MYOCARDIAL INFARCTION WITH NON-OBSTRUCTIVE CORONARY ARTERIES (ABOUT 50 CASES)

Authors and affiliations:

YOUSRA OUSSOU, NOUR EL HOUDA SNOUSSI, KAWTAR MANOURI, NAWAL DOGHMI, JAMILA ZARZUR, MOHAMED CHERTI.

Department of Cardiology B, IBN SINA HOSPITAL CENTER, MOHAMMED V University, Rabat, Morocco

KEY WORDS:

Coronary syndrome, Troponin positive, MINOCA

ABSTRACT:

Myocardial infarction with non-obstructive coronary arteries (MINOCA) was first described over 80 years ago. The term has been widely and inconsistently used in clinical practice, influencing various aspects of disease classification, investigation and management. MINOCA encompasses a heterogenous group of conditions that include both atherosclerotic and non-atherosclerotic disease resulting in myocardial damage that is not due to obstructive coronary artery disease. In many ways, it is a term that describes a moment in the diagnostic pathway of the patient and is arguably not a diagnosis [1]. Central to the definition is also the distinction between myocardial infarction and injury. The universal definition of myocardial infarction distinguishes acute myocardial infarction, including those with MINOCA, from other causes of myocardial injury by the presence of clinical evidence of ischemia. However, these ischemic features are often non-specific causing diagnostic confusion, and can create difficulties for patient management and follow-up [2]. The purpose of this review is to summarize our current understanding of MINOCA and highlight important issues relating to the diagnosis, investigation and management of patients with MINOCA

INTRODUCTION:

Acute coronary syndromes (ACS) constitute a major public health problem because of their frequency, morbidity and mortality and their socioeconomic repercussions. Prevention is fundamental in the management of ACS. It requires a better knowledge of the etiopathogenesis of these ACS.

The diagnosis of MINOCA is based on two pillars: the definition criteria of the IDM according to its Fourth universal definition and the absence of angiographic evidence of "obstructive" coronary artery disease [3]:

1. Acute myocardial infarction (modified from the criteria of the "Fourth Universal Definition of IDM:

- Detection of a rise or fall in cardiac troponin at least one value greater than the upper reference limit of the 99th percentile

  AND

- Clinical evidence of the infarction (at least one of the elements):

  o Symptoms of myocardial ischemia

  o New ischemic electrocardiographic changes (ST segment, T wave, Q wave, BBG)

  o Development of pathological Q waves

  o Imaging evidence of new viable myocardial loss or new segmental kinetics abnormality

  o Identification of a coronary thrombus by angiography

2. Coronary arteries not obstructed by angiography:

- Defined as the absence of obstructive disease on angiography (i.e. no coronary artery stenosis> 50%) in any major epicardial vessel. This includes patients with:

  o normal coronary arteries (without angiographic stenosis)

  o Slight light irregularities (angiographic stenosis <30%)

  o Moderate atherosclerotic coronary lesions (strictures> 30% but <50%)

3. The absence of a specific alternative diagnosis explaining the clinical presentation

- Other diagnoses include, but are not limited to, non-ischemic causes such as infection, pulmonary embolism, aortic dissection, and myocarditis.

The 50% angiographic threshold is partly arbitrary, especially since there is significant inter- and intra-observer variability in the visual coronary angiographic assessment of the degree of stenosis. In addition, the dynamic nature of the physiopathological mechanisms of ACS may be the cause of changes over time in the angiographic appearance of a coronary lesion and its degree of stenosis, in particular due to fluctuations in vasomotor tone and the unstable nature of the guilty plaques (embolization of a plaque thrombus or removal of the platelet clot).

<u>**MATERIAL AND METHODS:**</u>

We report a descriptive retrospective study based on the analysis of the results of the medical files of patients hospitalized in the cardiology department B of the Ibn Sina CHU in rabat, with a duration of 8 years, from 2014 to 2021.

Inclusion criteria: We included patients who presented with acute coronary syndrome with or without ST segment elevation associated with a significant elevation of troponins with coronary angiography: an angiographically normal coronary network, or with coronary lesions <50%.

Exclusion criteria: We excluded from this study:

- Patients with acute coronary syndrome without troponin elevation.
- The patients havingpresent a syndrome coronary acute with pathological coronary angiography or not having benefited from coronary angiography.
- Myocarditis.
- Tako Tsubo Syndromes.

Goal of the study:

- Define the epidemiological, clinical, biological and ultrasound characteristics with a view to an etiological diagnosis of patients in the MINOCA subgroup.
- Show the contribution of MRI, intravascular ultrasound (IVUS), optical coherence tomography (OCT), as well as the value of screening for thrombophilic diseases in the diagnosis and therapy of MINOCA.
- To determine the prognosis of patients with MINOCA and the factors predicting mortality.

