Device fracture as a potential complication of a left ventricular microaxial pump catheter: a case report

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Background
The use of an Impella pump catheter has advanced substantially in the last few years due to the simple insertion procedure and smaller device size. However, its use is still associated with some risks and complications. Here, we report a device fracture as a rare complication that occurred during the device extraction a few days after the initial insertion.

Case summary
A 74-year-old man with cardiogenic shock due to acute non-ST-segment elevation myocardial infarction presented to our hospital, and he was transferred to the cath lab for emergency percutaneous coronary intervention (PCI). An Impella CP pump was inserted without any complication prior to PCI. After successful PCI, the patient was transferred to the intensive care unit with device left for continued haemodynamic support. After 3 days, as the patient’s condition remarkably improved, we tried to remove the device. However, a persistent mechanical resistance hindered the further catheter retraction; therefore, a decision was made to remove the catheter under fluoroscopy. Indeed, the fluoroscopy revealed a broken distal part of the pump at the level of the ascending aorta. The retained catheter tip was eventually snared with a snare catheter and removed without any complication.

Discussion
An Impella microaxial pump may improve the overall outcome by providing haemodynamic support in critically ill patients. However, its application is not without complications. Intravascular device tip fracture, as demonstrated in this case report, is a rarely reported complication. The use of a snare catheter can be an option in retrieving a broken pump.

Keywords
Left ventricular assist devices • Cardiogenic shock • Percutaneous coronary intervention • Case report • Acute myocardial infarction

ESC Curriculum
6.4 Acute heart failure • 7.1 Haemodynamic instability • 3.2 Acute coronary syndrome • 7.3 Critically ill cardiac patient

Learning points
• Microaxial left ventricular assist device represents a major advance in interventional cardiology; however, its use can be associated with some rare complications, such as a device fracture.
• The fractured device fragment can be safely retrieved by using the interventional catheter system without the need for surgical intervention, as demonstrated in this report.

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Introduction

The use of percutaneous left ventricular assist devices (LVADs), such as an Impella pump catheter, has advanced substantially in the last few years due to the simple insertion procedure and smaller device size.\(^1\)\(^,\)\(^2\) However, their use is still associated with some risks and complications. Here, we report a device fracture as a rare complication that occurred during the device extraction a few days after the initial insertion.

Timeline

| Organized timeline—the sequence of events |
|------------------------------------------|
| Day 0 | • Presentation of the 74-year-old patient with cardiogenic shock due to acute myocardial infarction |
|       | • Emergency transfer to the cath lab for Impella implantation and emergency percutaneous coronary intervention (PCI) |
|       | • Uncomplicated Impella—implantation and PCI |
|       | • Patient’s transfer to the intensive care unit with Impella left for continued haemodynamic support |
| Day 3 | • Indication for the Impella pump removal after successful weaning |
|       | • However, the pump cannot be removed because of the pull-out resistance. The bedside echocardiography reveals no pump inside of the left ventricle. A decision was made to remove the pump under fluoroscopy in the cath lab |
|       | • Fluoroscopy reveals the fractured distal part of the Impella pump inside of the ascending aorta |
|       | • Successful retrieval of the broken part using a snare catheter |
| Day 13 | • Discharge of the patient from the hospital in a good clinical and haemodynamic condition |

History of presentation

A 74-year-old man presented to our hospital with cardiogenic shock due to acute non-ST-segment elevation myocardial infarction. No relevant illnesses, except arterial hypertension, were known at the time of admission. The electrocardiogram showed ST-T depressions in anterior and anterolateral leads along with the episodes of intermittent ventricular tachycardia. At the time of admission, the blood pressure was 74/52 mmHg, heart rate 112/min, and 88% oxygen saturation on 8 L nasal cannula. Echocardiography revealed anterior wall hypokinesis that was not available, as the patient’s condition further deteriorated and the decision was made for emergency cardiac intervention.

Management

The patient was immediately transferred to our cath lab for invasive revascularization. Due to the intermittent asystolic episodes, temporary pacing electrode was placed in the right ventricle. Because of cardiovascular shock and severely impaired LV function, the 14F Impella CP pump was inserted via the right femoral artery under fluoroscopy without any complication prior to percutaneous coronary intervention (PCI). The emergency coronary angiography through the left femoral artery revealed the proximally located subtotal left anterior descending (LAD) coronary artery stenosis as a culprit lesion. The PCI with the LAD stenting (3.5 x 23 mm drug-eluting stent) was performed swiftly and without any complication. Thereafter, the patient was transferred to the intensive care unit with the device left for continued haemodynamic support of initially 3.5 L/min as a bridge to recovery (Figure 1).

