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CASE REPORT

ADVANCED

CLINICAL CASE

Retrieval of Entrapped Catheter-Mounted Axial Flow Pump From Mitral Subvalvular Apparatus Using a Snare Catheter

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ABSTRACT

Axial-flow ventricular assist devices are being increasingly used to support hemodynamically compromised patients undergoing percutaneous coronary intervention. Periprocedural valvular complications have been recognized in a few case reports. We present a unique case of entanglement of the Impella within he mitral subvalvular apparatus, retrieved successfully using a snare under fluoroscopic guidance. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:1494–1498) © 2021 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 67-year-old man presented to the emergency department with a 4-day history of dull central chest pain and shortness of breath. He was in hemodynamically stable condition, and his physical examination results were unremarkable. An electrocardiogram (ECG) showed Q waves in V_1 and V_2 with ST-segment depression in the inferolateral leads (**Figure 1**). Laboratory data showed significant elevation of the high-sensitivity troponin I (hs-cTnI) to 11,720 ng/l. A transthoracic echocardiogram (TTE) revealed reduced left ventricular (LV) ejection fraction (LVEF ~35%), with thinned, akinetic, mid and apical anterior segments. The patient received a diagnosis of non-ST-segment elevation myocardial infarction (NSTEMI) and was urgently transferred to the cardiac catheterization laboratory for emergent coronary angiography (CA). This revealed severe distal left main stem (LMS) disease involving the ostium of the left anterior descending (LAD) and left circumflex (LCX) arteries with further severe disease in the proximal LAD (Video 1), and moderate disease in the mid right coronary artery (RCA). He was admitted to

LEARNING OBJECTIVES

- To emphasize the need to carefully place the axial-flow ventricular assist devices into the LV cavity under fluoroscopic guidance to avoid devastating iatrogenic aortic and mitral valve complications.
- To recognize the possible migration of the axial-flow pump into the LV cavity which may result in entrapment of the pigtail catheter beneath the mitral subvalvular apparatus.
- To understand how to retrieve the entangled axial-flow pump from around the papillary muscle using Ensnare.

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the coronary care unit (CCU) for multidisciplinary team discussion.

MEDICAL HISTORY

The patient had no medical history of clinical significance, but he was diagnosed with diabetes mellitus during the admission.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included acute coronary syndrome (ACS) consistent with either NSTEMI or late-presentation ST-segment elevation myocardial infarction (STEMI).

INVESTIGATIONS

The patient underwent cardiac magnetic resonance (CMR) imaging, which showed extensive infarction in the LAD territory, with thinned and akinetic mid and apical anterior segments, and hypokinetic basal and mid anteroseptal segments, with severely depressed LV systolic function (LVEF ~37%).

MANAGEMENT

The case was discussed by the multidisciplinary team. The consensus was that his optimal treatment would be revascularization by coronary artery bypass graft (CABG) surgery. Unfortunately, while awaiting surgery the patient experienced cardiac arrest with ventricular fibrillation, requiring cardioversion. There was no access to emergency surgery, and the opinion was that his condition was too unstable to allow the use of bypass; therefore, after successful resuscitation, patient was intubated and transferred to the cardiac catheterization laboratory. Our aim was to stabilize his cardiac output by unloading the left ventricle with the Impella CP axial-flow pump and proceed to percutaneous coronary intervention (PCI) of the LMS bifurcation.

Right femoral artery access was gained, and a 14-F peel-away sheath was inserted, through which an axial-flow pump catheter was placed across the aortic valve. In the 2 o'clock position of the Impella sheath,

