

Spontaneous coronary artery dissection cohort study: A nationwide Tunisian series

Dissection spontanée des artères coronaires : Série nationale tunisienne

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ABSTRACT

Introduction: Spontaneous coronary artery dissection (SCAD) has emerged as an important cause of acute coronary syndrome (ACS) but remains insufficiently characterized. This study aimed to evaluate early and long-term outcomes of patients with SCAD.

Methods: A national wide, 25-year (since 2000), study with prospective (since 2017) inclusions of patients presenting for ACS with documented SCAD. Primary endpoint was in-hospital and long term major adverse cardiac and cerebrovascular events (MACCE).

Results: 87 patients. Mean age 47.5±11 years, 71% female, 84% had no or only one conventional cardiovascular risk factor. Pregnancy-associated (P-SCAD) accounted for 9%. ST-segment elevation myocardial infarction and cardiogenic shock were described in 51% and 7%. 101 SCAD lesions (60% type 1, 37% type 2 and 3% type 3) were noted. Left anterior descending was the most affected vessel (72%), multivessel involvement was observed in 26% and severe tortuosities were reported in 38%. Conservative strategy was possible in 84% of patients; among them 15% required subsequent urgent clinically driven revascularization. Coronary angiography and percutaneous interventions were associated with five major complications of which one was fatal. Six in-hospital deaths were reported (7%), 4 of them were P-SCAD. After 16-month median follow-up, overall major events and mortality rates were 17% and 9% respectively. Two SCAD recurrences were reported.

Conclusions: SCAD affected a middle-aged, predominantly female population, with no or few conventional risk factors. In-hospital mortality was high especially in P-SCAD. Coronary angiography and interventions for SCAD were associated with frequent complications, and a conservative management should be preferred when possible.

Key word: Spontaneous coronary artery dissection; Acute coronary syndrome; Pregnancy; Outcome

RÉSUMÉ

Introduction: La dissection spontanée de l'artère coronaire (DSAC) reste insuffisamment caractérisée. Cette étude visait à évaluer l'évolution précoce et à long terme des patients avec DSAC.

Méthodes: Étude nationale menée sur 25 ans (depuis 2000), avec inclusions prospectives (depuis 2017) de patients avec DSAC documentée. Le critère de jugement principal était les événements indésirables cardiaques et cérébrovasculaires majeurs intrahospitaliers et à long terme.

Résultats: 87 patients. Âge moyen 47,5±11 ans, 71% de femmes, 84% ne présentaient aucun ou un seul facteur de risque cardiovasculaire conventionnel. L'association à une grossesse (DSAC-P) représentait 9%. Un infarctus du myocarde avec sus-décalage de ST et un choc cardiogénique ont été décrits respectivement chez 51% et 7% des patients. 101 lésions de DSAC (60% de type 1, 37% de type 2 et 3% de type 3) ont été observées. Une stratégie conservatrice était possible chez 84% des patients dont 15% ont nécessité une revascularisation ultérieure urgente. Une stratégie invasive a été associée à cinq complications majeures, dont une fatale. Six décès hospitaliers ont été rapportés (7%), dont quatre DSAC-P. À 16 mois, les taux d'événements majeurs et de mortalité étaient respectivement de 17% et 9%. Deux récurrences de DSAC ont été rapportées.

Conclusions: La DSAC a affecté une population d'âge moyen, majoritairement féminine, présentant peu ou pas de facteurs de risque conventionnels. La mortalité hospitalière était élevée, en particulier dans la DSAC-P. Une stratégie invasive était associée à des complications fréquentes et une prise en charge conservatrice devrait être privilégiée lorsque cela est possible.

Mots clés : Dissection spontanée de l'artère coronaire ; Syndrome coronarien aigu ; Grossesse ; Pronostic

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INTRODUCTION

SCAD is a potentially fatal and increasingly recognized cause of acute coronary syndromes (ACS). Natural history is widely unpredictable varying from spontaneous healing to life-threatening complications associated to dissection extension or recurrence. Consensus documents of societies from European Society of Cardiology and American Heart Association [1,2], based primarily on a review of national registries [3–14], summarized the state-of-the-art owing to associated conditions, precipitating factors, diagnosis tools, acute therapeutic and long-term management strategies. Given the many outstanding questions and lack of randomized data, this national multicenter study with aimed these objectives: a) analysing the epidemiological, clinical and angiographic profile of SCAD patients, b) identifying the determinants of acute management strategies, c) and evaluating the short and long-term prognosis of these patients.

METHODS

Study design

This was a multicenter observational descriptive study made of cohort of patients who presented for ACS with the final diagnosis of SCAD. It was conducted at a national level. The investigated period extended from January 2000 to Mai 2024. Prospective recruitment was planned since January 2017.

Study population

Inclusion criteria: Only dissections with documented ACS as revealing event have been considered. The consensual definition used was that of dissection of one or more epicardial coronary arteries that is not associated with atherosclerosis, trauma, aortic dissection, or iatrogenic intervention [1,2]. All coronary angiographies (CAG) were reviewed, and core lab confirmation of SCAD was mandatory to inclusion. Two senior interventional cardiologists' concordant categorization as SCAD was required with major aim of eliminating atherosclerotic dissections.

Exclusion criteria: Cases of traumatic or iatrogenic coronary dissections have been conceptually not included. Were also excluded patients with any suspected atherosclerotic plaque at the level of the index lesion or the rest of the coronary network (37 cases among screened CAG) and those without available follow-up (3 patients with no available follow-up).

