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CASE REPORT

INTERMEDIATE

CLINICAL CASE

High Risk Coronary Atherectomy, Perforation, and Successful Percutaneous Treatment

When Impella Support Prevents Catastrophe

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ABSTRACT

We report a case of coronary perforation during high-risk percutaneous coronary intervention with Impella (Abiomed, Danvers, Massachusetts) support that resulted in cessation of pulsatile arterial flow. Maintenance of systemic perfusion due to antecedent placement of Impella 2.5 allowed for successful treatment with pericardiocentesis and covered stent placement, early discharge, and complication-free follow-up. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2020;2:664–7) © 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/).

A 90-year-old man presented with 2 weeks of progressive shortness of breath and left sided chest pressure that was worsened by exertion.

PAST MEDICAL HISTORY

The patient's past medical history included hypertension, cerebrovascular accident without residual deficits, and peripheral arterial disease.

LEARNING OBJECTIVES

- To understand the use of MCS in appropriately selected patients undergoing HR-PCI.
- To understand the role of percutaneous MCS for swift, percutaneous management of PCI complications, including coronary artery perforation.

DIAGNOSIS

An electrocardiogram demonstrated new right bundle branch block with lateral T-wave inversions. Initial and peak troponins were 0.1 and 9.5 ng/ml, respectively. Intravenous heparin and oral aspirin were started for non-ST-segment elevation myocardial infarction.

INVESTIGATIONS

Echocardiography showed anterior wall hypokinesis with left ventricular (LV) ejection fraction of 42%. Coronary angiography (CA) demonstrated 90% calcified occlusion of the distal left main coronary artery (LM), 90% severely angulated, calcified mid-left anterior descending coronary artery (LAD), 60%

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tubular mid-left circumflex artery, and mild right coronary artery lesions. The patient was referred to our hospital for coronary revascularization.

The patient was hemodynamically stable and was offered percutaneous coronary intervention (PCI) or optimal medical therapy. After a thorough risk/benefit discussion, the decision was made to pursue high-risk PCI using hemodynamic support given his high ischemic burden and likelihood to benefit from revascularization. Computed tomography angiography to assess potential access sites showed extensive bilateral ilio-femoral calcific atherosclerosis and minimal left subclavian and axillary artery disease.

SEE PAGE 668

MANAGEMENT

The patient was taken to the catheterization laboratory and an Impella 2.5 (Abiomed, Danvers, Massachusetts) was placed percutaneously via the left axillary artery. Blood pressure prior to insertion was 102/61 mm Hg, which increased to 118/77 mm Hg at power level 8. CA confirmed the previous findings (**Figure 1**, Video 1). Rotational atherectomy of the distal LM and proximal and mid-LAD was performed with a 1.5-mm burr (Video 2). Soon thereafter, the patient developed narrowed pulse pressure and severe hypotension to 71/49 mm Hg. CA demonstrated extravasation of contrast at the mid LAD consistent with coronary perforation (**Figure 2**, Video 3). Despite the addition of dopamine, the arterial waveform quickly became nonpulsatile with mean pressure 55 mm Hg. Bedside echocardiography demonstrated a pericardial effusion with tamponade and profoundly depressed LV function. Despite the lack of arterial pulsatility, the patient remained alert and conversant.

The patient was empirically transfused with 1 U of packed red blood cells. Contemporaneous balloon occlusion of the perforated segment and pericardiocentesis with removal of 1,150 ml of frank blood was performed. The effusion resolved, and a pulsatile arterial waveform returned. Three overlapping 2.8 × 19, 3.5 × 19, and 4.0 × 19 mm Graftmaster Covered Stents (Abbott, Chicago, Illinois) were deployed with no further contrast extravasation (**Figure 3**). A 3.5 × 33 mm drug-eluting stent was deployed across the LM lesion, overlapping with the proximal most covered stent. Intravascular ultrasound-guided post dilation was performed using 3.5 and 4.0 mm noncompliant balloons. Post-intervention angiography showed no residual stenosis and TIMI (Thrombolysis In Myocardial Infarction) flow grade 3 (Video 4).

DISCUSSION

By reducing LV wall tension and myocardial oxygen demand while augmenting coronary and systemic perfusion, mechanical circulatory support (MCS) allows high-risk patients to undergo PCI with acceptable morbidity and mortality risks. Pre-operative placement of MCS has particular relevance in the high-risk percutaneous coronary intervention (HR-PCI) population, where baseline LV compromise and procedural ischemia is the norm, and the risks of complications, including coronary perforation, cardiogenic shock, and cardiac arrest, are increased (1-3). The present case illustrates successful percutaneous coronary perforation repair while under previously established Impella support, all in a patient who remained conscious and alert due to maintenance of tissue perfusion. By unloading the left ventricle, Impella may have allowed for an increased volume of blood to enter the right ventricle than would otherwise be the case during a large effusion, and enhanced circulation compared with what would be the case without mechanical circulatory support.