ABBREVIATIONS AND ACRONYMS

ACS = acute coronary syndrome

CA = coronary angiography

CABG = coronary artery bypass graft

CMR = cardiac magnetic resonance

ECG = electrocardiogram

LVEF = left ventricular ejection fraction

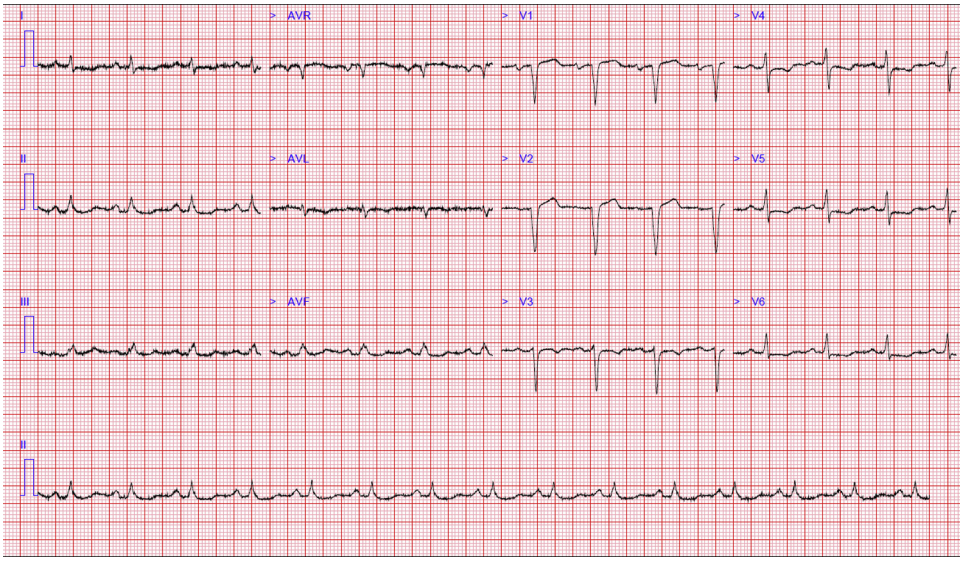
MI = myocardial infarction

PCI = percutaneous coronary intervention

TEE = transesophageal echocardiography

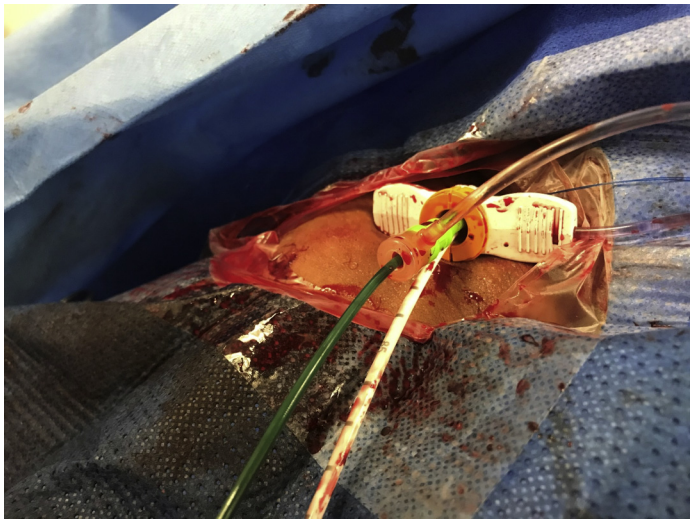
TTE = transthoracic echocardiography

FIGURE 1 Electrocardiogram at Presentation



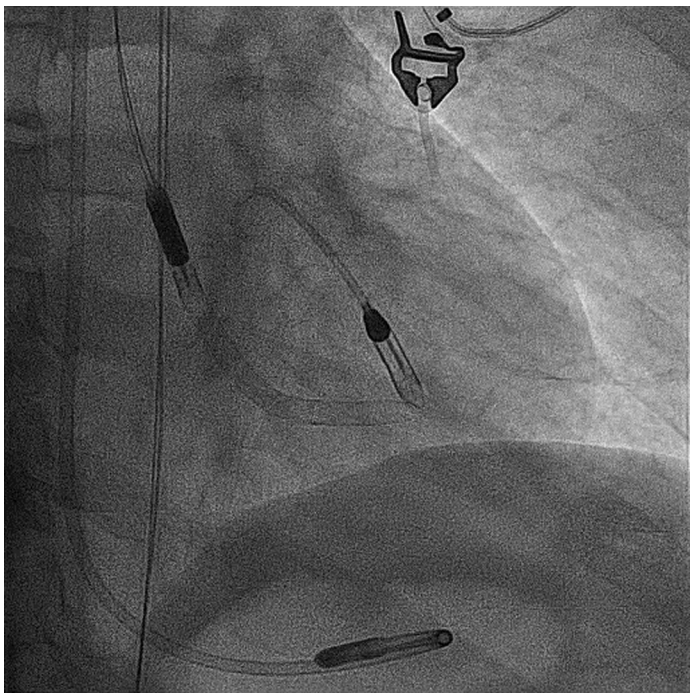
Initial electrocardiogram at presentation showing Q-waves in V_1 and V_2 with ST-segment depression in the inferolateral leads.