RESULTS:

During the period of our 8-year study, 50 had a coronary network that was found to be normal or near normal on coronary angiography. The prevalence of MINOCA was 2.99%.

The mean age of our patients was 54 ± 16 years [41; 69]. Women were affected at an older age **(Fgure1).**

The 140 patients in our series were divided into: 28 women or 56% of the patients and 22 men or 44% of the patients.

For the FRCV studied, we retain in order of decreasing frequency (**Figure2**):

Obesity: 34%

Smoking: 32%

Dyslipidemia: 28%

Arterial hypertesion: 24%

Diabetes: 22%

Familial coronary artery disease: 12%

The main medical histories found were: hypothyroidism: found at the house of of them patients who were under treatment, atrial fibrillation in 3 patients had known permanent AF and they were a low INR. Takayasu's disease in one patient was followed in internal medicine under treatment. A Behçet's disease in one patient was monitored in internal medicine with colchicine. Depression under treatment in a pregnant patient with 38 weeks of amenorrhea. No patient was known to have severe valve disease in our series.

The patient consultation time varies between 2 hours as a minimum and D5 as a maximum time with an average time of 48 hours.

The physical examination was poor. Indeed, it was unremarkable in 41 patients (82%). Among our patients, 9 were admitted with a left heart failure (18%).

17 patients with ACS with persistent ST segment elevation or 34% and 33 patients with ACS without persistent ST segment elevation (66%).

The topographic distribution of electrical abnormalities was described in 46 patients (since 4 patients had BBG), the following results were found (**Figure3**) :

Previous: 12 patients (24%)

Lower: 17 patients (34%)

Lateral: 9 patients (18%)

Circumferential: 1 patient (2%)

Deep septal: 5 patients (10%)

ST elevation in AVR: 2 patients (4%)

A spontaneous idioventricular rythm is also noted in a single patient.

Three cases of old AF were noted. Ventricular extrasystole was noted in 5 patients and only one patient presented (probably junctional) , a ventricular tachycardia was reduced by CEE and amiodarone.

Only one case of Moritz I 2nd degree AVB has been identified. He was spontaneously regressive.

All the patients in our study underwent repetitive dosing of troponin cardiac enzymes (Tus) which was positive. The CPK assay which was performed in 7 patients.

The thrombophilia assessment was performed in only 5 patients, or 10% of the population, of whom only returned pathologically in favor of a protein S deficiency. Unfortunately, even women of childbearing age, and who are under contraception, had not previously benefited from screening for thrombophilia to prevent thromboembolic events.

The serologies were carried out for 5 patients, including 3 patients a syphilitic serology alone was done but all coming back negative

On transthoracic echocardiography, Six patients had dilated LV (12%), and 44 had normal size LV (88%).

The mean LVEF was 50% with extremes varying from 35% to

65%.

It was retained in 35 patients, ie 70%, while 20% had EF between 40 and 49% and 10% of patients had LVEF <40%.

27 patients (54%) had no abnormalities in myocardial segmental kinetics and 23 patients (46%) had abnormalities in myocardial

Two cases of loose calcified aortic stenosis were found. Two patients had apical thrombus.

TTE detected an echogenic, isolated, rounded, mobile, 5x20 mm LA mass attached to the IAS in a patient admitted for NSTEMI with troponin positive and in whom was supplemented by OTE. And the patient was transferred to the cardiovascular surgery department for resection of the mass, which was found to be myxoma on histological examination.

On coronary angiography, all the patients in our study underwent a coronary angiography following their admission with a mean delay of 5 days [6 hours; 10J].

We distinguished the angiographic aspect of our patients into three categories:

- No lesions: in 33 patients (66%)
- <30%: in 6 patients (12%)
- Between 30 and 50%: in 11 patients (22%)

The spasm was identified in 20 patients (40%) by visualization of spontaneous spasm on coronary angiography in 14 patients, and by a positive ergonomics test in 6 patients.

A thrombotic lesion was identified in three patients **(Figure4),** who were placed on anti GPIIb / IIIa, heparin and antiplatelet aggregation, with coronary artery control within 24 hours which demonstrated the total disappearance of the thrombosis (**Figure5**).

Otherwise, no cases of spontaneous coronary dissection were noted in our series.

MRI made it possible to retain the diagnosis of ischemic heart disease in 4 patients by the presence of localized endocardial enhancement, well systematized in the late stages.

From the data of the clinical examination and the paraclinical examinations, we have selected the aetiologies, some of which are confirmed by the appropriate examinations and others have been retained on a set of arguments (**Figure6**)

Spastic cause was retained in 20 patients in front of the spontaneously resolving transient elevation of the ST segment with visualization of spontaneous spasm on coronary angiography in 14 patients, and in front of a positive Methergin test in 6 patients.

