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INTERMEDIATE

CASE REPORT: CLINICAL CASE

Supporting High-Risk Percutaneous Coronary Interventions With Mechanical Devices

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ABSTRACT

The use of mechanical circulatory support to maintain appropriate hemodynamics in high risk percutaneous coronary intervention cases is a new frontier. Treatment of cases that were once considered prohibitive may now be possible. Due to a paucity of data, guidelines offer no guidance about the use of mechanical circulatory support in such cases. This case, the first documented case of extracorporeal membrane oxygenation support for percutaneous coronary intervention (PCI) of a vein graft supplying the entire coronary circulation, adds to the medical literature demonstrating a likely benefit in the use of mechanical support during high risk PCI in patients without shock. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2020;2:702–4) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

PRESENTATION

A 62-year-old man presented to an outside hospital with complaints of resting and exertional interscapular back pain over the past few weeks that had progressed. These complaints were consistent with prior stable anginal-equivalent pain but were no longer responsive to nitroglycerin therapy. The patient had a blood pressure 109/70 mm Hg, and he was bradycardic with heart rate 47 beats/min and saturations 97% in room air.

LEARNING OBJECTIVES

- To recognize the correlation between PCI in lesions supplying large territories of myocardium and the risk for ventricular decompensation and failure.
- To consider the role of novel mechanical circulatory support during PCI for hemodynamically stable patients undergoing PCI with 1 vessel supplying their coronary circulation.

On physical examination, he had normal rate, regular rhythm, normal heart sounds, and intact distal pulses. Exam revealed no gallop and no friction rub.

MEDICAL HISTORY. Prior myocardial infarction and subsequent 4-vessel coronary artery bypass grafting (CABG) 22 years ago, resultant severe ischemic cardiomyopathy with a left ventricular ejection fraction of 15% to 20% with New York Heart Association functional class III symptoms, nonsustained

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Case Reports* author instructions page.

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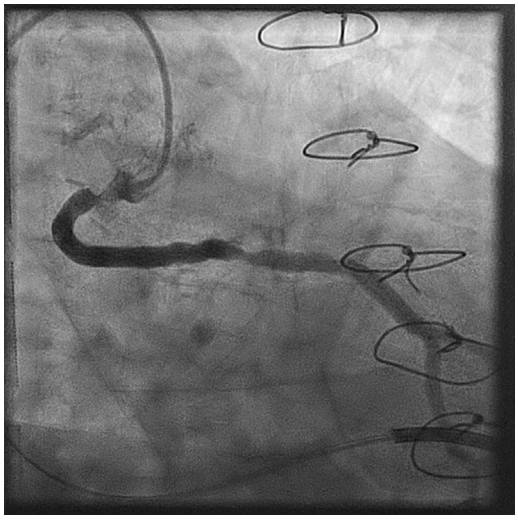
FIGURE 1 Angiography of the Saphenous Vein Graft With Culprit Occlusions



ventricular tachycardia with an implanted cardioverter-defibrillator for primary prevention, hypertension, hyperlipidemia, and transient ischemic attack. The CABG had been performed solely with vein grafts: one to the left anterior descending, one to the right coronary artery, and one as a jump graft to both the first and the second obtuse marginal arteries. A left heart catheterization performed 2 years previous to his presentation showed subtotally occluded left main and right coronary arteries and totally occluded vein grafts to the right coronary artery and to the left anterior descending.

DIFFERENTIAL DIAGNOSIS. Differential included myocardial infarction (both type I and type II), aortic dissection, and noncardiovascular pain including musculoskeletal pathologies.

INVESTIGATIONS. Serum troponin level was elevated. Given the consistency of the pain with the patient's previously stable angina, coronary angiography was performed. This showed ostial left main and proximal right coronary artery chronic total occlusions with a saphenous vein graft (SVG) to the obtuse marginal branch artery as his only remaining conduit supplying essentially his entire coronary circulation through distal collateral vessels. The patent graft had 2 high-grade lesions in the proximal and mid-to-distal portions (**Figure 1**, Video 1).

MANAGEMENT. The patient was transferred to the authors' tertiary facility for evaluation and a discussion about redoing the sternotomy and CABG versus performing high-risk percutaneous coronary intervention (PCI). The advanced heart failure team met with the patient and discussed possible left ventricular assist device implantation. He emphatically declined long-term mechanical circulatory support (MCS) but accepted the proposition of short-term mechanical assistance. A nuclear myocardial viability study showed viability only in the circumflex territory. The cardiothoracic surgery team declined to redo the sternotomy.