FIGURE 2 Single Access Technique



Axial-flow pump insertion in the right femoral artery showing single access technique.

FIGURE 3 Fluoroscopy 1



Fluoroscopic view showing entanglement of the axial-flow pump around the mitral subvalvular apparatus.

a short 7-F glide sheath was inserted using a single access technique (**Figure 2**). A 7-F VL3.5 guide catheter (Boston Scientific) was introduced, and run-through wires were inserted into to the LAD and LCX. The LMS was treated with the double-kiss crush stenting technique using a 3 × 19 Biomatrix stent in the LCX and a 4 × 19 Biomatrix to the LAD/LMS. The proximal LAD to diagonal was stented with 3 × 36 Biomatrix stent (Video 2). The procedure was uneventful at this juncture, with the patient in stable hemodynamic condition.

A decision was made to leave the axial-flow pump in situ to maintain hemodynamic stability; however, during removal of the peel-away sheath, the axial-flow pump pigtail catheter migrated forward into the LV and became entangled within the mitral subvalvular apparatus (**Figure 3**). Gentle traction was applied, but the axial-flow pump remained angulated and could not be pulled back (Video 3). Transesophageal echocardiography (TEE) was performed and confirmed that the axial-flow pump was wrapped around the subvalvular mitral apparatus (Video 4). The automated Impella controller showed a flat pressure trace, suggesting no left ventricle to aortic flow. We gained access to the left femoral artery with an 8-F sheath. A 7-F MPA guide catheter (Boston Scientific) was passed, and through this, a 7-F Ensnare was advanced to snare the distal pigtail end of the axial-flow pump catheter, which was prolapsing back into the ascending aorta. The snared pigtail end of the axial-flow pump catheter was then advanced, pushing the pigtail back through the aortic valve into the LV while simultaneously withdrawing the whole system and thereby straightening the axial-flow pump device (**Figure 4,** Video 5). Releasing the catheter then allowed the pigtail to be retrieved and disentangled from the mitral apparatus (**Figure 5,** Video 6). In view of the patient's relative hemodynamic stability, the axial-flow pump was removed along with the femoral sheath, and the femoral artery was sealed with 2 preclose sutures. The patient was transferred to the intensive care unit.

DISCUSSION

Axial-flow ventricular assist devices are mechanical support devices that are being increasingly used for the support of hemodynamically compromised patients undergoing high-risk PCI (1). The placement of axial-flow pump devices is associated with rare but potentially serious complications. The most frequently reported complications are bleeding, vascular injuries, and distal thrombus formation (2,3). There have been case reports of mitral subvalvular

chordae tendineae injury and rupture during the positioning of the axial-flow pump, resulting in acute severe mitral regurgitation (4).

A recently published case report demonstrated entrapment of the Impella inlet in the mitral subvalvular apparatus in the context of cardiogenic shock after coronary revascularization of STEMI (5). The patient underwent explantation of the Impella after 96 hours. Subsequent assessment of the mitral valve with 3-dimensional TEE revealed evidence of severe eccentric mitral regurgitation not amenable to mitral valve repair, and the patient underwent bioprosthetic mitral valve replacement (5). Interestingly, in our case, the axial-flow pump had also migrated deeply into the LV, resulting in entrapment of its pigtail catheter around the mitral subvalvular apparatus; however, as described we successfully retrieved it using a snare catheter under fluoroscopic guidance.