Ischemic heart disease (probably by erosion or disruption of plaque) was retained in 4 patients (diagnosed by MRI)

Embolic cause :

- **Cruorical:** it was retained in the 3 patients with AF, a spontaneous grade III intra-auricular contrast detected in 2 patients and in front of the poor anti-coagulation.
- **Calcium** : it is retained in two patients with severe calcified aortic stenosis (ACR).
- **Tumor** : in the patient with OG myxoma.

Bechet's disease: in a 36-year-old patient, smoking, followed in internal medicine for Bechet's disease, was admitted to our department for ACS without ST segment elevation with a troponin peak at 5 ng / ml with normal coronary angiography.

Takayasu disease: in a 45-year-old patient followed for Takayasu's disease was admitted for ACS without ST segment elevation with troponins positive. Coronary angiography showed an associated thrombotic load.

Coagulation abnormality due to protein S deficiency was held in front of a single patient.

Undetermined cause was retained in 16 patients or 32% of the population.

From a therapeutic standpoint, the patients in our study benefited from conventional medical treatment based on conventionnel therapeutic of myocadial infraction (**Table 1)**

11 patients with an ACS with progressing persistent ST + benefited from thrombolysis with an average delay of 4 hours, ie 22% of patients were thrombolysed.

Tenecteplase was used as a thrombolytic product in all patients.

Successful thrombolysis was noted in 5 patient patients. There were no incidents or complications in per and post thrombolysis. Thrombolysed ST + ACS were previously located in 5 patients (50%), and 5 patients in inferior (50%).

Finally, specific management has been chosen for each etiology. Indeed, the therapeutic approach of Behçet's disease was based on corticosteroid therapy and antiplatelet therapy. an indication for a specific treatment has been proposed for the case of Takayasu's disease. For Cruoric embolism, anticoagulant therapy was optimized with a target International Normalized Ratio (INR) as recommended. The two patients with the non-tight stenosis required regular monitoring. The case with myxoma underwent surgical treatment and pathological examination confirmed the myxoma. And finally, the patient with protein S deficiency was not initially put on Sintrom (she was pregnant in 38 weeks of amenorrhea) and was referred to hematology.

The immediate and medium-term evolution of our patients was favorable, no deaths were reported. However, we could not label the long-term outcome of our patients.

DISCUSSION:

MINOCA constitute a rare entity (between 6 and 8% of ACS) but variable according to the age of the population studied and according to the definition of the normal or almost normal character of the coronary angiography. In the literature, this prevalence is variously assessed according to the authors and varies between 1% and 12%. This diversion in the results would be due to the inclusion criteria, namely the definition of normal coronary angiography [4].

Some authors have found higher prevalence of around 12% since they included in their population patients with insignificant lesions with strictures <30%, others only considered those with strictly normal coronary arteries. Thus, the more severe the inclusion criteria, the lower this prevalence.

In our study, the number of young patients with an age <45 years was 13 or 26% of the population and those with an advanced age ≥ 65 years was 16 or 32% of the population.

Da Costa [5] also found a mean age of 50 ± 13 years in his series which grouped 91 cases of myocardial infarction with angiographically healthy coronary artery disease.

Several studies have shown that the average age of patients with MINOCA is lower than those with MICAD.

The GRACE study [6], normal coronary angiograms were more frequent in women with 12% of normal coronary angiograms compared to 6% in men (p <0.001). Which agrees with the results of our series.

In the literature, the frequency of smoking varies from 40 to 92%. Smoking was found in 16 patients (32% of all male and female patients; and 72% of men alone).

The other cardiovascular risk factors are well established in Table 2 showing a comparison with other studies.

In fact, studies have shown that patients with MINOCA are characterized by a minority of cumulative cardiovascular risk factors (**Table 2**), in comparison with patients with MICAD [7].

Clinically, in the literature, the inaugural nature of the pain was found in 60 to 80% of cases, which agrees with the result of our study.

Electrically, the anterior localization was the most frequent in several studies [8]. In our study, we noticed a predominance of the lower localization.

In our study the mean LVEF was 50% with extremes varying from 35% to 65%. In the literature, LVEF was often retained. LV dysfunction can be explained by total coronary occlusions secondarily repermeabilized with poorly developed collateral circulation.

In our study, cardiac MRI made it possible to retain the diagnosis of ischemic heart disease in 4 cases. MRI is increasingly available and can confirm myocardial ischemia to accurately categorize patients according to the contemporary definition of MINOCA. In addition to the diagnostic labeling of MINOCA patients, it can further refine the elimination of differential or alternative diagnoses as named in the recommendations, which has a direct effect on treatment strategies and prognosis depending on the cause.