Unsupported HR-PCI is associated with significant morbidity and mortality. Among a cohort of HR-PCI cases at a high-volume center, 20% of patients without pre-operatively placed MCS died, developed cardiac arrest, required vasopressors, or necessitated rescue MCS (4). By augmenting flow, Impella improves coronary and end-organ perfusion, and can help prevent hemodynamic instability during HR-PCI (5-7). In multiple U.S. and European registries of Impella-supported HR-PCI, relatively low rates of 30-day mortality were observed (2,3,5). Randomized

ABBREVIATIONS AND ACRONYMS

CA = coronary angiography

HR-PCI = high-risk percutaneous coronary intervention

LAD = left anterior descending coronary artery

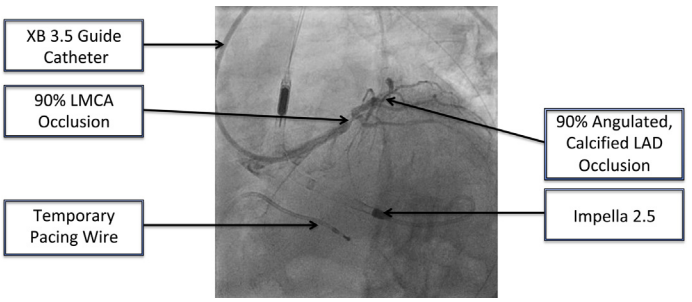
LM = left main coronary artery

LV = left ventricle

MCS = mechanical circulatory support

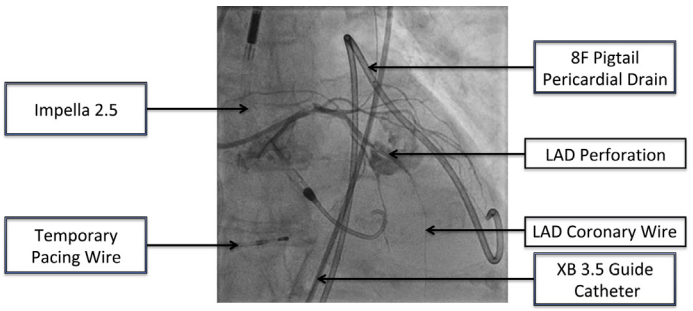
PCI = percutaneous coronary intervention

FIGURE 1 Diagnostic Angiogram Demonstrating 90% Occlusion of the LMCA, and 90% Occlusion of the Mid-LAD Coronary Artery



LAD = left anterior descending; LMCA = left main coronary artery.

FIGURE 2 Large Perforation of the LAD Coronary Artery After Atherectomy



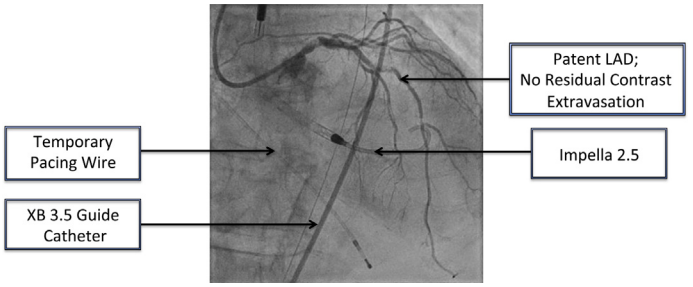
LAD = left anterior descending.

controlled data from the PROTECT II trial comparing Impella-supported and intra-aortic balloon pump-protected HR-PCI have been mixed with 90-day data suggesting an advantage in major adverse events with Impella support (7,8). Full percutaneous axillary artery access for those with severe lower extremity peripheral disease is an attractive option with relatively low rates of hemothorax, subclavian artery dissection, and mammary artery compromise (9).

Complex, calcified coronary lesions increase the risk of coronary perforation during PCI (6). Mortality rates after coronary artery perforations are as high as 40% when cardiac tamponade develops (6). With MCS, the negative consequences of coronary artery perforation during HR-PCI can be mitigated while the perforation is addressed either percutaneously or surgically (10).

Although HR-PCI using Impella support complicated by coronary perforation has previously been reported (11), the present case is the first report to demonstrate survival after this approach. Impella allowed for the maintenance of distal perfusion while the source of the patient's hemodynamic collapse—pericardial tamponade from a coronary perforation—was swiftly addressed without complication.

FIGURE 3 Resolution of Coronary Perforation After Placement of 3 Covered Stents in the Affected LAD Territory



LAD = left anterior descending.

FOLLOW-UP

Immediately post-PCI, dopamine was weaned off and the Impella was removed without difficulty. On post-operative day 2, there was no further pericardial drainage, there was no pericardial effusion on echocardiography, and the patient was discharged to home in stable condition. Through 6 months of follow-up, the patient has remained free of cardiovascular symptoms.

CONCLUSIONS

The use of Impella device implantation and support prior to initiation of HR-PCI for complex coronary disease may mitigate the profound negative hemodynamic consequences of procedural complications. By providing adequate time for the successful treatment of coronary perforation using coronary balloon tamponade, pericardiocentesis, and covered stent implantation, mechanical support with the Impella device allowed for the rapid cessation of vasopressor agents, immediate removal of the Impella device following the case, early hospital discharge to home, and complication-free survival beyond 6 months of follow-up, all despite the transient loss of arterial pulsatility. This report provides further evidence that appropriately selected patients undergoing HR-PCI may benefit from established MCS before complications occur.

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KEY WORDS cardiac assist devices, coronary angiography, hemodynamics, percutaneous coronary interventions

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