After serial discussions, a joint plan was made by the cardiology and cardiothoracic surgery teams to pursue extracorporeal membrane oxygenation (ECMO)-supported PCI. As the patient's cardiac function was completely dependent upon 1 SVG, it was felt that Impella support (AbioCor, Danvers, Massachusetts) would be insufficient for augmenting cardiac output should he experience significant cardiac decompensation during the PCI, as this could quickly lead to biventricular failure.

Both teams were present on the day of the procedure in the catheterization laboratory. A 25-F venous ECMO cannula was placed in the right femoral vein, and a 19-F arterial cannula was placed in the left femoral artery. After ECMO support was initiated, PCI of the SVG was performed with balloon angioplasty and stenting of both discrete lesions (**Figure 2**, Video 2). There were no immediate complications. The patient was weaned from ECMO support, and decannulation was performed in the catheterization laboratory. The patient was transferred to the intensive care unit and received low-dose inotropic support that was rapidly tapered. He was discharged 3 days later and was able to walk hundreds of feet without any chest discomfort.

DISCUSSION

There are increased risks of ventricular decompensation and eventual failure when myocardial territories have decreased perfusion during percutaneous interventions. The larger the at-risk area becomes, the less favorable the risk:benefit ratio for intervention becomes. Many nonsurgical patients have anatomy that is considered too high risk for attempting intervention, as operators may feel that there is no reasonable expectation against mortality with the risks of intervention in these patients. Looking at the role of MCS in shock lends some hope for future developments that will improve that risk:benefit ratio.

ECMO, for example, has shown a life-saving role in the treatment of some patients with cardiogenic shock (1). The American College of Cardiology/American Heart Association's ST-segment elevation

ABBREVIATIONS AND ACRONYMS

CABG = coronary artery bypass grafting

ECMO = extracorporeal membrane oxygenation

MCS = Mechanical circulatory support

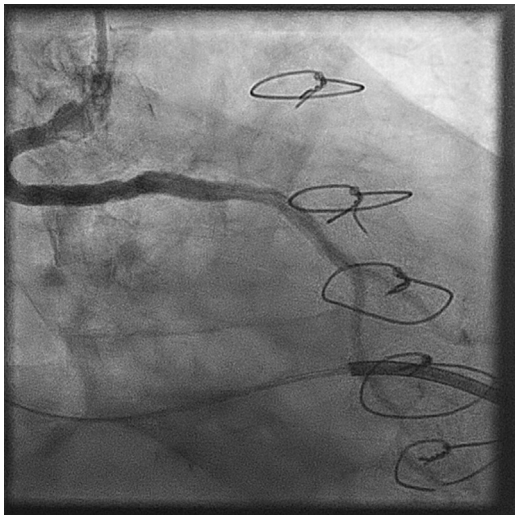
NYHA = New York Heart Association

PCI = percutaneous coronary intervention

STEMI = ST-segment elevation myocardial infarction

SVG = saphenous vein graft

FIGURE 2 Angiography of the Saphenous Vein Graft Post-Stenting



myocardial infarction (STEMI) guidelines have a Class IIa recommendation for use of MCS in STEMI patients with unstable hemodynamics (2). The European Society of Cardiology's myocardial revascularization guidelines have a Class IIb recommendation for short-term use of MCS in patients with acute coronary syndromes and unstable hemodynamics (3). New research is bringing light to its role in supporting high-risk PCI in patients without shock (4–7). However, there are no current guideline recommendations for or against MCS in hemodynamically stable patients.

FOLLOW-UP. After his initial recovery period, the patient went home in good condition and has continued to follow-up with his medical team outside of the authors' healthcare system.

CONCLUSIONS

As with other forms of MCS, ECMO support for nonshock, high-risk PCI is terrain still being charted in the modern era. The practice is increasingly substantiated by case reports and case series. Studies of patients with non-STEMI without cardiogenic shock have been promising. After reviewing PubMed and Google Scholar, the authors believe this is the first report of a successful ECMO-supported PCI of an SVG to preserve a patient's only remaining viable myocardium. This case adds to a growing body of medical literature in support of further research of MCS during coronary interventions. It is anticipated that future research will be able to help guide the role of MCS in patients without shock who require PCI.

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KEY WORDS cardiac assist devices, myocardial infarction, myocardial revascularization, percutaneous coronary intervention

APPENDIX For supplemental videos, please see the online version of this paper.