean BMI ± SD	24.9 ± 4.2
Mean lengh of hospital stay ± SD	6.6 ± 3.7
≥ 1 CVRF (%)	7 (58.4%)
Smoker	5 (41.7%)
Current	2 (16.7%)
Past	3 (25%)
AHT	5 (41.7%)
Dyslipidemia	4 (30.4%)
Overweight (BMI 25.9 – 29)	4 (30.4%)
Obesity (BMI ≥ 30)	1 (8.4%

History of CV events	5 (41.7%)
Familial history of CV events	5 (41.7%)

Cases reports

HN was a 42 years old woman without any CVRF who presented an acute chest syndrome (ACS) after coughing. The electrocardiogram (ECG) showed a STEMI, which lead to the introduction of anticoagulation and double antiplatelet therapy as well as further examinations. On the CAG a probable spontaneous dissection left anterior descending coronary artery (LAD) was found. To better characterise the lesion, a cardiac computerized tomography (CCT) and a cardiac MRI were performed, which confirmed the diagnosis, and showed a apical akinesis without any ventricular thrombosis. The absence of thrombosis is the reason why the anticoagulation was stopped. At this point, some more exams were proposed to the patient in order to identify a potential underlying condition. An immune screening was performed, which did not show any particularity. An ultrasound of the kidney's arteries was performed, which showed no signs of fibromuscular dysplasia (FMD). The patient was then sent back home with a double antipaletet therapy (acetylsalicylique acid, tricagrelorum), a beta blocker (metoprolol) and a ACE inhibitor (Enalapril).

MCC was a 67 years old woman known for extra systoles, treated hypertension (by a ACE inhibitor), untreated dyslipemia, and positive familial anamnesis about cardiovascular events. She experienced an ACS without obvious trigger, which woke her up during the night. The ACS lasted for 5 hours before resolving spontaneously. When she arrived at the ER, she was painless, but the ECG showed a ST-elevation in V2, which motivated the administration to give her double antiplatelet therapy and anticoagulation. The CAG revealed a SCAD from the mid LAD to the distal tip of this one (of this one what?) with a TIMI-3 flow. No therapeutically gestures were done during the CAG. A cardio CT was then executed, and it confirmed the diagnosis. A cardiac ultrasound was performed in order to look for an akinetic abnormality, which was not found. A conservative treatment was introduced including asetylsalicylique acid and tricagrelorum. A CAG control was planned 3 month later, on which the lesion of the LAD

had disappeared, showing the recovery of the SCAD under conservative management. Further angiological examinations were performed and no signs of FMD or connective diseases were found.

RC was a 50 years old woman, known for cigarette smoking but who had stopped 20 years ago, and no other CVRF. She experimented an ACS without any obvious trigger. The clinical presentation and the ECG were in favour of a NSTEMI, reason why she was initially treated with anticoagulation and double anti palette therapy. She then underwent a CAG, which showed a SCAD of the circumflex artery's first branch without intimal flap, speaking for a intra mural hematoma. No therapeutically gestures were done during the CAG. The anticoagulation was stopped, with the intention of not increasing the hematoma. The next day a cardiac ultrasound was performed, showing an infero-lateralis hypokinesia with a left ventricular ejection fraction slightly decreased and also a mitral insufficiency graded 2/4. A conservative management was proposed, with a 3 month double antipaletet therapy and a CAG control after that. Further examination did not show any signs of FMD.

KC was a 52 years old woman known for having had a stenting of the LAD 9 years before. She presented sudden ACS while walking (moderate effort). When she arrived at the CHUV, there were no modifications on the ECG and the laboratory only showed slightly elevated troponin. Considering these facts, a CAG was planned for the next day. The CAG revealed a big dissection of the right coronary artery with a low blood flow, which requires the implantation of 3 stents. After the intervention, the blood flow was good (TIMI-3), but despite this fact the patient still complained about chest pain, partially relived by the morphine. Shortly after the CAG, the patient experimented a cardiorespiratory arrest with ventricular fibrillation. Once she was stabilized, the CAG showed an extension of the right coronary artery dissection, which needed the implantation of a new stent. From that moment on, the recovery was good and a cardiac ultrasound found a left ventricular ejection fraction slightly under the standards, with an inferior akinesia. Beta blocker and ACE were progressively introduced, as well as appointments to the GP in order to adapt the posology. Also, lifetime acetylsalicylic acid and statine were planned, with one year ticagrelorum (because of the active stents). For insurance purpose, no further examinations were performed but an etiological evaluation was recommended including kidney's arteries ultrasound and immune evaluation.