Definitions

Angiographic criteria for diagnosis and classification of SCAD lesions: After careful review of CAGs, patients meeting angiographic criteria established by Saw et al. [15] were selected. Typical pattern was "the dual lumen and/or radiolucent flap often associated with

contrast hold-up" pathognomonic aspect (type 1). In cases suggestive of type 2 (diffuse luminal narrowing or stenosis, usually >20 mm) or type 3 SCAD (mimicking atherosclerosis with a focal or tubular stenosis <20 mm, but with no atherosclerosis in the other coronary arteries), diagnosis is often challenging. This was established in front of intracoronary imaging confirmation of intramural hematoma (IMH) or for lack, on the arguments of spontaneous healing after conservative management, particularly when the clinical probability (based on associated conditions) was high [1,2].

Severe coronary tortuosity: was defined by three or more consecutive curvatures between 90 and 180° or two or more consecutive curvatures greater than 180° at a major epicardial artery dissection site [16].

SCAD extension: was defined as the expansion of the IMH of the unhealed lesion of SCAD occurring at the acute phase of the index event [1].

SCAD recurrence: was defined as de novo dissection unrelated to the index dissection, affecting different coronary segments and occurring usually remotely (beyond 30 days) from the index event [1,17].

Pregnancy associated SCAD (P-SCAD): P-SCAD have no universal definition. Most cases occur during the third trimester or in the early post-partum period. Early in the pregnancy and very late cases (up to several months after delivery in women who are still breastfeeding) are possible [1,2].

Data collection

We carried out an exhaustive search in cardiac catheterization laboratories archives of public cardiology departments which accepted to participate to the study. For the private sector, we solicited all interventional cardiologists by phone call and mailing. We picked up patients' medical records and contacted them for consent and follow-up.

Study endpoints

The primary endpoints were in-hospital and long term major adverse cardiac and cerebrovascular events (MACCE): a composite of all-cause death, myocardial infarction, stroke and target lesion revascularization. Secondary endpoints were evaluation of natural history and subsequent unplanned need for revascularization after conservative treatment [18]. Recurrence of SCAD was also investigated.

Statistical analysis

Individual patient data were pooled and analysed. Baseline characteristics were reported as percentage, mean $\pm$ standard deviation, or median (interquartile range).

RESULTS

Clinical and angiographic characteristics

Eighty-seven patients were included. Baseline characteristics were summarized in table 1. In this study, female predominance (71%) was observed with a mean age of 47.5 ± 11 years and extremes ranging from 22 to 74 years old. Seventy-one percent of patients had no or less than one conventional risk factor for atherosclerosis. Investigation of associated conditions revealed that 9% ($n=8$) of cases had P-SCAD. Other reported associations and precipitating factors were outlined in table 1. Of note, no screening of fibromuscular dysplasia (FMD) was performed in this study. SCAD presentation was as follows: ST elevation myocardial infarction (STEMI) ($n=44$, 51%) and non-ST elevation myocardial infarction (NSTEMI) ($n=43$, 49%). Among STEMI patients, 24 cases were evolving and 20 were late presentations. Five NSTEMI patients were at very high ischemic risk due to ventricular tachycardia (2 cases), and recurrent angina despite medical treatment (3 cases), transient segment ST elevation was noted in 5 cases. Cardiogenic shock was noted at initial presentation or complicated subsequent evolution in six patients (7%). Mean left ventricular ejection fraction was $49 \pm 12\%$.

Among the 87 enrolled patients, 101 SCAD lesions were identified. Majority (60%) of SCAD lesions were type 1 while type 2 and type 3 were pointed out in 37% and 3%, respectively. Along the study period, type 2 pattern was increasingly recognized reaching 67% of cases in the last quintile. Left descending coronary artery (LAD) and / or its diagonal branches were the predilection site of SCAD (72%), followed by left circumflex coronary artery (LCX) and / or its marginal branches (32%) and right coronary artery (RCA) (20%). Left main coronary artery (LMCA) involvement was observed in 15% of patients (Figure 1). SCAD lesions were often long (≥ 20 mm in 89% of cases). Severe tortuosity was noticed in 37% of cases. It is of note that one SCAD case was associated with a myocardial bridge and another with a coronary cameral fistula (Table 1).

Management strategies and outcomes

Management strategies are summarised in figure 2.

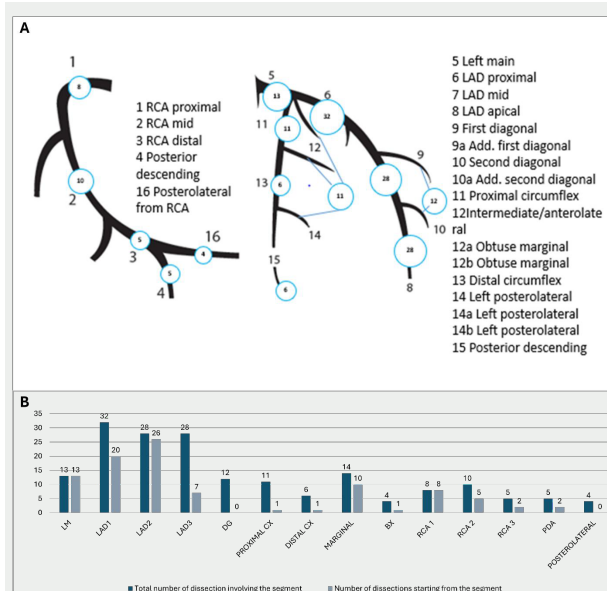
Of 24 patients with evolving STEMI, six patients received fibrinolysis therapy with clinical and electrical success in four of them. After angiographic investigation, initial management included conservative treatment in 73 patients (84%), percutaneous coronary intervention (PCI) in twelve (14%) patients and coronary artery bypass (CABG) in two patient (2%).

