WHAT'S YOUR DIAGNOSIS?

Thinking Outside the 'Cage'

Joshua Mercado-Maldonado, MD; Javier Mirabal, MD; Eric Aviles, MD; and Jaime Rivera-Babilonia, MD

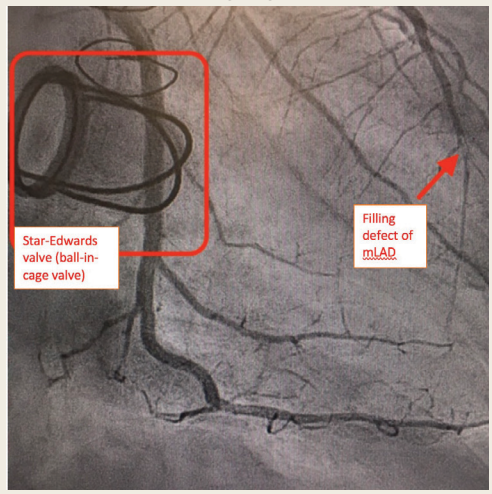
A patient with persistent chest pain and previous mitral valve replacement had no recurrence of pain once target international normalized ratio was reached.

Joshua Mercado-Maldonado and **Jaime Rivera-Babilonia** are PGY-5 Cardiology Fellows, **Javier Mirabal** is a PGY-6 Cardiology Fellow, and **Eric Aviles** is a Staff Cardiologist, all at VA Caribbean Healthcare System in San Juan, Puerto Rico.
Correspondence: Joshua Mercado-Maldonado (joshua9288@hotmail.com)

Fed Pract. 2021;38(6). Published online June 11. doi:10.12788/fp.0138

A 74-year-old male veteran presented at an urgent care clinic in Aguadilla, Puerto Rico, with a sharp, nonradiating, left-sided precordial chest pain that started while cleaning his house and gardening. The patient described the pain as 9 on the 10-point Wong-Baker FACES Pain Rating Scale, lasting about 5 to 10 minutes and was alleviated with rest. The patient's medical history consisted of multiple comorbidities, including a mitral valve replacement with a Star-Edwards valve (ball in cage) in 1987. The electrocardiogram performed at the clinic showed no acute ischemic changes. Due to the persistent pain, the patient was transferred to Veterans Affairs Caribbean Healthcare System in San Juan, Puerto Rico, for further evaluation and management. On arrival, the patient had an international normalized ratio (INR) of 2.22; elevated high-sensitive troponin enzyme readings of 56 ng/L at 6:38 PM (0h); 61 ng/L at 7:38 PM (1h); and 83 ng/L at 9:47 PM (3h), reference range, 0-22 ng/L, and changes that prompted admission to the cardiac critical care unit. Two days later, a follow-up enzyme level was 52 ng/L. Cardiac catheterization revealed an acute filling defect at mid-left anterior descending artery and remaining coronary arteries with < 25% atherosclerosis (Figure). A myocardial perfusion study was performed for myocardial viability. The results showed a small, reversible perfusion defect involving the apical-septal wall with the remaining left ventricular myocardium appearing viable. Aspirin was added to the patient's anticoagulation regimen of warfarin. Once target INR was reached, the patient was discharged home without recurrence of angina.

FIGURE Cardiac Catherization Angiogram



Abbreviation: mLAD, mid-left anterior descending. An acute filling defect at mLAD artery and remaining coronary arteries with < 25% atherosclerosis can be seen.

- What is your diagnosis?
- How would you treat this patient?

