Myocarditis Presenting as Myocardial Infarction with Non-Obstructive Coronary Arteries (MINOCA) in a Young Man: A Case Report

Giovanni Reynaldo[1], Rachmat Hamonangan[2], Princella Monica[1]*

[1]St. Carolus Hospital, Jakarta, Indonesia.
[2]Division of Cardiovascular, Department of Internal Medicine, St. Carolus Hospital, Jakarta, Indonesia.

Corresponding Author:
Rachmat Hamonangan, MD. Division of Cardiovascular, Department of Internal Medicine, St. Carolus Hospital. Jl. Salemba Raya no. 41, Jakarta 10440, Indonesia. Email: rachmath1415@gmail.com; gioreynaldo@yahoo.com.

ABSTRACT

Myocardial infarction with non-obstructive coronary arteries (MINOCA) is a unique disorder that manifests as an acute myocardial infarction clinically without overt coronary arteries obstruction on angiography. Herein, we report a 17-year-old male presented with a chest pain occurring 3 hours before admission and fever lasting for 2 days. Electrocardiogram examination showed ST elevation in lead II, III, aVF and V3-V6. Laboratory tests results showed a normal leukocyte level of 9850/µL, an elevated troponin of 3.55 ng/mL and an elevated quantitative CRP of 46 mg/L. Coronary angiography performed, indicating 20-30% stenosis of the left anterior descending artery, left circumflex artery and right coronary artery, whereas in typical acute myocardial injury, angiography shows >50% coronary stenosis. Additional cardiac MRI examination showed a fulfillment of Lake Louis Criteria for myocarditis, with further findings of acute myocardial edema in the lateral wall of left ventricle, with left ventricle ejection fraction of 59.73%. As researchers are still working on the definition of MINOCA, present knowledge of the causes, pathophysiology, clinical features, or specific phenotypes of MINOCA is also limited. A stepwise diagnostic approach is needed to diagnose MINOCA, with subsequent differential diagnosis exclusion.

Keywords : *MINOCA, Myocarditis, Myocardial infarction, Angiography, Chest Pain, Electrocardiogra.*

INTRODUCTION

Myocardial infarction with non-obstructive coronary arteries (MINOCA) is a unique clinical entity that demonstrates acute myocardial infarction (AMI) clinically without overt coronary artery obstruction on angiography. As researchers are still working on the definition of MINOCA, present knowledge of the causes, pathophysiology, clinical features, or specific phenotypes of MINOCA is also limited. Furthermore, the diagnosis and management of these patients are yet to be improved. Thus, this case report is expected to advance the current understanding of MINOCA, especially those caused by myocarditis.

CASE ILLUSTRATION

A 17-year-old male without any significant medical history presented to the emergency department with chest pain occurring 3 hours before admission. He underwent similar chest pain 1 day earlier, lasting for 2 hours. He also got a fever in the last 2 days. The patient reported no history of smoking, diabetes mellitus, hypertension, or prior heart disease. He had already been vaccinated for COVID-19 with Sinovac, the second dose being 3 months earlier. There was no history of heart diseases nor autoimmune diseases in his family.