Table 1. Baseline characteristics, management strategies and outcomes.

	87 patients / 101 lesions / 122 arteries
Age	47.5 ± 11
Females	62 (71%)
Cardiovascular risk factors	
• Diabetes	9 (10%)
• Smoking	20 (23%)
• Hypertension	16 (18%)
• Dyslipidemia	10 (11%)
• Family history of coronary artery disease	6 (7%)
• No risk factors	44 (51%)
History of Cardiovascular disease	4 (5%)
Precipitating factors and associated conditions	
• Depression	10 (11%)
• Hypothyroidism	4 (5%)
• Emotional stress	24 (28%)
• Intense physical activity	6 (7%)
• Drugs use	3 (3%)
• Fibrodysplasia	0%
• Systemic inflammatory disease	3 (3%)
• Migraine	6 (7%)
• Hormonal therapy	6 (7%)
• P-SCAD	8 (9%)
Presentation	
• STEMI	44 (51%)
• NSTEMI	43 (49%)
• Hemodynamic instability at admission	2 (2%)
• Ventricular arrhythmia at admission	2 (2%)
Echocardiographic data	
• Left ventricular ejection fraction	$49 \pm 12\%$
• Left ventricular thrombus	3 (3%)
• Mechanical complication (Acute mitral regurgitation)	1 (1%)
Angiographic data	101 lesions / 122 involved arteries
• One vessel disease	64/87 (74%)
• Two vessel disease	18/87 (21%)
• Three vessel disease	4 /87 (5%)
• LMCA	13/122 (14%)
• LAD/Dg	65/122 (72%)
• LCx/Mg	27/122 (22%)
• RCA/PDA/PLA	17/122 (14%)
• Bifurcation involvement	40/101 (40%)
• Type 1	61/101 (60%)
• Type 2a	20/101 (20%)
• Type 2b	17/101 (17%)
• Type 3	3/101 (3%)
• Coronary tortuosity	38/101 (38%)
• Myocardial bridge	1/101 (1%)
• Coronary cameral fistula	1/101 (1%)
Intracoronary imaging	
• IVUS	4 (5%)
• OCT	0
Computed coronary tomography angiography	6 (7%)

Table 1. Baseline characteristics, management strategies and outcomes.

	87 patients / 101 lesions / 122 arteries
Pharmacologic therapy	
• Aspirin	85 (98%)
• Clopidogrel	85 (98%)
• Ticagrelor	0
• Prasugrel	0
• Dual antiplatelet therapy	84 (97%)
• Low molecular weight heparin	55 (63%)
• Unfractionated heparin	31 (36%)
• Thrombolysis	6 (7%)
• Beta-Blockers	74 (85%)
• Angiotensin-converting enzyme inhibitor / Angiotensin receptor blocker	66 (76%)
• Mineralocorticoid receptor antagonist	16 (18%)
• Statins	81 (93%)
Conservative strategy	
	72 (83%)
Urgent myocardial revascularization	
	14 (16%)
• Percutaneous coronary intervention	12 (14%)
• Coronary artery bypass grafting	2 (2%)
Circulatory support	
	3 (3%)
• ECMO	1 (1%)
• Intra-aortic balloon pump	2 (2%)
Median hospitalisation duration	
	6 days
In-hospital death	
	6 (7%)
In-hospital MACCE	
	9 (8%)
Median follow-up duration	
	16.5 months
Angiographic control after conservative strategy	
	44 (57%)
• Healing	23 (52%)
• Persistence	17 (39%)
• Extension	4 (9%)
Secondary revascularisation after conservative strategy	
• Percutaneous coronary intervention	11 (14%)
• Coronary artery bypass grafting	2 (3%)
Recurrent SCAD	
	2 (3%)
Overall long-term MACCE	
	17%

**Figure 1.** Coronary artery segments involved in spontaneous coronary artery dissection.

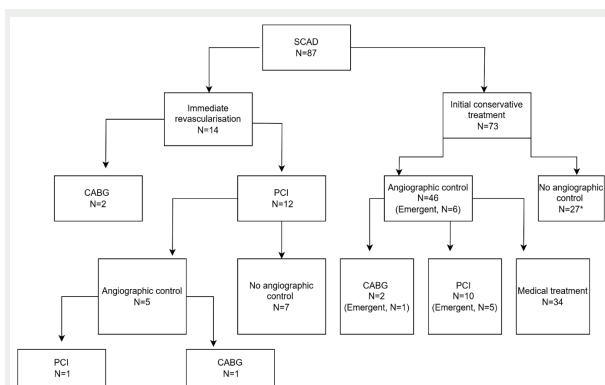
Panel A: Schematic distribution of involved segments according to SYNTAX segmentation. **Panel B:** Involved segments and originating segments of spontaneous dissection coronary lesions. (N=179 dissected segments within 101 lesions defined by their starting segments, in 87 patients). LAD: left descending coronary artery, LCX: left circumflex coronary artery, LMCA: left main coronary artery, PL: posterolateral coronary artery, RCA: right coronary artery.