BRS was a 43 years old woman known for a familial history of CV events, but no other CVRF. She described various episode of chest pain (each of them lasting for about 10 to 20 minutes), with irradiation in both arms. It began 24 hours before she arrived at the CHUV. She was unable to identify a specific trigger, but she was coughing for several days before the chest pain. The ECG showed a ST-elevation in II, III et aVF and the laboratory found an elevation of troponin and CK. The CAG revealed a SCAD of the right coronary artery with a low blood flow (TIMI-1), without any signs of coronaropathy. The ventriculographia showed a preserved function, with an inferior hypokinesia. A conservative management was introduced with double antiplatelet therapy. Two days after the CAG, the patient underwent a cardiac ultrasound, which appeared to be normal. Further examinations showed no signs of FMD, and no signs of connective tissue disorders.

AF was a 43 years old woman known for active cigarette smoking but no others CVRF, which experimented an ACS while doing a low intensity exercise (flat walking). The ECG showed ST- segment elevation in the inferior territory, and ST- segment lowering in V1 to V3, typical of a STEMI, reason why she received a double antiplatelet therapy and anti-coagulation. The CAG showed a spontaneous dissection of the proximal part of the 2nd left marginal branch of the circumflex artery. The blood flow was TIMI-3, justifying the continuation of the conservative treatment without any therapeutic gesture during the procedure. A cardiac CT was performed 24 hours later, to ensure that the dissection had not expanded. An etiological evaluation was made and did not show any signs of FMD or connective tissue disorders. The patient went home with a double antiplatelet therapy and an ACE.

SE was a 41 years old woman, without any CVRF apart from obesity (BMI = 35), who experienced ACS in the middle of the night. She reported that she had experienced the same kind of pain a week before, while she was also lying in her bed, which lasted less than 20 minutes. The cardiac exams (ECG + laboratory) spoke in favour of a STEMI, reason why she received a double antiplatelet therapy, anti-coagulation, nitrovasodilator and intraveinous morphine. The CAG found a dissection of the LAD without any signs of coronaropathy, but with an hypokinesis of the apex. She left the hospital with a double anti-paletet therapy, an anticoagulation, a beta blocker, and an ACE.

MG was a 35 years old woman in the peripartum period. She had developed an arterial hypertension lately during pregnancy, and also gestational diabetes. She was known for smoking cigarettes, and no other CVRF. Eight days after the delivery she experienced ACS. The ECG confirmed a STEMI, and a cardiac ultrasound showed a good ventricular function. She received a double antiplatelet therapy and anti-coagulation. The CAG found a dissection from the proximal part of the LAD to the first diagonal branch. Proximally the dissection was C type, and the flow was TIMI-3. However, the stenosis distally was severe and reached 90% of the reference diameter. A conservative management was decided: the anti-coagulation was stopped in order to continue with antiplatelet therapy, beta blocker and ACE. A week later, another CAG was performed to see the evolution of the SCAD. It showed a great amelioration of the lesions, with only a discreet line of dissection in the first diagonal artery. Three months later, a CAG control was made, which found no signs of SCAD, showing a spontaneous healing under conservative management. The only residual visible sign on the CAG was a slightly under the standard left ventricular ejection volume.

SS was a 58 years old woman known for a family history of CV events, hypertension, and active cigarette smoking. She presented an inferior STEMI without any trigger. The CAG showed a dissection of the distal part of the circumflex, with a 90-99% stenosis (reference diameter = 1mm). The decision of a conservative management was made, and a double anti-paletet therapy plus a temporary anticoagulation (48h) were initiated. She left the hospital with her usual treatment, which consisted of ACE, statine, and beta blocker, plus the double anti-paletet therapy. Because the patient did not live in Switzerland, no follow up exams were planned.

BO was a 33 years old male, without any demonstrated CVRF. He was sleeping when he experienced violent chest pain, with irradiation in both arms associated with dyspnoea and palpitations. It is interesting to notice that he reported vomiting because of an abuse of alcohol. The examinations speak for a STEMI, reason why he received double anti-paletet thepary, anticoagulation, but also nitrovasodilator, and morphine (which only partially relived the pain). The CAG found a dissection of the LAD from the proximal part to the distal part with a dissection flap. The blood flow was TIMI-3 in the proximal and medium part, but in the really distal part of the AIV, it was TIMI-0 (notice that the reference's diameter there was < 2mm). Considering the good blood flow and the absence of clinical signs for a residual ischemia, no therapeutic gesture was done

and a conservative treatment was introduced. A few days after the event, the patient complained about chest pain, which was linked to respiratory movements. It was associated with a small pericardial effusion. The diagnosis of a post infarcts pericarditis was made. After that, a cardiac angio-CT and ultrasound showed a localized dissection, without aortic extension, and a slightly reduced left ventricular ejection fraction. Further investigations were conducted, which showed no signs of FMD or connective tissue disorders. A CAG was performed three months later, showing no signs of CAD, with a TIMI-3 blood flow in the totality of the LAD.