Late enhancement (RT) MRI techniques after injection of gadolinium chelates are of critical importance since MRI diagnosis is largely based on the detection and analysis of the distribution of enhanced myocardial lesions. Unfortunately, for a significant number of MINOCA, the underlying etiology is not specified on MRI: either because of a negative MRI, or because of MRI results

remaining equivocal, compatible with several diagnoses. The fact that these MRI negative MINOCAs have lower troponin values compared to the MINOCAs for which the MRI is conclusive raises the hypothesis that the main limitation of the MRI lies in its insufficient spatial resolution for the detection of small foci of necrosis. Besides,

High spatial resolution (HR) MRI techniques using three-dimensional (3D) late enhancement (RT) imaging in free breathing have recently been developed for the precise study of the atrial wall [10]. These techniques were then evaluated for the study of scarred ventricular myocardium in the rhythmic domain to guide invasive ablation procedures for ventricular arrhythmias. These promising new techniques of free-breathing RT have improved spatial resolution.

Pierre et Al conducted a study in France to compare the results provided by standard MRI and HR-RT sequence, which included 229 patients with the diagnosis of MINOCA. 172 of which have been explored by both techniques at the same time [11].

Indeed, the detection rate of a definite myocardial RT was higher with the HR-RT sequence than with standard RT acquisitions (64% vs. 51%, p <0.001) [12].

The management of patients with MINOCA for whom MRI has unfortunately not made it possible to specify the etiological diagnosis remains a thorny therapeutic dilemma.

To this end, many techniques have been proposed in order to detect angiographically occult causes of infarction in a context of MINOCA: intracoronary ultrasound, optical coherence coro-tomography or even biological screening of the causes of thrombophilia.

Coronary thrombosis is the most common end event leading to acute coronary syndrome in myocardial infarction patients with "frankly" obstructive coronary lesion, whereas blurry or minor filler agiographic images may suggest rupture. plaque, it can be definitively diagnosed using intracoronary imaging [13], OCT being the preferred modality due to its higher resolution. However, IVUS can be considered as an alternative to OCT to a lesser extent [14].

Reynolds et al. presented the largest study to date, involving 145 women with a diagnosis of MINOCA. In this study, MRI was interpretable in 116 patients. The combination of OCT and MRI identified the cause of MINOCA in 84.5% of patients. A lesion visible on OCT was identified in 42% of patients with an infarction detected by MRI and in 79% of patients with a regional lesion detected by MRI [15].

Unfortunately, no patient in our study received OCT.

Endocoronary ultrasound (IVUS) is one of the major contributions to a better understanding of the pathophysiological mechanisms of MI in angiographically healthy coronary artery patients [16]. Indeed, it makes it possible to determine the average thickener of the intima, to assess the diameter and the surface of the arterial segments explored and to study coronary vasomotricity. In Glacov's series, endocoronary ultrasound made it possible to objectify a reversal of the vasomotor responses of the angiographically normal coronary segments during noradrenergic stimulation [17].

Currently, with the advent of endocoronary ultrasound (IVUS) which is a new technique of vascular imaging, it allows better analysis with a qualitative and quantitative study of the arterial wall. It also offers a virtual histological study and tissue characterization with analysis of intracoronary flow. It has made it possible to overcome the limitations of coronary angiography which lie primarily in its very principle, because it is a luminography which underestimates endothelial damage and cannot reveal certain fissured plaques [18].

MINOCA is a heterogeneous entity of very varied aetiologies:

Ben Romdhane's study concluded that protein C, S and antithrombin III deficiencies play an important role not only in the occurrence of infarcts in young subjects but also in the occurrence of embolic accidents following an infarction [19]. In our series, it was identified in a single patient.

Homocysteinemia is implicated in the genesis of early coronary atherosclerosis and associated with vascular and hematological abnormalities leading to a pro atherogenic and prothrombogenic environment.

The anti-phospholipid antibody syndrome is defined by the association of venous and / or arterial thrombosis and] / or repeated fetal losses and the presence of anti-phospholipid antibodies. In our series, this syndrome was not objectified in any patient. In the literature, its prevalence in MI in young subjects varies from 4.4 to 43% [20].

Estrogestogestogens have long been known to be a factor favoring the increase in cardiovascular accidents of thrombotic origin. In our study, 7 of our patients were on estrogen-progestogen contraception but no screening for thrombophilia was performed before, nor as a preventive measure before prescribing contraception.

Behçet's disease is a multisystem inflammatory vasculitis that can affect vessels of all sizes, characterized by mildness of the mucosal and joint skin involvement and the severity of ocular, neurological and vascular manifestations [21]. In our series, a patient followed for Behçet, the latter of which was retained as the etiology of his ACS.

Other connectivitis such as systemic lupus erythematosus, periarteritis nodosa, scleroderma, dermatomyositis and polymyositis can be complicated by coronary syndromes with elevation of troponins and normal coronary angiography via several mechanisms: lesions of specific arteritis, thrombosis, vascular stenosis as well as coronary spasm and early infraangiographic atherosclerotic lesions associated with long-term corticosteroid therapy [18-19]. A case of Takayasu's disease was retained in our series.