Overall, immediate revascularizations were required in 14 cases:

- Eight patients with evolving STEMI with cardiogenic shock in five of them.
- Two patients with refractory acute heart failure in the setting of NSTEMI and late-STEMI presentations.
- One patient with refractory angina in the setting of an NSTEMI with a TIMI 2 blood flow.
- One patient with a high anatomical risk driven by three-vessel proximal dissections.
- Two patients with no clinical or anatomical high-risk features were revascularized at the operator's discretion.

After conservative strategy (n=73), six patients (7%) needed subsequent urgent clinically driven revascularization (four due to recurrent ischemic symptoms and two to refractory cardiogenic shock). In this group, a total of 46 angiographic controls (42 CAG, 4 CT-coronary angiography) were performed at a median delay of 36 days, IQR [10–96]. Spontaneous healing, persistence, or extension of dissection were reported in 52%, 39% and 9%, respectively (Figure 2). It should be noted that among the 30 patients systematically controlled later than 30 days of the index event, 77% showed complete healing.

CAG and PCI have been associated with five complications commonly observed in the setting of SCAD. The first was relevant to additional iatrogenic LMCA dissection in a patient presenting for isolated mid-LAD dissection with fatal outcome. The second was attributed to occlusive hematoma extension to LCX ostium after LMCA to LAD dissection stenting with favourable outcome after LCX "bail-out" stenting according to "T and Protrusion" technique (Figure 3). The third complication was in relation with stent malapposition due to vessel

**Figure 2.** Flowchart of initial and subsequent management strategies regarding myocardial revascularisation among patients with spontaneous coronary artery dissections, (N=87 patients).

*Cause of no control: refusal by nine patients, non-viable myocardium in eight patients, distal lesion and/or small reference diameter in seven patients, sudden death before follow-up in one patient, focal non-significant lesion in one patient, excessive frailty (dementia) in one patient. SCAD: Spontaneous coronary artery dissection; PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass graft.

enlargement secondary arterial wall disruption, persistent on late angiographic and intravascular ultrasound controls (Figure 4). The fourth complication was in relation with an extensive LMCA to LAD dissection primarily managed by entry tear stenting at the level of LMCA ostium only with secondary recurrent angina

due to distal dissection worsening. Distal stenting was complicated by stent dislodgment successfully snared with further full dissection coverage by two overlapping long DES. The fifth complication consisted in hematoma distal extension after RCA dissection lesion stenting.

