Case Report

Myocardial Infarction With Nonobstructive Coronary Arteries: What Does an Interventionist Need to Know?

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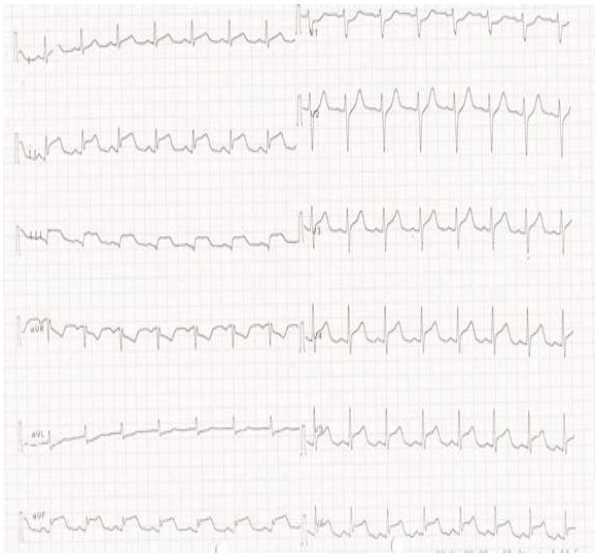
ABSTRACT

A 38-year-old man presented to the emergency department with ongoing chest pain. The patient had a sudden onset of central, crushing chest pain for 7 hours, with severity increasing in the last 2 hours. The symptoms were associated with sweating. He was a known case of hypertension and was on medication for the preceding 2 years. The patient was also prediabetic. His mother had hypertension and diabetes mellitus. There was no history of hypertension, diabetes mellitus, or cardiovascular disease in his siblings.

On general examination, the patient had an O_2 saturation level of 95%, a pulse rate of 110 beats per minute, and a blood pressure of 110/90 mm Hg. On systemic examination, no abnormality was detected. Additionally, the complete blood count, renal function tests, blood sugar random test, and electrolytes were within normal limits. Electrocardiography demonstrated an ST elevation in the inferolateral leads. He also had a CPK-MB level of 82 IU/L and a troponin level of 11.6 IU/L. Echocardiography revealed a hypokinetic left ventricular inferior wall.



With a diagnosis of acute inferolateral wall myocardial infarction (MI), the patient was taken to the catheterization laboratory, where coronary angiography revealed normal coronary arteries. He was admitted to the CCU and was treated with aspirin, clopidogrel, low-molecular-weight heparin, atorvastatin, beta-blockers, anxiolytics, proton-pump inhibitors, and stool softeners. On the following day, cardiac magnetic resonance revealed curvilinear, confluent, and patchy subendocardial enhancement in the inferoposterior wall of the left ventricle. The features were compatible with MI. He was conservatively managed and was discharged on the fifth post-MI day.

Figure 1: The electrocardiogram shows an ST elevation in the inferolateral leads.

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KEYWORDS: MINOCA, STEMI, NSTEMI

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In the 1980s, DeWood et al[1] reported that approximately 10% of patients with myocardial infarction (MI) had nonobstructive coronary artery disease. Currently, the prevalence may be even higher in the era of high-sensitivity cardiac troponin assays because of the lower specificity to diagnose acute MI.[2] Myocardial infarction with nonobstructive coronary arteries (MINOCA) occurs in between 5% and 15% of patients presenting with acute ST-segment elevation myocardial infarction (STEMI) or non-NSTEMI.[3] Many terms have been coined to describe patients with acute MI or acute coronary syndrome with normal or near-normal coronary arteries such as MINOCA, MINCA (MI with normal coronary arteries), and INOCA (ischemia and no obstructive coronary artery disease).[4,5] The term "MINOCA" is incorporated into the recently published Fourth Universal Definition of acute MI.[6] Compared with obstructive coronary artery disease, factors associated with MINOCA include the female sex, younger age (<55 y), genetics, and physiological stress.[7] A higher prevalence rate of MINOCA was found in younger patients (58.8% vs 61.3%; *P*<0.001), females (43% vs 24%; *P*<0.001), non-white patients (25% vs 12%; *P*<0.0001), and patients presenting with non-STEMI (78% vs 51%; *P*<0.0001) by comparison with acute AMI with obstructive coronary artery disease.[8-11] Accurate diagnosis and subsequent management require the appropriate use of intravascular imaging and coronary function testing, in addition to echocardiographic and cardiac magnetic resonance imaging (CMR) to assess for the presence of infarction or myocardial disorders without coronary involvement.[12] MINOCA is not a benign diagnosis, with outcomes similar to those of patients with acute MI and obstructive coronary disease up to 1 year (12-month mortality=0.6% vs 2.3%, respectively; *P*=0.68).[12]