Coronary embolism is a rare cause of myocardial infarction and the precise diagnosis remains a challenge for the cardiologist. Indeed, the prevalence of this entity remains unknown because of the diagnostic difficulty in the acute phase. In a Prizel biopsy study in 419 patients, only 13% had embolic migration myocardial infarction. These embolisms were often fibrinocruoric [19].

In our series, 3 cases of migration of Cruoric emboli were selected in subjects with ACFA, and who were put on anti GP IIb / IIIa with disappearance of the thrombotic carge within 24 hours. two cases of calcified aortic stenosis (ACR) were noted and complicated by ACS with normal coronary angiography, with very calcified aortic sigmoid on echocardiography which suggests a calcium embolic cause, and finally coronary embolization by an atrial myxoma left was retained.

Coronary spasm is considered a common etiology of healthy coronary infarctions. In fact, in his study Raymond found that coronary spasm was present in 5 out of 16 cases, ie 31% of cases which benefited from an ergonovine maleate test. In our study, the spastic component was retained in 20 patients in front of the transient elevation of the ST segment spontaneously resolving with visualization of spontaneous spasm on coronary angiography in 14 patients, and in front of a positive Methergin test in 6 patients [16-20].

Spontaneous coronary artery dissection (SCAD) is the very rare etiology, which today is most often objectified thanks to an almost systematic use of coronary angiography in cases of chest pain with release of troponins and to a wider use of I endocoronary imaging in case of diagnostic ambiguity [18]. Its pathophysiology is also better known. In our study no case of SCAD was reported.

Finally, in 32% of the patients in our series, the etiological assessment was negative, endothelial dysfunction and infraangiographic atheroma plaques can be strongly implicated.

On the therapeutic level, MINOCA having many possible pathological mechanisms, it is not certain that the classic strategy of secondary prevention and treatment of type 1 myocardial infarction is suitable for MINOCA patients, and there is no no solid recommendation at present on the treatment to be prescribed in the event of a diagnosis of MINOCA [21].

All our patients have benefited from conventional treatment based on antiplatelet agents, anticoagulants and anti-ischemic treatment. Thrombolysis has been indicated in patients with persistent ST segment elevation.

The patients in whom a spasm was demonstrated were put on calcium channel blockers, and beta-blockers were contraindicated in them.

A specific treatment was indicated according to the objectified aetiologies. Namely, to increase anticoagulant treatment in patients with low dose AF, close monitoring for calcified aortic stenosis and resection of the myxoma.

For the patient with Behçet's disease, the therapeutic approach is based on corticosteroid therapy in addition to anti-ischemic treatment.

The patients, in whom no obvious cause was identified, were treated as acute coronary syndromes of atheromatous origin and were kept on conventional treatment (Beta-blocker, Aspirin, Statin, ACE inhibitor, Control of risk factors) on discharge. This behavior has been adopted by several teams.

Comparisons of the prognosis of MINOCA and IDM patients with obstructive coronary artery disease (MI-CAD) are difficult due to variations in the relevant pathophysiological mechanisms. MINOCA is a group of syndromes with multiple causes. The prognosis of MINOCA is closely related to the cause of the disease, which should be actively investigated. In a systematic review, the 12-month all-cause mortality rate of patients with MINOCA was found to be 4.7% [20-21].

A study on a large sample of 14,045 patients with MINOCA indicated that their mortality rate was higher than that of patients with MI-CAD within 30 days (4.48 and 3.46%, respectively) [18-21].

The KAMIR-NIH study found that there was no difference between the prognosis of MINOCA and MI-CAD patients during the 2 years of follow-up (9.1 and 8.8%, respectively), as well as 'no significant difference in CV deaths, non-cardiac deaths, and infarction recurrence between 2 groups [21].

In our study, no case of death was reported during the hospital phase, 10 cases of abortion were noted but progressed well under diuretics.

CONCLUSION:

Acute coronary syndromes (ACS) constitute a major public health problem because of their frequency, morbidity and mortality and their socioeconomic repercussions. Prevention is fundamental in the management of ACS. It requires a better knowledge of the etiopathogenesis of these ACS.

Future research that is warranted in MINOCA is evaluating the most appropriate treatment for these patients, particularly for those in whom no underlying pathogenic mechanism has been identified.

The aim of our work was to evaluate in patients with acute coronary syndromes with elevation of troponins with an angiographically healthy coronary network is to define the epidemiological, clinical, biological and ultrasound characteristics with a view to an etiological diagnosis, to insist on the importance of MRI (with HR +++ sequencing) and above all of intracoronary imaging for diagnosis and treatment, and finally to predict the development and prognosis of this condition in the hospital phase and at a distance.