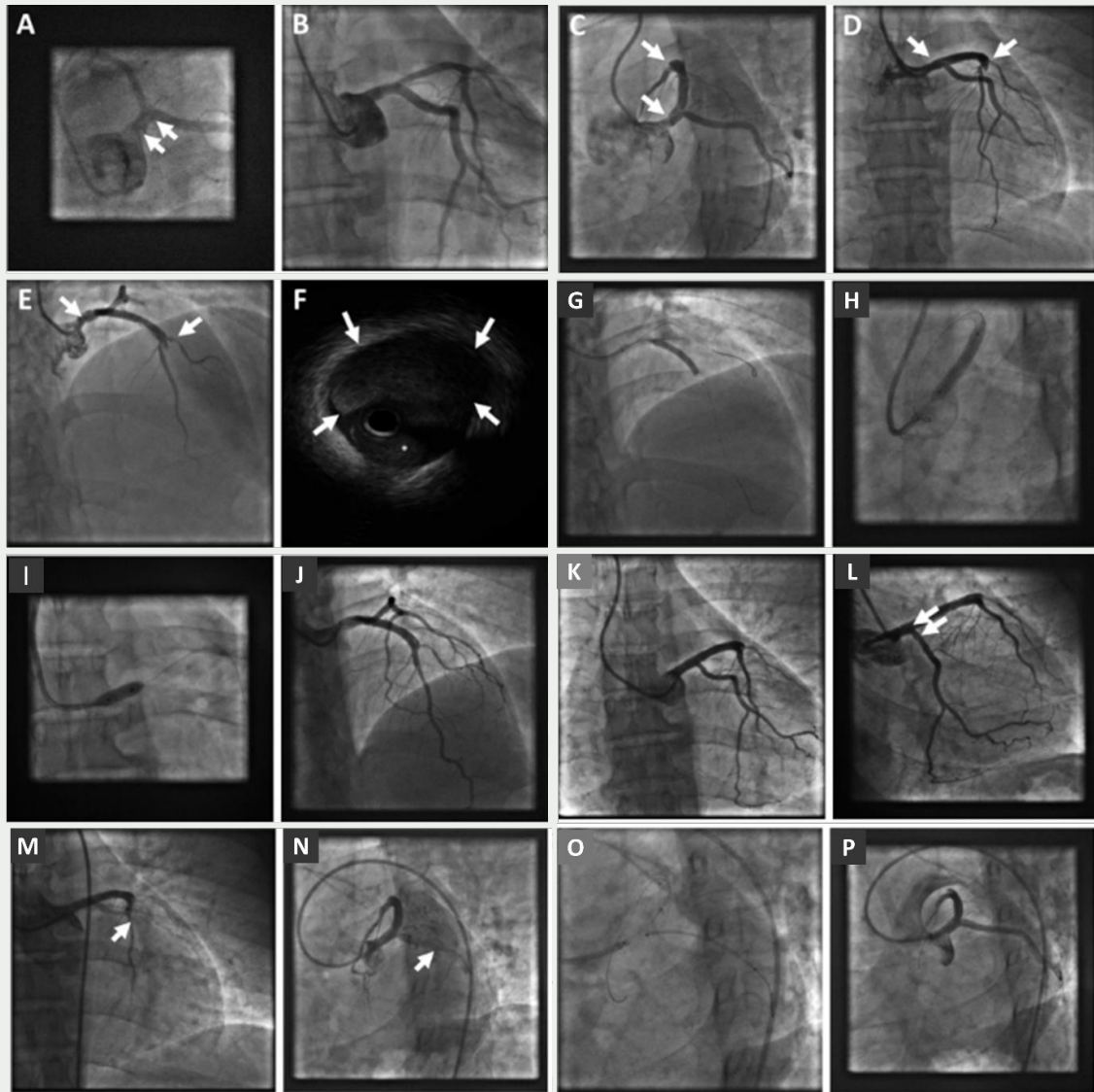


Figure 3. Side branch occlusion after main branch stenting in the setting of spontaneous coronary artery dissection.

A-B: Initial coronary angiogram showing spontaneous LMCA managed conservatively; **C-D-E:** Angiographic control 12 days later showing worsening of dissection with extension of false lumen distally to mid-LAD; **F:** Intravascular ultrasound PCI guidance, **asterisk:** true lumen, **arrows:** false lumen; **G-H-I:** Provisional stenting of LMCA to LAD with final proximal optimization technique; **J-K:** Immediate angiographic control after PCI; **L-M-N:** Progression of intramural hematoma to side branch with occlusion of LCX few minutes later; **O-P:** successful bail-out stenting of LCX (T-and-protrusion technique). **LMCA:** left main coronary artery dissection; **LAD:** left anterior descending coronary artery; **LCX:** left circumflex coronary artery. PCI: percutaneous coronary intervention.

Hemodynamic support was indicated in three patients: two by the mean of intra-aortic balloon pump including one case as bridge to surgery and one by an extracorporeal membrane oxygenation (ECMO) bridge to CABG for a cardiogenic shock in a 29-year-old patient with post-partum LMCA to LAD dissection.

During in-hospital stay, six deaths (7%) were reported mainly due to cardiogenic shock in five patients, among whom four were post-partum patients with extensive multivessel dissections and in one case, to a fatal complication of coronary catheterization: iatrogenic dissection of LMCA superimposed to mid-LAD SCAD. Of note, four out of the six in-hospital deaths were observed

in the setting of P-SCAD.

Median follow-up period was 16.5 months IQR [10–60]. Overall MACCE rate was 17% with two late cardiac deaths (2%), three myocardial infarction (3%) of which two were related to recurrent SCAD (2%) (figure 5), two target vessel revascularisations (2%), one ischemic stroke (1%). All MACCE details were summarized in table 2.

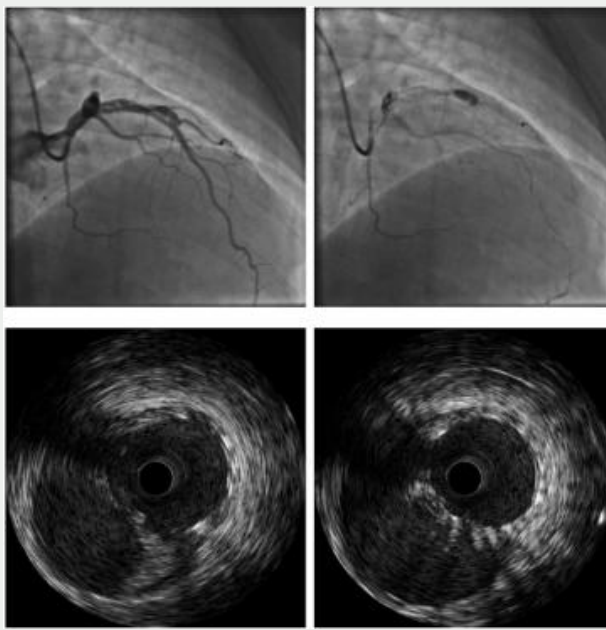


Figure 4. Intravascular ultrasound imaging showing late stent malapposition due to vessel enlargement secondary to arterial wall dissection. (Long term angiographic and IVUS follow-up of 40 years old female patient presenting with Non-ST segment elevation myocardial infarction in 12 days post-partum setting with type 1 spontaneous coronary artery dissection managed with T and Protrusion technique on the LMCA bifurcation. Long term follow up showed partially thrombosed false aneurysm of the left descending coronary artery with a late stent malapposition at this location, likely related to the resorption of an important initial intramural hematoma).

Pregnancy associated spontaneous coronary artery dissection subgroup analysis

In the setting of P-SCAD (n=8, 9%), all cases occurred in the postpartum period. Mean age was 35.6 ± 2.3 years. Two patients were multiparous and six were primiparous. Two of them were treated for infertility. Delivery was performed vaginally or by caesarean section in six and two patients respectively. In this context, five patients presented for STEMI and three for NSTEMI. Cardiogenic shock was noted in four cases. LMCA or LAD involvement were observed in five cases (63%). Multivessel dissections were noted in a majority of six cases (75%). Short-term assistance cardiac devices were used in three cases (37%) of which one was bridge to CABG. In-hospital mortality in this setting was 50% (Table 3).

