Stenting of an outflow graft obstruction after implantation of a continuous-flow, axial-flow left ventricular assist device

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See related commentary pages e13-4.

Implantation of a left ventricular assist device (LVAD) is an established treatment strategy for patients with refractory heart failure and improves both survival and quality of

life.¹⁻⁴ Although bleeding, infection, thromboembolism, device malfunction, right heart failure, and multisystem organ failure are known complications of LVAD implantation, the incidence of life-threatening outflow tract obstruction as a result of either device migration leading to a kink at the aortic graft anastomosis or unacceptable lie of the outflow graft is unknown. Obstructive complications from the kinking or malpositioning of an inflow or outflow cannula have previously been managed by device replacement by other investigators.² We describe the management of an outflow graft stenosis after migration of a HeartMate II LVAD (Thoratec Corporation, Pleasanton, Calif) with balloon angioplasty and stent placement.

CLINICAL SUMMARY

A 64-year-old man with ischemic cardiomyopathy after coronary artery bypass grafting in 2004, with class IV

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FIGURE 1. A and B, Ventriculography (A) and computed tomographic imaging (B) of the left ventricular assist device outflow graft before stenting. C and D, Ventriculography (C) and computed tomographic imaging (D) of the left ventricular assist device outflow graft after stenting.

TABLE 1. Pre-stent and post-stent hemodynamics and left ventricular assist device settings

	Pre-stent	Post-stent
Heart rate (beats/min)	100	80
Systemic blood pressure (mm Hg)	116/85/95	85 (nonpulsatile)
Pulmonary artery pressure (mm Hg)	47/28	28/18
Central venous pressure (mm Hg)	18	18
Left ventricular pressure (mm Hg)	100/16	n/a
Outflow graft gradient (mm Hg)	41	15
LVAD speed (rpm)	9800	9800
LVAD flow (L/min)	3.7	4.7
LVAD pulsatility index	5.1	2.6
LVAD power (W)	6.1	5.7

LVAD, Left ventricular assist device; n/a, not available.

New York Heart Association heart failure underwent implantation of an axial-flow LVAD as a bridge to transplant in 2011 at another institution. One year later, he was admitted to his implanting center with heart failure, had his condition “medically optimized,” and was discharged. He came to our institution with “low-flow” alarms and progressive dyspnea. On examination, he had a pulsatile blood pressure. Despite increase of the LVAD speed to 12,000 rpm, echocardiography showed dilated left ventricle with 1:1 aortic valve opening. Hemolysis laboratory values, including lactate dehydrogenase and plasma-free hemoglobin were normal. Computed tomographic angiography did not reveal inflow cannula obstruction but yielded suspicion of outflow graft stenosis, kink, or obstruction (Figure 1).

Informed consent was obtained for this high-risk endovascular procedure. The patient was taken to the hybrid operating room. After induction of general anesthesia, the patient was placed in the supine position with the left arm abducted. The chest, left arm, groins, and legs were prepared and draped. After the administration of 5000 units of unfractionated heparin, the left radial artery was accessed, and with sterile Seldinger technique, a 5F pigtail catheter was placed across the aortic valve into the left ventricle.

Initial hemodynamic parameters were obtained (Table 1), and a ventriculogram revealed predominant flow through the aortic valve and a tight stenosis of the outflow graft (Figure 1). The pigtail was pulled back into the ascending aorta and exchanged for a 0.035-inch angled Glidewire (Terumo Medical Corporation, Somerset, NJ) and a Kumpe catheter (Cook Medical Inc, Bloomington, Ind), which were used to navigate into the outflow graft across the stenosis. Pressure measurements were obtained across the stenosis (Table 1). A 10 × 37-mm balloon expandable stent was then placed

across the stenosis and postdilated with a 12-mm balloon. Post-stent hemodynamics (Table 1) and ventriculography showed predominant flow through the LVAD. Intravascular ultrasonography across the outflow graft showed no residual stenosis. Pull-back measurements showed minimal gradient across the stent (41 mm Hg pre-stent vs 15 mm Hg post-stent). Echocardiography showed continuous aortic valve closure and decompressed left ventricle. The patient was extubated on post-procedure day 1. On post-procedure day 5, a follow-up computed tomographic angiography was obtained and confirmed patency and good positioning of the stent (Figure 1). Six months later the patient remained free of symptoms and without evidence of LVAD dysfunction or thromboembolic events.

DISCUSSION

Obstruction of the LVAD outflow graft is a rare but potentially lethal complication with an unknown incidence. Although pump replacement has been traditionally undertaken to address this issue, it can be technically challenging and associated with a high morbidity and mortality. This is particularly true of repeated LVAD exchanges. We present the first reported case of successful percutaneous balloon angioplasty and stent placement to treat an LVAD outflow graft obstruction. Future approaches may require intravascular interrogation to rule out thrombus and the development of protection devices to limit thromboembolism during stent delivery. If thrombus is present, we would favor surgical LVAD exchange if possible. This report suggests that percutaneous diagnostic and therapeutic approaches should be considered in the management of LVAD dysfunction.

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