Acute coronary syndrome (ACS) consists of clinical suspicion of myocardial ischemia or laboratory confirmation of myocardial infarction (MI). ACS includes 3 major entities: non-ST elevation MI (NSTEMI), unstable angina, and ST-elevation MI (STEMI). ACS usually occurs as a result of a reduced supply of oxygenated blood to the myocardium, which is caused by restriction or occlusion of at least 1 of the coronary arteries. This alteration in blood flow is commonly secondary to a rupture of an atherosclerotic plaque or spontaneous dissection of a coronary artery. In rare cases, this reduction in blood flow is caused by a coronary embolism (CE) arising from a prosthetic heart valve.[1,2]

One of the first descriptions of CE was provided by Rudolf Virchow in the 1850s from postmortem autopsy findings.[3] At that

time, these coronary findings were associated with intracardiac mural thrombus or infective endocarditis. During the 1940s, CE was described in living patients who had survived a MI, and outcomes were not as catastrophic as originally believed. In the 1960s, a higher than usual association between prosthetic valves and CE was suspected and later confirmed by the invention and implementation of coronary angiography. Multiple studies have been published that confirm the association between prosthetic valves (especially in the mitral position), atrial fibrillation (AF), and a higher than usual rate of CEs.[4,5]

DISCUSSION

The prevalence of this disease has varied during the years. Data from autopsies of patients with ACS and evidence of thromboembolic material in coronary arteries originally estimated a prevalence as high as 13%.[6,7] After the invention of diagnostic angiography, consensus studies have established the prevalence to be approximately 3% in patient with ACS.[1] The prevalence may be higher in patient with significant risk factors that may increase the probability of CEs, like prosthetic heart valves and AF.[2]

In 2015 Shibata and colleagues proposed a scoring system for the diagnosis of CE. The scoring system consisted of major and minor criteria.[6] Diagnosis of CE is established by ≥ 2 major criteria; 1 major and 2 minor; or ≥ 3 minor criteria. This scoring system increases the diagnostic probability of the disease.[1,6]

The major criteria are angiographic evidence of coronary artery embolism and thrombosis without atherosclerotic components (met by this patient); concomitant coronary emboli in multiple coronary vascular territories; concomitant systemic embolization without left ventricular thrombus attributable to acute MI; histological evidence of venous origin of coronary embolic material; and evidence of an embolic source based on transthoracic echocardiography, transesophageal echocardiography, computed tomography, or magnetic resonance imaging.[1,6] The minor criteria are 25% stenosis on coronary angiography except for the culprit lesion (met by this patient); presence of emboli risk factors, such as prosthetic heart valve (met by this patient); and AF.[1,6]

Management of CE remains controversial; aspiration of thrombus may be considered in the acute setting and with evidence of a heavy thrombus formation. This may allow for restoration of flow and retrieval of thrombus formation for histopathologic evaluation. However, it is important to mention that in the setting of STEMI, aspiration has been shown to increase risk of stroke and lead to increased morbidity. If aspiration of thrombus provides good restoration of flow, there is no need for further percutaneous intervention. Benefits of aspiration in low thrombus burden are not well established and do not provide any additional benefit compared with those of anticoagulation.[6-11]

Anticoagulation should be initiated in patients with AF and low bleeding risk, even when CHA_2DS_2-VASc (congestive heart failure, hypertension, aged ≥ 75 years, diabetes mellitus, stroke or transient ischemic attack, vascular disease, aged 65 to 74 years, sex category) score is low. In patients with prolonged immobilization, recent surgery, pregnancy, use of oral contraceptives/tamoxifen, or other reversible risks, 3 months of anticoagulation has been shown to be sufficient. In the setting of active cancer or known thrombophilia, prolonged anticoagulation is recommended. Thrombophilia testing is not recommended in the setting of CE.[1]

The America College of Cardiology/American Heart Association guidelines for valvular heart disease recommend that patients with mechanical prosthetic aortic valves should be started on a vitamin K antagonist with a target INR of 2 to 3. (Class 1A). Prosthetic mitral and high thromboembolic valves require a higher INR target above 3.0. The addition of antiplatelet agents, such as aspirin in doses of 75 to 100 mg, should be started to decrease risk of thromboembolic disease in all patients with prosthetic heart valves.[12]

CE is not a common cause of ACS. Nevertheless, it was considered in the differential diagnosis of this patient, and diagnostic criteria were reviewed. This patient met the diagnostic criteria for a definitive diagnosis of CE. These included 1 major and 2 minor criteria: angiographic evidence of coronary artery embolism and thrombosis without

atherosclerotic components; < 25% stenosis on coronary angiography except for the culprit lesion; and presence of emboli risk factors (prosthetic heart valve).