Table 3. Comparison of presentation, management strategy and outcome between spontaneous coronary artery dissection in general population and in pregnancy associated dissections.

	Total N=87	P-SCAD N=8	Non P-SCAD N=79	P value
STEMI	44 (51)	5 (63)	39 (49)	0.69
Cardiogenic shock	6 (7)	4 (50)	2 (3)	<0.01
Multivessel involvement	23 (26)	6 (75)	17 (22)	<0.01
LMCA involvement	14 (16)	4 (50)	10 (13)	<0.01
Mechanical circulatory support	3 (3)	3 (37)	0	<0.01
Immediate revascularisation	14 (16)	3 (37)	11 (14)	0.069
MACCE	15 (17)	5 (60)	10 (13)	<0.01
Overall mortality	8 (9)	4 (50)	4 (5)	<0.01

MACCE: Major adverse cardiac and cerebrovascular events; P-SCAD: Pregnancy-associated spontaneous coronary artery dissection; STEMI: ST segment elevation myocardial infarction.

02/11/2021
NSTEMI



21/07/2022
CAG SYSTEMATIC
CONTROL



04/11/2024
NSTEMI

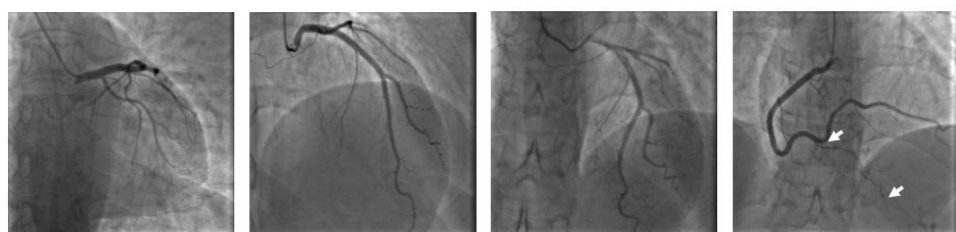


Figure 5. Spontaneous coronary artery dissection recurrence case. Type 2A spontaneous coronary artery dissection of left anterior descending artery with spontaneous healing at 2-month control, and dissection recurrence at the posterior descending artery level after 36 months follow-up in 42-year-old female patient presenting with non-ST segment elevation myocardial infarction.

Table 2. In-hospital and long term major adverse cardiac and cerebrovascular events.

Patient	Age	Gender	Condition	Presentation	Anatomical site of dissection	Initial treatment	MACCE	Timing	Details
1	55	F	-	Evolving STEMI	LMCA LAD LCX	PCI	Death	In-hospital	Cardiogenic shock
2	40	F	Post- Partum	Late STEMI	LMCA LAD LCX RCA	Conservative then CABG	Death	In-hospital	Cardiogenic shock, secondary dissection extension after conservative treatment with mechanical complication (Acute MR) refractory to IABP
2	42	F	Post- Partum	Evolving STEMI	LMCA LAD LCX	PCI	Death	In-hospital	Cardiogenic shock
4	35	F	Post- Partum	Evolving STEMI	LMCA LAD DG LCX	PCI	Death	In-hospital	Cardiogenic shock refractory to IABP
5	29	F	Post- Partum	Evolving STEMI	LMCA LAD	CABG	Death	In-hospital	Cardiogenic shock refractory to ECMO
6	27	F	Infertility	Evolving STEMI	LMCA LAD	PCI	Death	In-hospital	Cardiogenic shock iatrogenic LMCA dissection
7	47	M	Crohn's disease	NSTEMI	RCA	Conservative	Stroke	In-hospital	Ischemic stroke
8	50	F		NSTEMI	LMCA LAD	Conservative	Death	3 months	Sudden cardiac death (LVEF=30%)
9	37	F	Post-partum	NSTEMI	LAD	PCI	NSTEMI	3 months	Persistence of dissection
10	24	M	-	Late STEMI	LAD	PCI	Death	12 months	Sudden cardiac death (waiting for ICD, LVEF=30%)
11	53	F	Smoker	NSTEMI	LMCA LAD LCX	PCI then CABG	Recurrence	12 months	Recurrence of dissection after 1 year of index event
12	35	M	-	NSTEMI	LAD	PCI	TLR	12 months	In stent restenosis treated with DES
13	46	F	-	Evolving STEMI	LAD	Primary PCI	TLR	12 months	In stent restenosis treated with DES
14	42	F	-	NSTEMI	LMCA LAD LCX	Conservative	Recurrence	36 months	Recurrence of SCAD involving PDA
15	46	F	Rheumatoid Polyarthritis (prednisolone)	NSTEMI	RCA	Conservative	Stroke	60 months	Ischemic stroke

CABG – Coronary Artery Bypass Grafting; DES – Drug-Eluting Stent; DG – Diagonal Branch; ECMO: Extracorporeal membrane oxygenation; ; IABP: Intra-aortic balloon pump; LAD – Left Anterior Descending Artery; LCX – Left Circumflex Artery; LMCA – Left Main Coronary Artery; LVEF – Left Ventricular Ejection Fraction; MACCE – Major Adverse Cardiac and Cerebrovascular Events; MR – Mitral Regurgitation; NSTEMI – Non-ST-Elevation Myocardial Infarction; PCI – Percutaneous Coronary Intervention; RCA – Right Coronary Artery; SCAD – Spontaneous Coronary Artery Dissection; STEMI – ST-Elevation Myocardial Infarction; TLR: Target lesion revascularisation.