REFERENCES:

1. Thygesen K, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, et al. Fourth universal definition of myocardial infarction (2018). Eur Heart J. 2014 Jan 14; 40 (3): 237–69.

2. **Rhew SH, Ahn Y, Kim MC, Jang SY, Cho KH, Hwang SH, et al**. Is Myocardial Infarction in Patients without Significant Stenosis on a Coronary Angiogram as Benign as Believed? Chonnam Medical Journal. 2016; 48:39.

3. **asmah Safdar, MD, MSc; Erica S. Spatz, MD, MS; Rachel P. Dreyer, PhD; John,**resentation, Clinical Profile, and Prognosis of Young Patients With Myocardial Infarction With Nonobstructive Coronary Arteries (MINOCA): Results From the VIRGO Study, journal of the American Heart Association, 2020.

4. **Jacqueline E. TamisHolland, MD, FAHA, Chair Hani Jneid, MD, FAHA, Vice Chair**

Harmony R. Reynolds, Contemporary Diagnosis and Management of Patients With Myocardial Infarction in the Absence of Obstructive Coronary Artery Disease,A Scientific Statement From the American Heart Association, Circulation. 2019; 139: e891 – e908.

5. **Mauricio R, Srichai MB, Axel L, Hochman JS, Reynolds HR.** Stress cardiac MRI in women with myocardial infarction and nonobstructive coronary artery disease. Clin Cardiol**.** 2016; 39: 596–602. doi: 10.1002 / clc.22571

6. Wei J, Bakir M, Darounian N, Li Q, Landes S, Mehta PK, Shufelt CL, Handberg EM, Kelsey SF, Sopko G, Pepine CJ, Petersen JW, Berman DS, Thomson LEJ, Bairey Merz CN. Myocardial scar is prevalent and associated with subclinical myocardial dysfunction in women with suspected ischemia but no obstructive coronary artery disease: from the Women's Ischemia Syndrome Evaluation-Coronary Vascular Dysfunction Study. Circulation. 2018; 137: 874–876. doi: 10.1161 / CIRCULATIONAHA.117.031999

7. Mommersteeg PM, Arts L, Zijlstra W, Widdershoven JW, Aarnoudse W, Denollet J. Impaired health status, psychological distress, and personality in women and men with nonobstructive coronary artery disease: sex and gender differences: the TWIST (Tweesteden Mild Stenosis) Study . Circ Cardiovasc Qual Outcomes. 2017; 10: e003387

8. Montone RA, Niccoli G, Fracassi F, Russo M, Gurgoglione F, Camma G, Lanza GA, Crea F. Patients with acute myocardial infarction and non-obstructive coronary arteries: safety and prognostic relevance of invasive coronary provocative tests. Eur Heart J. 2018; 39: 91–98.

9. **Lindahl B, Baron T, Erlinge D, Hadziosmanovic N, Nordenskjöld A, Gard A, et al.** Response by Lindahl et al to Letter Regarding Article, _Medical Therapy for Secondary Prevention and Long-Term Outcome in Patients With Myocardial Infarction With Nonobstructive Coronary Artery Disease '. Circulation. 2017 12; 136: 1082–3.

10. **. Nordenskjold AM, Baron T, Eggers KM, Jernberg T, Lindahl B.**Predictors of adverse outcome in patients with myocardial infarction with non-obstructive coronary artery (MINOCA) disease. Int J Cardiol. 2018; 261: 18–23

11. **Ballesteros-Ortega D, Martínez-González O, Gómez-Casero RB, Quintana-Díaz M, de Miguel-Balsa E, Martín-Parra C, et al**. Characteristics of patients with myocardial infarction with nonobstructive coronary arteries (MINOCA) from the ARIAM-SEMICYUC registry: development of a score for predicting MINOCA. Vasc Health Risk Manag. 2019; 15: 57–67.

12. **Pasupathy S, University of Adelaide, Central Adelaide Local Health Network, Tavella R, University of Adelaide, Central Adelaide Local Health Network, et al**. Myocardial Infarction With Non-obstructive Coronary Arteries - Diagnosis and Management. European Cardiology Review. 2015; 10: 79.

13. **Pizzi C, Xhyheri B, Costa GM, Faustino M, Flacco ME, Gualano MR, et al**. Nonobstructive Versus Obstructive Coronary Artery Disease in Acute Coronary Syndrome: A Meta-Analysis. J Am Heart Assoc. 2016 16; 5.

14. **Barr PR, Harrison W, Smyth D, Flynn C, Lee M, Kerr AJ.** Myocardial infarction without obstructive coronary artery disease is not a benign condition (ANZACS-QI 10). Heart Lung Circ. 2018; 27: 165–174.