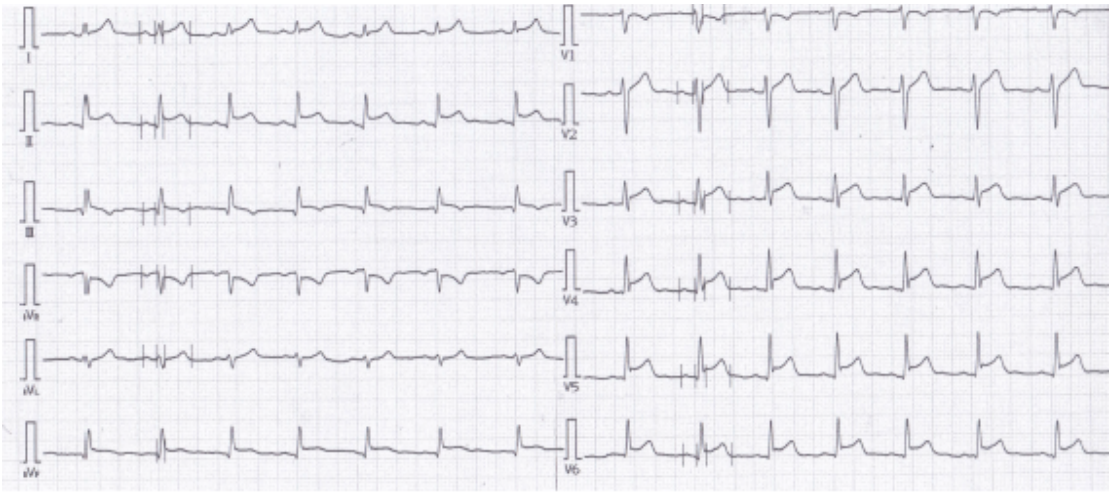

Figure 1. ECG show ST Segment elevation in lead II, III, AvF, V4-6.

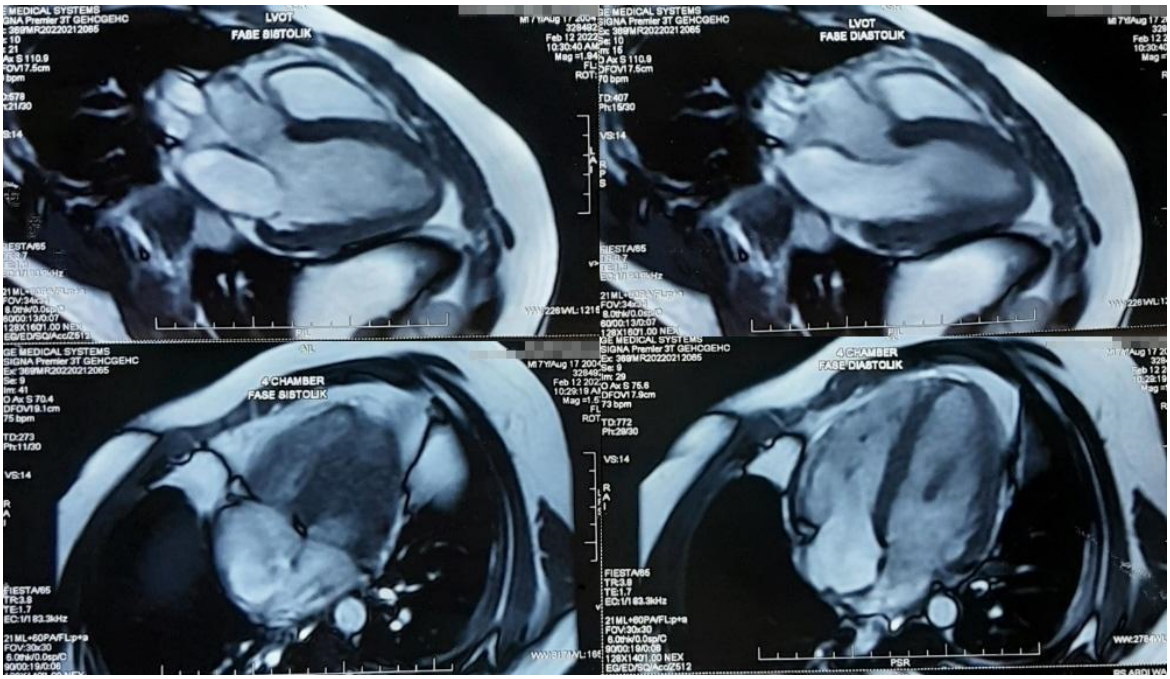

Figure 2. Cardiac MRI show hyperintensity of the mid myocardium in lateral wall of left.