Discussion

To our knowledge, this is the first SCAD national study led in Africa and the largest on African and Middle East region levels. The major findings of this series can be summarized as follows: a) SCAD affected predominantly women and middle-aged patients; b) Majority of patients had no or less than one conventional cardiovascular risk factor; c) Nine percent of cases were related to pregnancy; d) STEMI presentations accounted for 51%; e) Cardiogenic shock was observed in 7% of cases; f) Type 1 was the most common angiographic pattern with type 2 being increasingly recognized, LAD coronary artery was the most commonly affected vessel (72%) and multivessel involvement and severe tortuosities were described in 26 and 37% of patients respectively; g) Initial conservative treatment was most often undertaken (84%) but subsequent urgent revascularization was needed in 15% during in-hospital stay highlighting the need of close monitoring when this strategy is adopted; h) CAG and

PCI were associated with technical complications often described in SCAD patients. i) In-hospital mortality was 7%; when considering P-SCAD subgroup, this rate was of 50%. ii) At 16.5-month median follow-up, overall MACCE rate was 17% with 9% mortality rate.

Comparative data from our study and previously published series were summarized in table 4. In this study, women represented 71% of patients. In published series, the clear women predominance was almost constant, and SCAD has been implicated in a high proportion of young women presenting for ACS [3–16,20]. Previously considered a pathology of young adults, SCAD affected middle-aged patients with a mean age of 47.5 ± 11 years in this cohort. This was in accordance with contemporary large series [3–5,8,14]. In 1931, Pretty reported the first case of SCAD: it was the case of sudden death of 42-year-old woman secondary to repeated vomiting [19]. Since then, several associated conditions and precipitating factors have been correlated to SCAD [1,2]. Pregnancy was one of the most investigated favouring

factor [20–26]. In recent data, P-SCAD represented around 2 to 15% of SCAD cases [3,8,27,28] and only 4.5% in the largest SCAD study to date [5]. It accounted for 9% of patients in this national series confirming that SCAD was not confined to pregnancy. Apart from pregnancy, FMD and SCAD association was supported by several data [3,6,7,17,18,20,26–30]. In this series, this issue was not investigated in front of logistical obstacles. Spectrum of SCAD clinical presentations is wide and variable in severity. In this study, it was equally distributed between STEMI and NSTEMI (51 and 49% respectively) and cardiogenic shock complicated 7% of cases. In the literature, proportion of STEMI was 26–55% compared to NSTEMI cases [3,4,6,10–12,20]. A 2 to 5% cardiogenic shock rate was reported among SCAD patients in recent series [6,10,20]. While type 1 was the most observed angiographic pattern in this study (60%), it represented only 29 to 48% in contemporary series [3,6,12,20]. This discrepancy could be attributed to misdiagnosis of types 2 and 3 of Saw et al classification [17], situations that can lead to up to 2/3 of missed diagnoses, particularly in absence of intracoronary imaging assessment [12,17]. Type 2 pattern is increasingly recognised reaching 67% of cases in the last quintile period of this series. LAD was the most common SCAD location (72%) and multivessel dissections were noted in 26% of patients, with one case presenting the three types in different arteries. LAD involvement was likewise predominant in most series [4,6,10,12,20,26] but not all [3]. Rate of multivessel involvement was greater than that reported in literature (ranging from 5 to 13%) [3,4,6,10–12,20]. In accordance with the high rate of severe coronary tortuosity associated with SCAD reported by Eleid et al. (up to 78%) [18], this feature was found in 37% of patients. Finally, an association of SCAD with myocardial bridging was described in one patient of our series; such an association was only reported once in the literature [31], and with coronary cameral fistula in one patient with no similar case found in the previous SCAD reports to the best of our knowledge.

Initial conservative management was possible in most of patients. This strategy was appropriate as recommended by scientific statements in the absence of high-risk clinical or anatomical presentations (hemodynamic instability, ongoing ischemia, LMCA and/or multiple proximal dissections) [1,2]. It should be noted that early complications related to a recurrent infarction can occur in 5 to 10% of cases [10,12,26]. Among patients treated conservatively in this series, the need for subsequent urgent revascularization was observed in 15% of cases. Therefore, close monitoring of patients during the early phase after conservative management is recommended by SCAD experts [1,2] in the absence of clinical or angiographic predictors of potential dissection worsening [11,32,33]. There is no consensus on monitoring duration and time to angiographic control in this setting.

Overall, 25% of patients underwent PCI either immediately or after conservative treatment failure. Major complications of CAG or PCI were reported. These acute complications fit into the framework of CAG or PCI pitfalls in the setting of SCAD [1,2,34,35] and a high rate

of PCI technical failure was described in the literature, reaching 53% in the Mayo Clinic Series [11]

CABG has been recommended as a SCAD treatment option in the situation of patients with LMCA or multiple proximal dissections or as a bail-out strategy after technical failure or complication of PCI [1,2]. In this study, surgical revascularization was indicated in only four patients (5%) in front of high anatomical risk, associated with hemodynamic compromise in one of them.