CE is rare, and review of the literature reveals that it accounts for < 3% of all ACS cases. Despite its rarity, it is important to recognize its risk factors, which include prosthetic heart valves, valvuloplasty, vasculitis, AF, left ventricular aneurysm, and endocarditis. The difference in treatment between CE and the most frequently encountered etiologies of ACS reveals the importance in recognizing this syndrome. Management of CE remains controversial. Nevertheless, when the culprit lesion is located in a distal portion of the vessel involved, as was seen in our patient, and in cases where there is a low thrombi burden, anticoagulation instead of thrombectomy is usually preferred. Patients with prosthetic mechanical valves have a high incidence of thromboembolism. This sometimes leads to thrombi formation in uncommon locations. Guidelines of therapy in these patients recommend that all prosthetic mechanical valves should be treated with both antiplatelet and anticoagulation therapies to reduce the risk of thrombi formation.

CONCLUSION

Physicians involved in diagnosing ACS should be aware of the risk factors for CE and always consider it while evaluating patients and developing the differential diagnosis.

Author disclosures

The authors report no actual or potential conflicts of interest with regard to this article.

References

1. Raphael CE, Heit JA, Reeder GS, et al. Coronary embolus: an underappreciated cause of acute coronary syndromes. *JACC Cardiovasc Interv.* 2018;11(2):172-180. doi:10.1016/j.jcin.2017.08.057
2. Popovic B, Agrinier N, Bouchahda N, et al. Coronary embolism among ST-segment-elevation myocardial infarction patients: mechanisms and management. *Circ Cardiovasc Interv.* 2018;11(1):e005587. doi:10.1161/CIRCINTERVENTIONS.117.005587
3. Oakley C, Yusuf R, Hollman A. Coronary embolism and angina in mitral stenosis. *Br Heart J.* 1961;23(4):357-369. doi:10.1136/hrt.23.4.357
4. Charles RG, Epstein EJ. Diagnosis of coronary embolism: a review. *J R Soc Med.* 1983;76(10):863-869.
5. Bawell MB, Moragues V, Shrader EL. Coronary embolism. *Circulation.* 1956;14(6):1159-1163. doi:10.1161/01.cir.14.6.1159
6. Shibata T, Kawakami S, Noguchi T, et al. Prevalence, clinical features, and prognosis of acute myocardial infarction attributable to coronary artery embolism. *Circulation.* 2015;132(4):241-250. doi:10.1161/CIRCULATIONAHA.114.015134
7. Prizel KR, Hutchins GM, Bulkley BH. Coronary artery embolism and myocardial infarction. *Ann Intern Med.* 1978;88(2):155-161. doi:10.7326/0003-4819-88-2-155
8. Lacunza-Ruiz FJ, Muñoz-Esparza C, García-de-Lara J. Coronary embolism and thrombosis of prosthetic mitral valve. *JACC Cardiovasc Interv*. 2014;7(10):e127-e128. doi:10.1016/j.jcin.2014.02.025
9. Jolly SS, Cairns JA, Yusuf S, et al. Outcomes after thrombus aspiration for ST elevation myocardial infarction: 1-year follow-up of the prospective randomised TOTAL trial. *Lancet.* 2016;387(10014):127-135. doi:10.1016/S0140-6736(15)00448-1
10. Fröbert O, Lagerqvist B, Olivecrona GK, et al. Thrombus aspiration during ST-segment elevation myocardial infarction [published correction appears in *N Engl J Med*. 2014 Aug 21;371(8):786]. *N Engl J Med.* 2013;369(17):1587-1597. doi:10.1056/NEJMoa1308789
11. Kalçık M, Yesin M, Gürsoy MO, Karakoyun S, Özkan M. Treatment strategies for prosthetic valve thrombosis-derived coronary embolism. *JACC Cardiovasc Interv.* 2015;8(5):756-757. doi:10.1016/j.jcin.2014.11.019
12. Nishimura RA, Otto CM, Bonow RO, et al. 2017 AHA/ACC focused update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation.* 2017;135(25):e1159-e1195. doi:10.1161/CIR.0000000000000503