Electrocardiogram (ECG) examination showed ST elevation in lead II, III, aVF and V4-V6. Laboratory tests results showed a normal leukocyte level of 9850/µL, elevated troponin of 3.55 ng/mL, elevated quantitative CRP of 46 mg/L and a negative SARS-CoV-2 PCR test. Further coronary angiography was performed, indicating 20-30% stenosis of the left anterior descending artery (LAD), left circumflex artery (LCX) and right coronary artery (RCA). The following laboratory tests showed ASTO of 400 IU/mL, TSH of 1.895 µIU/mL, anti-ds-DNA of <10 IU/mL, HbA1C of 6.8%, LDL cholesterol of 99 mg/dL, triglyceride of 156 mg/dL, and uric acid of 8.2 mg/dL. ANA profile showed positive results with SSA native (69 kDa) being +3, and anti-CMV IgG showed a positive result of 1.1 AU/mL. Anti-CMV IgM, anti-HSV, anti-HIV, HBsAg and anti-HCV were negative. Additional cardiac MRI examination showed a fulfillment of Lake Louis Criteria for myocarditis, with further findings of acute myocardial edema in the lateral wall of left ventricle, with left ventricle ejection fraction of 59.73%.

Afterwards, the patient was admitted to the High Care Unit. He was given subcutaneous fondaparinux 1x2.5 mg, intravenous pantoprazole 1 x 40 mg, oral acetylsalicylic acid 1x80 mg, nebivolol 1x2.5 mg, sacubitril valsartan 2x50 mg, rosuvastatin 1x40 mg, trimetazidine 1x80 mg and colchicine 2x0.5 mg. Later, the chest pain subsided and there was improvement in ECG examination as well as troponin test (0.547 ng/mL). The patient was discharged and further follow-up after 1 month showed no notable clinical findings. Then, the patient was scheduled for a follow-up cardiac MRI examination in 3 months, which showed improvement of myocardial edema.

DISCUSSION

Myocardial infarction with non-obstructive coronary arteries (MINOCA) encompasses approximately 6-15% of those presenting clinically with acute myocardial injury (AMI) without angiography showing typical >50% coronary stenosis.[1] Compared to obstructive AMI, the demographic and clinical manifestations of MINOCA slightly differ. Patients diagnosed with MINOCA are barely younger, with an average age of 58 years for MINOCA and 61 years for obstructive AMI.[2] Women are twice as likely to have MINOCA than men, as opposed to the obstructive AMI more commonly associated with men.[3] MINOCA has also been featured with less cardiovascular risk factors such as hypertension, metabolic disorders and other conventional risk factors.[2,4] Prognostic outcomes of MINOCA are still unclear, with studies showing overall results of no difference for better prognosis in MINOCA than obstructive coronary artery disease.[5-7]

The Fourth Universal Definition of Myocardial Infarction defines MINOCA as a group of patients with myocardial infarction with no angiographic obstructive CAD (≥50% diameter stenosis in the major epicardial vessel). The myocyte injury, like the diagnosis of MI, should be indicated by an ischemic mechanism. Myocarditis without any ischemic mechanism should be excluded from MINOCA.[8] The following statement from the American Heart Association (AHA) defines the diagnostic criteria for MINOCA as a patient with (1) Acute myocardial infarction (modified from the "Fourth Universal Definition of Myocardial Infarction" Criteria), (2) Non-obstructive coronary arteries on angiography, and (3) No specific alternate diagnosis for the clinical presentation. Myocarditis can cause a clinically subtle non-ischemic myocyte injury mimicking myocardial infarction (excluded from MINOCA) or presents as part of MINOCA (with the mechanism stated below).[3]

Several specific causes of MINOCA have been identified, but the pathophysiology of MINOCA is far yet to be explored. One mechanism involves atherosclerosis caused by plaque disruption in the coronary artery. Any plaque rupture, erosion, or calcific nodules can trigger thrombus formation leading to distal artery embolization, spasm, or complete transient thrombosis with spontaneous thrombolysis, ending with acute myocardial injury. Another mechanism involves nonatherosclerotic causes, including epicardial coronary vasospasm, coronary microvascular dysfunction, coronary thrombosis/embolism, spontaneous coronary artery dissection (SCAD), and a supply-demand mismatch. Myocarditis is one specific etiology that can cause MINOCA, in which pathophysiology comprises coronary microvascular dysfunction caused by myocardial edema with subsequent ischemic myocardial injury.[3] A previous meta-analysis by Tornvall et al. showed myocarditis itself is common in MINOCA, with a prevalence of 33%.[9] It should be remembered that myocarditis itself could occur without any myocardial infarction and mimic the clinical findings in MINOCA.[10]