15. hygesen K, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, et al. Fourth Universal Definition of Myocardial Infarction **(2018).** J Am Coll Cardiol 2018; 72: 2231–64

16. **Khesroh A, Al-Roumi F, Al-Zakwani I, Attur S, Rashed W, Zubaid M**. Gender differences among patients with acute coronary syndrome in the Middle East. Heart Views. 2017; 18:77.

17. Agewall S, Beltrame JF, Reynolds HR, Niessner A, Rosano G, Caforio AL, et al. ESC working group position paper on myocardial infarction with non-obstructive coronary arteries. Eur Heart J 2017; 38: 143–5

18. **Thygesen, K .; Alpert, JS; Jaffe, AS; Chaitman, BR; Bax, JJ; Morrow, DA;** White, HD Fourth Universal Definition of Myocardial Infarction (2018). J. Am. Coll. Cardiol. 2018, 72, 2231–2264 ..

19. **Sieve-Holland I**. Sex and Outcomes After Percutaneous Coronary Intervention: A Cause for Concern for Young Women and Those With ST-Segment Elevation Myocardial Infarction? J Am Heart Assoc. 2017 20; 6.

20. banez B, James S, Agewall S. ESC Scientific Document Group. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J. 2017; 39 (2): 119–177.**.

21. **Niccoli G, Scalone G, Crea F.** Acute myocardial infarction with no obstructive coronary atherosclerosis: mechanisms and management. Eur Heart J. 2015; 36 (8): 475–481.

CONFLICT OF INTEREST

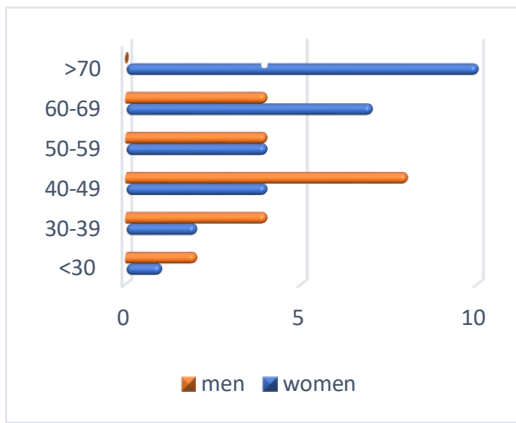The authors declare no competing interest.

FIGURES AND TABLES

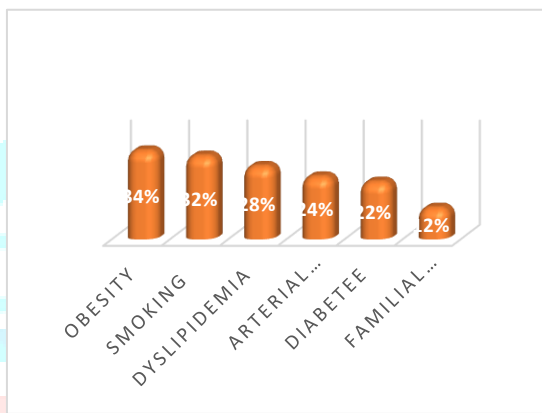**Figure 1: Distribution of the population according to age groups according to sex.**
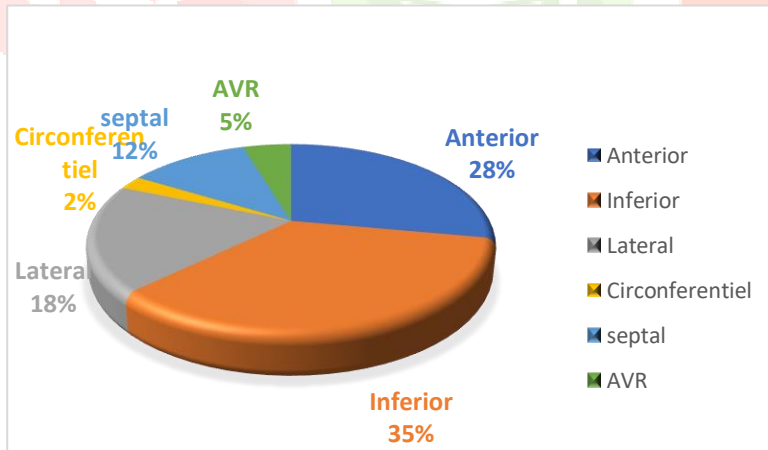

