



Resolution of sudden left ventricular assist device failure due to outflow graft narrowing

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Clinical vignette

A 51-year-old male patient was implanted in 2017 with a centrifugal flow pump [HeartMate3[®] left ventricular assist device (LVAD), Abbott, Chicago, Illinois, USA] due to end-stage idiopathic cardiomyopathy. He experienced complete functional recovery (NYHA class I) and no adverse events occurred until October 2019, when he was admitted to our emergency department with chest pain and dyspnoea. The clinical examination showed signs and symptoms of high left filling pressure. Pulmonary oedema was evident on chest radiography. The transthoracic echocardiogram (TTE) showed a severely dilated left ventricle, severe mitral regurgitation, normal movement of the aortic valve leaflets, with significant flow through the valve. LVAD parameters showed a normal estimated pump flow, pump-power and pulsatility index. The Hemodynamic Ramp Test failed to reduce left ventricular end-diastolic diameter (LVEDD) or the grade of mitral regurgitation. Pharmacological therapy with a high dose of furosemide and sodium nitroprusside was commenced immediately. This resulted in a mild clinical improvement as well as reduction of the LV chamber dimensions. Unfortunately, two days later a sudden dramatic reduction of LVAD flow occurred, with subsequent cardiogenic shock. The patient was immediately assisted and peripheral Venous-Arterial Extracorporeal Membrane Oxygenation (VA-ECMO) was implanted bedside as rescue therapy.

Surgical techniques

Preparation

The patient was immediately transported to the hybrid operating theatre because an occlusive stenosis of the LVAD outflow-graft was highly suspected. The left femoral artery was surgically exposed, and a 14 F introducer was inserted.

Operation

A 6F diagnostic catheter with a 0.035-inch guide wire was advanced through the 14 F introducer and positioned in the outflow graft to perform angiographic evaluation of the flow through the pump. When the contrast agent was injected, a severe stenosis was visible. The narrowing of the graft, most likely caused by a gelée collection compressing the outflow tract, was situated approximately two to three centimeters away from the connection of the graft with the centrifugal pump. Since pump exchange was considered a high-risk procedure, we planned to address the problem by stenting the narrowed zone percutaneously.

We started with a 0.035-inch super-stiff guide wire (EMERALD, Amplatz Super StiffTM J-curve, 260 cm; Cordis Cashel Cahir Road, Cashel, Co Tipperary, Ireland), with a self-modified J-tip, to allow landing near the centrifugal pump. At this point, we performed multiple predilatation with increasing diameter peripheral balloons, starting with an 8×40 mm and progressing to 12×40 mm

(eV3 EverCross, 0.035 OTW PTA Dilatation Catheter, 4600 Nathan Lane North Plymouth, MN 55442-2920 USA). A more supportive guidewire, (Amplatz Super Stiff J curve-tip 0.035, 260 cm, Boston Scientific, 302 Parkway Global Park, Heredia, Costa Rica) with a self-modified J shaped tip, was advanced into the outflow tract of the graft. Careful attention was paid to avoid entry into the nearby centrifugal heart-pump. Once the wire was *in situ*, we performed a dilatation with a balloon-expandable 34 mm × 16 mm (CP STENT™ NuMED, Inc.) covered stent, commonly used for the treatment of aortic coarctation. The delivery of the stent resulted in immediate evidence of blood-flow improvement through the outflow graft of the LVAD. The pump function fully recovered and provided an adequate cardiac output to the patient. VA-ECMO at this point was explanted and at the same time, due to severe right ventricular failure, a temporary percutaneous Right Ventricle Assistant Device (RVAD) was implanted.

Under fluoroscopic guidance, an Amplatz Super Stiff (Boston Scientific, Natick, MA, USA) 0.035-inch × 180-cm wire was inserted in the Swan-Ganz lumen and the pulmonary artery catheter was removed. A long flexible 17-French venous cannula, #CB96605-17 (Biomedicus; Medtronic, Minneapolis, MN, USA) was inserted over the stiff wire to the pulmonary artery through the right internal jugular vein and was used as the outflow cannula; the inflow cannula was 25 French in size, (Biomedicus; Medtronic) and was inserted in the inferior vena cava through the right femoral vein with its dilator tip *in situ*.

Completion

The patient was explanted from RVAD support and transferred from the intensive care unit after one week. One month later, we discharged the patient upon observing good functional capacity, whilst the analysis of the LVAD was consistently normal with no further alarms. Computed tomography (CT) confirmed the patency of the implanted stent.

Advantages

Outflow graft narrowing, by gelée concentration between the outflow graft and bend relief, represents a challenging complication in patients implanted with HeartMate3 (1-3).

Resolution by implanting a stent percutaneously is an effective low-risk procedure.

Caveats

The interventional treatment in case of outflow graft obstruction, as already described by Wert *et al.* (4), represents an effective strategy. Minimal-invasive approach and preparation of the bend relief with its opening and evacuation of the gelée masses is an alternative. In deciding between the two options, the surgical risks should be balanced against the risk of a more aggressive anticoagulation.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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