In-hospital mortality rates reported in large SCAD series ranged from 0 to 4.3% [4–16,20]. This rate was higher in this study reaching 7% and was mainly attributed to cardiogenic shock. In this series, all-cause and cardiac mortality were 9% at median follow-up of 16.5 months. Among in-hospital SCAD survivors, mortality rate was 5%. At nearly comparable follow-up duration, mortality among SCAD survivors in published data was relatively low, ranging from 0 to 1.2% [3,6,36]. Two SCAD recurrences were reported in this series. Variable rates of recurrent episodes have been reported in the literature, varying from 0 to 37% [6,13,16,26]. This was probably related to differences in study design, follow-up duration and recurrence definition.

Peripartum SCAD was associated with a high in-hospital mortality in this series. In this setting, STEMI was the main presentation, cardiogenic shock was frequent and LMCA and multivessel involvement were noted in most patients. All these findings were in accordance with literature where severe prognosis compared to non-peripartum SCAD patients have been highlighted in many series [5,14,20,25]. In a review of 120 cases of P-SCAD, Havakuk et al. [24] found that 76% of patients presented for STEMI and maternal complications were frequent: 24% of cardiogenic shock, 16% of ventricular fibrillation and 4% of in-hospital mortality. In the Canadian SCAD registry of 750 patients, the peripartum state emerged as the strongest independent predictor of MACCE [4,20].

Study limitations

Main limitations of this study were its retrospective inclusion between 2000 and 2017; low use of intracoronary imaging techniques partially explaining the preponderance of type 1 SCAD; non-screening for FMD, potential memory bias when interventional cardiologists were consulted directly for patients enrolment with the consequent impossibility to calculate SCAD incidence or prevalence among all CAG and among patients presenting for ACS given the large population studied over a long period of time.

Table 4. Demographics, management strategies and outcome of patients with spontaneous coronary artery dissection from contemporary series comparatively to our study cohort.

Author (year)	Patients (n)	Age	Female (%)	P-SCAD (%)	Initial CT (n, %)	Initial PCI (n, %)	Initial CABG (n, %)	Subsequent revascularization after CT (n, %)	In-hospital mortality (n, %)	Median / Mean follow-up duration (months)	Overall cardiac death (n, %)	De novo SCAD recurrences (n, %)
Vanzetto et al. (2009) [29]	23	46±9	74	0	10 (43)	8 (35)	2 (9)	0	1 (4)	16	2 (9)	0
Mortensen et al. (2009) [[28]]	21+	49±9	77	10	7 (33)	12 (59)	2 (9)	US	0	35	1 (5)	1 (5)
Tweet et al. (2012) [14]	189	44±9	92	15	94 (49.7)	82 (43.4)	15 (7.9)	9 (4.8)	1 (0.5)	28	2 (1.0)	29 (15.3)
Alfonso et al. (2012) [30]	27	52±10	85	4	US	US	US	9 (33)	US	24	US	0
Saw et al. (2014) [31]	168	52±9	92	2	134 (79.8)	31 (18.5)	3 (1.8)	3 (4.3)	0	24	1 (0.6)	22 (13.1)
Lettieri et al. (2015) [9]	134	52±11	81	US	78 (58.2)	51 (38.1)	5 (3.7)	2 (1.5)	3 (2.2)	22	4 (3.1)	6 (4.7)
McGrath-Cadell et al. (2016) [11]	40	45±10	95	8	27 (68)	12 (30)	2 (5)	1 (3)	0	16	0	3 (8)
Roura et al. (2016) [12]	34	47±12	94	15	26 (77)	8 (23)	0	0	0	4	1 (3)	1 (3)
Rashid et al. (2016) [9]	21	53±9	95	0	17 (81)	4 (19)	0	US	0	US	US	US
Rogowski et al. (2017) [32]	64	53±11	94	5	56 (87)	7 (11)	1 (2)	0	1 (2)	54	1 (2)	3 (5)
Motreff et al. (2017) [33]	55	50±10	100	4	40 (72)	14 (26)	1 (2)	US	US	US	US	US
DISCO (2018) [3,34]	373	51.5±10.3	90.6	4.4		58 (15.5)	1 (0.3)	32 (10.3)	0	12	0	6 (2.5)
Saw et al. (2019) [4]	750	52±10	89	4.5	632 (84.3)	89 (11.9)	2 (0.3)	19 (2.5)	1 (0.1)	1	1 (0.1)	1 (0.1)
Wudinger et al. (2024) [35]	156	52	74	6	100 (64)	52 (33)	6 (4%)	US	US	24	7 (5%)	11(7)
This series	87	47,5	70,9	9	73 (84)	12 (13)	2 (2)	11 (12)	6 (7)	16,5	8 (9)	2 (2.3)

CABG: Coronary artery bypass graft; CT: Conservative treatment; PCI: Percutaneous coronary intervention; P-SCAD: Pregnancy-associated spontaneous coronary artery dissection; SCAD: Spontaneous coronary artery dissection; US: Unspecified

CONCLUSIONS

SCAD affected a middle-aged, predominantly female population, with no or few conventional cardiovascular risk factors but with specific predisposing and precipitating conditions. In-hospital mortality was as high as 7% especially in peripartum related cases where it concerned 4 among 8 patients. Specific PCI complications could occur when PCI is performed in SCAD setting and conservative management should be preferred, when possible, provided close monitoring in the early phase. This ongoing Tunisian National SCAD registry will have for future directions a prospective Maghrebien, North African or African larger scale recruitment, with wider imaging guidance, standardized FMD screening, with a without randomized interventions to fill evidence gaps targeting antithrombotic agents and duration, revascularisation indications and specific strategies.

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