A stepwise diagnostic approach to MINOCA is made by defining the presence of acute myocardial injury, clarifying the working diagnosis of acute myocardial infarction, confirming the finding of non-obstructive CAD, further diagnostic workup for the existence of ischemia (MINOCA), and ruling out other non-ischemic etiology (not MINOCA).[1] A cardiac troponin test showing an acute rise or fall in cardiac troponin (cTn) above the 99th percentile upper reference indicates an acute myocardial injury.[3] The clinical evidence of infarction can be seen as at least 1 of the following: (1) Symptoms of myocardial ischemia, (2) New ischemic

electrocardiographic changes, (3) Development of pathological Q waves, (4) Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality in a pattern consistent with an ischemic cause, or (5) Identification of a coronary thrombus by angiography or autopsy.[3] The next step is to detect using invasive coronary angiography whether obstructive CAD is present, followed by the appropriate management guidelines, or non-obstructive CAD, defined as the absence of obstructive disease on angiography in any major epicardial vessel, including normal coronary arteries (no angiographic stenosis), mild luminal irregularities (angiographic stenosis <30%) and moderate coronary atherosclerotic lesions (stenosis >30% but<50%). Also consider clinically overt differential diagnosis such as sepsis, pulmonary embolism, cardiac contusion, heart failure, stroke, critical illness, acute toxicity, strenuous exercise and burns.[1,3]

If all the criteria above are met, a working diagnosis of MINOCA can be made, which is confirmed by subsequent investigations. A coronary angiogram should be re-evaluated for the possibility of side branch occlusion, missed obstructive CAD, or spontaneous coronary artery dissection. Cardiac ventriculography can also be considered if there is a possibility of Takotsubo syndrome. The last step is a preference based on clinical and angiographic presentation and considering local availability and expertise, which includes a non-invasive pathway with cardiac magnetic resonance (CMR) and an invasive pathway with optical computed tomography (OCT). CMR could detect any acute myocardial infarction, Takotsubo syndrome, acute myocarditis and other cardiomyopathies, while OCT can help detect any epicardial spasm, plaque-induced event and SCAD.[1]

The diagnostic criteria for MINOCA were fulfilled in this patient, with symptoms of myocardial ischemia, ST-elevation indicating ischemic ECG changes, an elevated troponin of 3.55 ng/mL and 20-30% stenosis found in coronary artery angiography. However, subsequent cardiac MRI examination indicated fulfillment of Lake Louis Criteria for the diagnosis of myocarditis, with findings of lateral and left ventricle myocardial edema suggestive of parvovirus infection. Currently, there is limited evidence of the simultaneous occurrence of acute myocarditis and MINOCA, with a possibility of either acute myocarditis mimicking MINOCA or acute myocarditis followed by MINOCA through coronary microvascular dysfunction.[1,3,9-11] The use of anti-inflammatory drug colchicine inhibits NLRP3 activity. Furthermore, anti-fibrotic effects of colchicine have also been reported.[12] It is recommended to be use as a first line therapy for treatment of acute pericarditis, which is similar to myocarditis.[12] Further supports the hypothesis that colchicine could also be useful in the treatment of myocarditis.[12] The fact that colchicine is inexpensive and its use worldwide is established, colchicine could be an ideal candidate for the treatment of potentially all forms of virus-induced myocarditis, including SARS-CoV2-related myocarditis syndromes.[12]

CONCLUSION

Patients with MINOCA usually present with clinical manifestations of acute myocardial infarction but with distinct demographic presentations. A stepwise diagnostic approach is needed to diagnose MINOCA, with subsequent differential diagnosis exclusion. Further studies are required to explain the coexistence of MINOCA and myocarditis.

CONFLICT OF INTEREST

All authors declare no conflict of interest related to this study.

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