Definition and Pathophysiology of MINOCA

The diagnosis of MINOCA requires the presence of acute MI (according to the Fourth Universal Definition of acute MI), nonobstructive coronary arteries on invasive coronary angiography (defined as no coronary stenosis≥50% in any potential infarct-related artery), and 3 no clinically overt specific cause for the acute presentation.[6] In a patient presenting with symptoms of ischemia, cardiac enzyme elevation, and echocardiographic or electrocardiographic features suggestive of acute MI, a working diagnosis is made during angiography in the absence of culprit obstructive coronary artery disease (epicardial coronary artery stenosis≥50%) or an apparent systemic cause for the presentation.[13,14] Approximately one-third of patients tend to present with suspected STEMI within an emergency setting, with the remaining majority being suspected as non-STEMI patients undergoing subsequent angiography.[3] MINOCA disorders can be classified within the fourth universal definition of MI.[6] They may meet the criteria for type I MI, where epicardial coronary artery disorders are diagnosed, or type II MI due to endothelial dysfunction or oxygen supply and demand mismatch, or myocardial injury.[6]

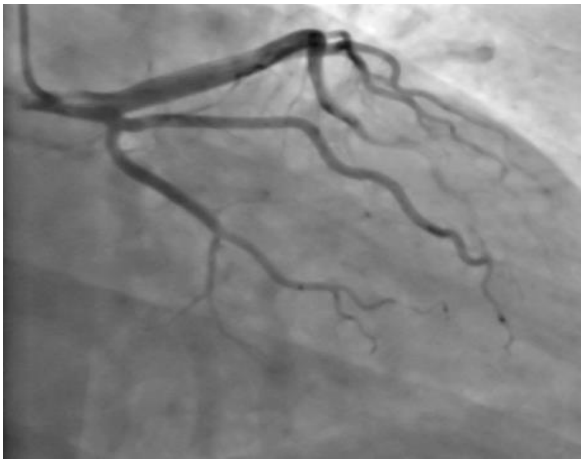


Figure 2: The image shows a normal left coronary system.

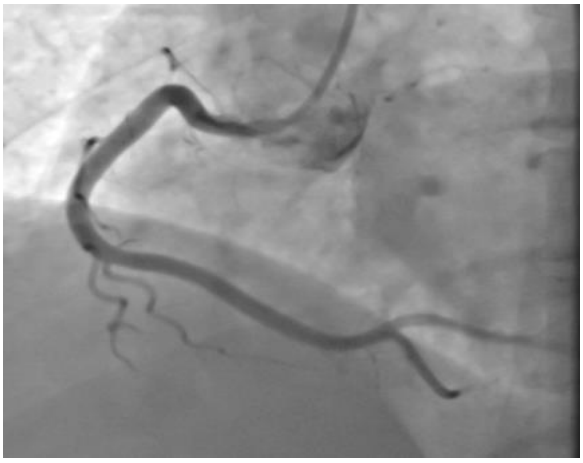


Figure 3: The image shows a normal right coronary artery.

Cardiac causes of MINOCA include plaque disruption and plaque erosion, spontaneous coronary artery dissection, coronary artery spasms, coronary microvascular dysfunction, and coronary thrombi or emboli.

Noncardiac causes of MINOCA can result in pericardial effusion, (end-stage) renal failure, sepsis, stroke, and other forms of type II MI such as anemia and hyperthyroidism. They can also be associated with chest pain, elevated cardiac enzymes, and electrocardiographic (ECG) changes.

Diagnosis and Evaluation of Patients With MINOCA

When a patient meets the criteria for a working diagnosis of MINOCA—namely universal acute MI criteria, infarct-related epicardial stenosis of 50% or less, and the absence of an overt alternative systemic cause—during angiography, then further invasive and adjunctive investigations should be considered at this point such as coronary intravascular ultrasound and optical coherence tomography.[15-17] Left ventriculography may also be of value in the assessment of other causes such as Takotsubo syndrome, and it is routinely performed in many percutaneous coronary intervention centers.[18] In addition to the measurement of left ventricular end-diastolic pressure (LVEDP), ventriculography may also indicate an epicardial territorial distribution of impaired kinesis, implicating a single epicardial artery, compared with a microvascular pattern involving an extended territory of 1 or more arteries. The upper limit of normal for LVEDP is 10 mm Hg, and an LVEDP value exceeding 18 mm Hg is associated with an adverse post-MI prognosis.[19] Following invasive angiography, transthoracic echocardiography should be performed, specifically to assess the presence of regional wall motion abnormalities, embolic sources, pericardial effusion, and typical features of Takotsubo syndrome.[20] CMR can identify inflammation, edema, and scar and can assess myocardial function by T1- and T2-weighted imaging.[21] CMR is an important diagnostic tool and is guideline-recommended in all patients with MINOCA.[22] If present on CMR, late gadolinium enhancement localizes the site of myocardial damage, and the pattern of distribution suggests the diagnosis.[23] Subendocardial or transmural enhancement is typical of ischemic etiology. Subepicardial enhancement may be observed in myocarditis, cardiac sarcoid, or cardiomyopathy associated with Duchenne muscular dystrophy. Mid-wall enhancement is associated with dilated cardiomyopathy, hypertrophic cardiomyopathy, Duchenne muscular dystrophy, Becker muscular dystrophy, Anderson–Fabry disease, sarcoidosis, or myocarditis. Finally, global endocardial enhancement is associated with amyloidosis, systemic sclerosis, hypereosinophilic syndrome, or Churg–Strauss syndrome, whereas the absence of late gadolinium enhancement may be in keeping with microvascular dysfunction or a noncardiac cause of the presentation.[24] CMR should be performed as soon as feasible after the identification of MINOCA (within 4 weeks after hospital admission). However, in between 8% and 67% of patients, no abnormalities could be found, leading to a therapeutic dilemma for clinicians.[25]