JB was a 76 years old woman known for a treated arterial hypertension, a treated hypercholesterolemia and an obstructive sleep apnoea syndrome. She presented ACS while doing exercise. The ECG and the laboratory did not show any abnormalities but due to the typical pain she was treated by simple antiplatelet therapy, and anticoagulation. A CAG was also programmed for a week later. The CAG showed a dissection of the distal part of the AIV, with a TIMI – 3 blood flow, and a non significative stenosis (less than 50%). She was went under conservative management.

Results' summary

SCAD localisation	
Left anterior descending	7
Left circumflex	4
Right coronary artery	1
Multivessels	0
Clinical presentation	
STEMI	8
NSTEMI	3
Isolated ACP	1
Mean troponin elevation (at the arrival) ±SD	294.9 ± 574.4
Mean CK peak ± SD	1561.4 ± 2289.4

Mean tortuosity score	2.7 ± 1.7
Mean myocardial fibrosis masse (in percent of total myocardial volume) ± SD	13.5 ± 7.6

Patients	**Culprit Vessel(s)**	**Present.**	**ECG Mod.**	**Troponin Elevation**	**CK Peak**	**Initial treatment**
1	Mid Left anterior descending	STEMI	-	1384	803	Conservative
2	Mid Left anterior descending	NSTEMI	Elevation ST –segment in V2	285	259	Conservative
3	1st marginal of circumflex artery	NSTEMI	Depressed ST – segment in V2 to V4	309	364	Conservative
4	Proximal to mid Left anterior descending	NSTEMI	No mod.	11	8018	PCI 3 stents
5	Right coronary artery	STEMI	Elevation ST – Segment in II, III, aVF	295	625	Conservative
6	2nd marginal of circumflex atery	STEMI	Elevation ST – segment in inferior derivation and Depressed ST	107	763	Conservative

			– semgents in V1 to V3			
7	Distal left anterior descending	STEMI	Elevation ST – segment in V2 to V3	199	774	Conservative
8	Proximal left anterior descending + 1st diagonal branch	STEMI	Elevation ST – segment in aVL and I + LBBB	79	1836	Conservative
9	Distal circumflex artery	STEMI	Elevation ST – segment in inferiors derivations	< 0.03	935	Conservative
10	Distal circumflex artery	STEMI	Elevation ST – segment in infero – lateralis derivations	2.89	333	Conservative
11	Proximal left anterior descending	STEMI	Elevation ST – segment in V2 + Negative T wave in III	1667	3981	Conservative
12	Left anterior descending	ACP	No mod.	8	46	Conservative

Discussion

Generally, the results we obtained match the ones found in the literature. We got 91% of women suffering from SCAD, which is close to the 80 – 90% described in the studies involving a large number of patients. The average age of 49 years old is also close to the ages described in larger cases series. The same goes for the length of the hospital stay.

Seven out of 12 patients underwent a MRI between 2 weeks and 3 month after the SCAD, in order to measure the sequalea. The average of 13.5 ± 7.6 % of the myocardial mass turned out to be fibrotic. In our study, half of the patients underwent a kidney sonography for FMD screening, but none of them was positively diagnosed. In the study of Presade et al, a strong link between SCAD and extracoronary vascular abnormalities was made, in particular with FMD, but they used advanced screening methods like computed tomography angiography of the head, neck, chest, abdomen and pelvis. [34] The difference of technique could partially explain the difference in the prevalence of FMD in our population.

In the case of the control study by Eleid et al., a link between coronary artery tortuosity and SCAD was put forward. They found an average tortuosity score of 4.41 ± 1.73 amongst patients having experienced SCAD, and 2.33 ± 1.49 amongst healthy controls. They also correlate the tortuosity score with the risk of recurrent SCAD. In our study, the average score is 2.7 ± 1.7, which is close to the one found in the control group. With an average follow up of 2 years, none of our 10 cases experimented another SCAD episode.

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