Figure 2: Prevalence of FRCV in the series

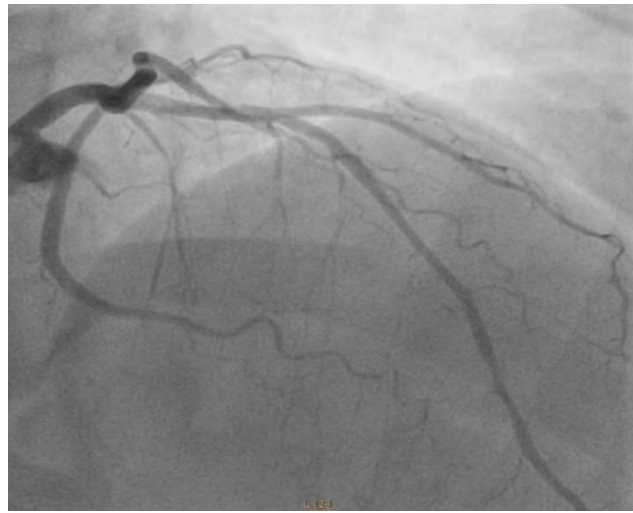**Figure 3: Distribution of ACS according to territory**

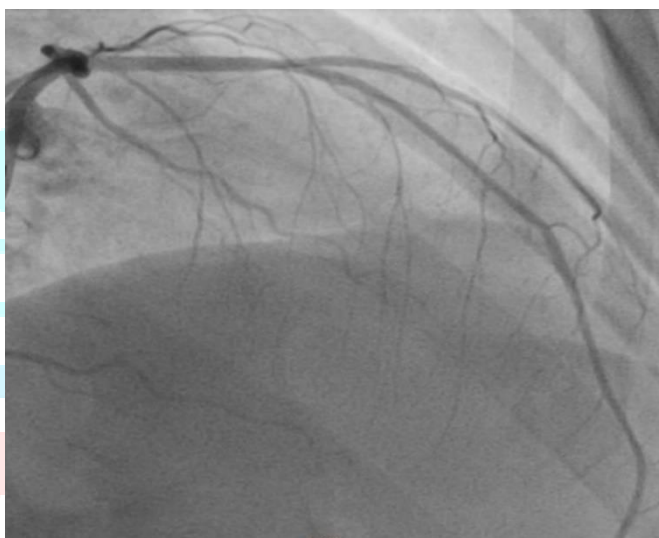**Figure 4: Coronary angiogram showing a thrombotic lesion of Left anterior descending artery**

Figure 5: Coronarography showing the disappearance of the thrombotic lesion of the proximal VIA after 24 hours under anti GP IIb / IIIa
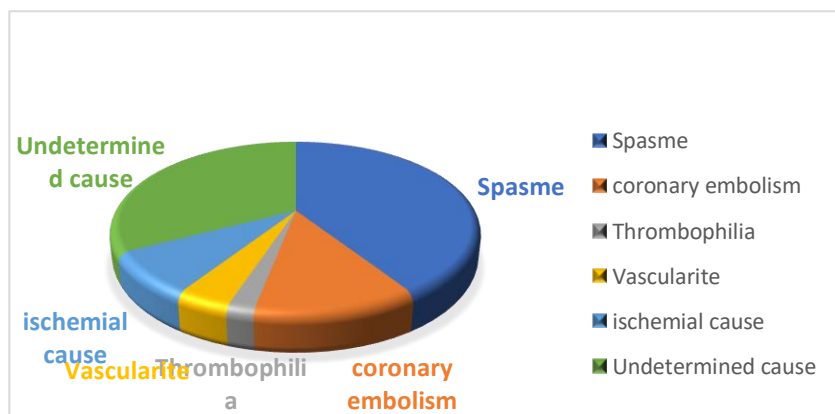

Figure 6: Prevalence of etiologies in the general population

ASPIRIN	50	100%
PIDOGREL	30	60%
ANTICOAGULANTS (admission)	50	100%
NITRAL DERIVATIVES	27	54%
BBLOQUANT	30	60%
IC	20	40%
IEC	35	70%
STATIN	40	80%
DIURETIC	10	20%
CORDARONE	1	2%
Thrombolytics (Tenecteplase)	11	22%
Anti GP IIb / III3	3	6%

Table I: Medical Treatment Administered in Study Patients

Series	Our (50)	Abid (24)	Shi Hyun (28)	Widimsky (49)	Hmida (26)	Dekhil (31)	DaCost	Raymond D (23)
Year	2021	2012	2012	2006	2004	2003	2001	1988
Population	50	21	100	26	39	46	91	74
Middle age	54	44.9	58	51	44	47.7	49	43
Female	56%	9.53	41%	15%	15%	22%	37%	43%
Tobacco	72%	60%	49%	8%	75%	73.9%	60%	72%
HTA	24%	23%	41%	23%	8%	21%	15.4%	14%
Diabetes	22%	9.5%	10%	8%	15%	17%	10%	1%
Obesity	34%	-	-	-	-	-	11%	-
Dyslipidemia	28%	14%	1%	-	15%	17%	20%	-
Familial coronary artery disease	12%	9.5%	12%	-	7.7%	8.7%	15%	43%

Table 2: Comparison of epidemiological characteristics and FRCV of studies reported in the literature