Indeed, the entire treatment course during device placement was unremarkable, particularly, no significant bleeding or haemolysis, flow alerts, and radiological or clinical evidence of pump malfunction or dislocation were observed. As the patient’s clinical condition and haemodynamics steadily improved, a decision was made to eventually remove the pump on Day 3 after implantation and successful weaning according to the manufacturer’s recommendations. Thus, the haemodynamic support was discontinued just before the device removal. However, a mechanical resistance, hindering further retraction of the catheter, was felt, and any removal attempts were therefore stopped. Since the alarm signal was turned off, no warning sound could be perceived. As the resistance persisted and the bedside echocardiography showed no device inside of the LV, a decision was made to remove the catheter under fluoroscopy in the cath lab. Indeed, the fluoroscopy revealed that the distal end of the pump was broken off and remained eventually at the level of the ascending aorta (Figure 2A). We first opted for the interventional retrieval of the fractured device. The retained catheter tip was eventually snared with a 4F loop snare catheter (Amplatz Goose Neck™ snare kit; Medtronic, Minneapolis, USA), removed without any complication via the right femoral artery (Figure 2B and C), and

Figure 1 The coronary angiogram (antero-posterior view) shows the correct position of the distal pump inside the left ventricle.
Device fracture as a potential complication

Follow-up

At the last follow-up visit, no relevant complaints but minimal groin haematoma were documented. Ultimately, the patient was discharged nearly 2 weeks later in a good clinical condition and virtually normalized LV function (EF 48%) in a follow-up transthoracic echocardiography.

Discussion

The Impella microaxial pump (Abiomed, Danvers, MA, USA), one of the most used percutaneous LVADs, is generally advanced to the LV under fluoroscopy via a retrograde transaortic approach without the need for extracorporeal oxygenation and surgical implantation. In patients with acute heart failure due to a cardiogenic shock, they can be left in place for a few days, until a stable haemodynamic condition is achieved.

By providing haemodynamic support in critically ill patients, LVADs may improve the overall outcome. However, their application is not without complications. Among them, groin bleeding is quite common after device placement or removal. Stroke, haemorrhagic or ischaemic in nature, remains, perhaps, the most feared complication related to LVAD application.

Intravascular device tip fracture, as demonstrated in this case report, is a rarely reported complication. A mismatch between the arterial diameter and the device size as well as the pump application for prolonged time can potentially lead to a device tip fracture.

One of the possible causes for device fracture may also be a catheter entanglement within the mitral subvalvular apparatus. However, no such risk association is yet known for calcified aortic valves. Since our patient's echocardiography displayed moderately calcified aortic valve leaflets, we do not preclude the possibility of the device entanglement within the calcified leaflets or subvalvular aorta, subsequently causing an obstruction and eventually the device fracture upon the catheter retrieval. In this regard, the bedside echocardiography—performed just prior to the removal of the pump and showing its proper positioning inside of the LV—may help to diminish the risk of device fracture. Another strategy to avoid this rare but potentially severe complication would be a pump removal in the cath lab in case of moderate/severe aortic or mitral calcification, particularly, if any obstruction is felt by the initial gentle retrieval of the microaxial pump.

Currently, transcatheter retrieval is a widely used method to extract foreign bodies. Several interventional catheter systems, such as a loop snare, a basket catheter, a guide wire, a balloon, or even an ablation catheter, can be applied to retrieve the device fragment. The loop snare method, as applied in this case, is one of the most common retrieval catheters. They have the advantage of being flexible, allowing them to follow the intravascular configuration to the ventricular, pulmonary artery, or peripheral arteries, while their disadvantage is weak gripping. This catheter is preferred in situations where a foreign body is attached to the vessel wall without a free edge. Instead, large fragments can be repositioned to the femoral vein and removed eventually by surgical cut-down.

Conclusions

One of the rare Impella-associated complications is a device fracture. The fractured fragment can be safely retrieved using a percutaneous loop snare catheter under fluoroscopy guidance. Particularly when resistance is experienced upon device removal or re-advance, and to avoid intravascular device fracture, it may be reasonable to remove the catheter under fluoroscopy in the cath lab.

We highlight this case to increase awareness on device fracture as a potential complication during device removal.
Lead author biography

Dr Natig Gassanov is currently an attending cardiologist and intensivist at the Hospital Idar-Oberstein, affiliated to the University Medicine Mainz, Germany. He completed his medical education and training in clinical and experimental cardiology at University of Cologne, Germany; Baylor College of Medicine, Houston, USA; and University of Montreal, Canada. His academic interests are stem cell research, regulation of cardiac differentiation, and cellular electrophysiology. Cardiac electrophysiology, including cardiac pacing, also remains his major clinical focus.

Supplementary material

Supplementary material is available at European Heart Journal – Case Reports online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

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