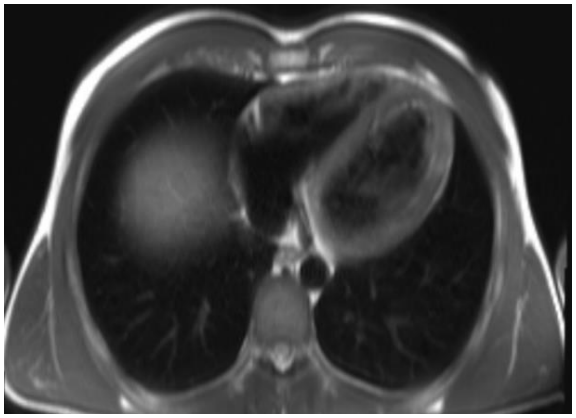


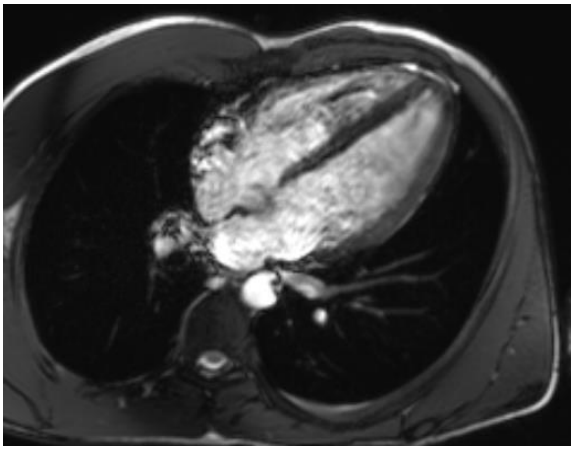
Figure 4: The cardiac magnetic resonance imaging shows subendocardial enhancement in the inferoposterior wall of the left ventricle.

Therapeutic Strategies for Patients With MINOCA

MINOCA secondary to plaque disruption or with evidence of ischemic damage on CMR receives dual antiplatelet therapy (12 months followed by a lifelong single agent), high-dose statin (including in patients with minimal plaque burden), beta-blockers, and angiotensin-converting enzyme inhibitors or angiotensin receptor blockers.[26,27] Mineralocorticoid receptor antagonists (MRA) may have a theoretical role in improving the outcomes of patients with MINOCA because aldosterone levels immediately after acute MI are associated with all-cause mortality. Aldosterone mediates the downstream effects of RAAS activation, including endothelial dysfunction, inflammation, and fibrosis. Nonetheless, at present, there are no trial data on MRA therapy in MINOCA patients.[28]

Outcomes of Patients With MINOCA

With outcomes similar to those of patients with acute MI and obstructive coronary disease up to 1 year (12-month mortality=0.6% vs 2.3%, respectively; *P*=0.68), MINOCA is not benign.[11] The mortality rate and the incidence rate of major adverse cardiac events (MACE) for patients with MINOCA are comparable with those of patients with obstructive coronary artery disease and are significantly worse than those in the general population.[29] Within the SWEDEHEART registry, approximately 1 in 4 patients experienced MACE within 4 years, with the events composed of death, recurrent MI, hospitalization with heart failure, and ischemic stroke.[30] The literature offers no studies on the effects of MINOCA on the quality of life, including persistent ischemic symptoms and psychosocial parameters. MINOCA-BAT will include a sub-study assessing the prevalence of angina pectoris, in addition to the health-related quality of life, anxiety, depression, and psychiatric comorbidities.[27]



CONCLUSIONS

MINOCA is a heterogeneous working diagnosis requiring further investigation during and after invasive angiographic studies. Clinicians should consider the use of intracoronary imaging and coronary physiology testing during angiography to assess for plaque disruption and vasospasticity. CMR with gadolinium contrast is recommended in all patients with MINOCA. MINOCA is not benign and has comparable outcomes with acute MI due to obstructive coronary artery disease. The treatment of the underlying cause is paramount, although it is currently often empirical. There is an unmet clinical need for stratified therapy for patients with MINOCA.

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