Snare-facilitated retrieval of the Impella has been described in a case report as a technique to avoid retraction-induced injury to the subvalvular apparatus (6). Similarly, in this case, the distal pigtail portion of the axial-flow pump was pushed by using a snare under fluoroscopic guidance into the LV to relieve the kink and straighten the device before successful removal from around the papillary muscle.

FOLLOW-UP

The patient had an uneventful recovery, and despite the requirement for inotropic agents and a short period of filtration, he was discharged from the intensive care unit after 30 days to the cardiology ward. Follow-up TTE after the procedure revealed trivial mitral regurgitation (Video 7).

CONCLUSIONS

We present a rare case of entangled pigtail catheter of an axial-flow pump beneath the mitral subvalvular apparatus, managed successfully using the 7-F Ensnare under fluoroscopic guidance without mitral valve injury.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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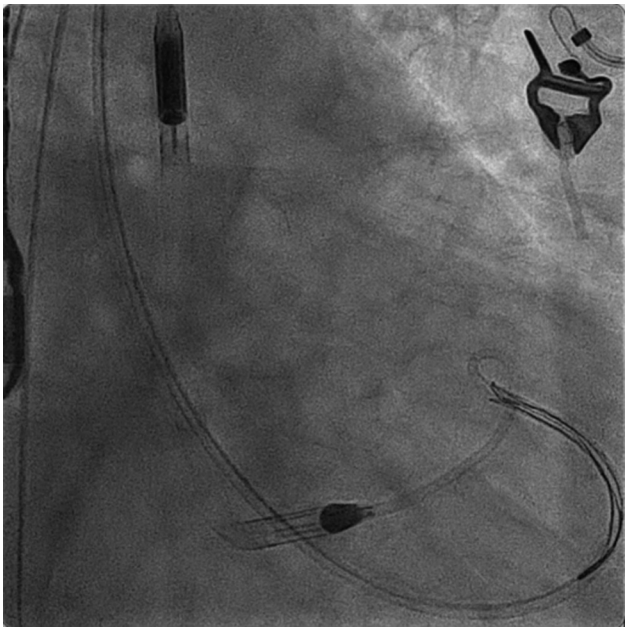
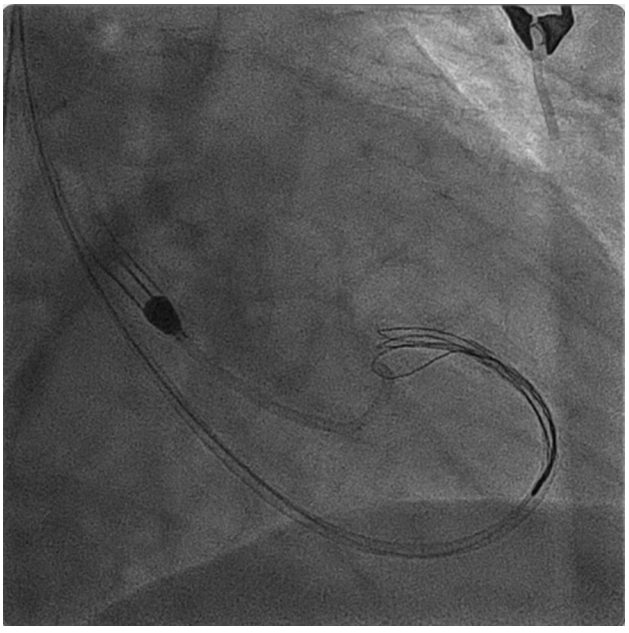
FIGURE 4 Fluoroscopy 2



Fluoroscopic view showing capture and prolapse of the axial-flow pump catheter across the aortic valve.

FIGURE 5 Fluoroscopy 3



Fluoroscopic view showing successful release of the entangled axial-flow pump catheter from the mitral subvalvular apparatus.

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KEY WORDS axial-flow pump, double kiss crush stenting, left main stem, left ventricular assist device, mechanical circulatory support, mitral valve injury, percutaneous coronary intervention

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