Left Ventricular Assist Device Outflow Cannula Obstruction Treated With Percutaneous Endovascular Stenting

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Thrombosis within the circuit of a left ventricular assist device (LVAD) is a major complication imparting significant morbidity and mortality. Recent management algorithms emphasize anticoagulation or surgery for LVAD thrombosis, depending on clinical presentation. We report a case of thrombotic LVAD outflow cannula obstruction treated successfully with percutaneous endovascular stenting.

Case Anecdote
A 72-year-old male underwent implantation of a HeartMate II left ventricular assist device (Thoratec, Pleasanton, CA) for end-stage dilated cardiomyopathy in December 2011. He had an uncomplicated course and returned to an active lifestyle. Thirty months later, he presented with intermittent low flow alarms, a mild decline in effort intolerance, and pedal edema.

Echocardiography demonstrated normal LV dimensions and inability to close the aortic valve, despite increasing pump speed. Serum lactate dehydrogenase was 295 IU/L and plasma free hemoglobin 7.0 mg/dL. Chest X-ray showed an intact bend relief. Computed tomography angiogram demonstrated an acute angulation of the outflow graft and narrowing of the lumen of the outflow cannula from extensive thrombus (Figure 1A). Invasive hemodynamic monitoring demonstrated normal cardiac output and filling pressures, and angiography confirmed the outflow obstruction (Figure 2B).

Given the patient’s age and the inherent risks of reoperation, an endovascular approach was undertaken. After left brachial artery cut down and systemic anticoagulation, a Kumpe catheter (AngioDynamics, Queensbury, NY) was placed retrograde into the outflow graft. An Amplatz wire was manipulated into the elbow of the LVAD. With the LVAD speed reduced to 6000 rpm, a 9x59 mm Atrium stent was deployed in the cannula. The stent was postdilated to 12 mm. A second overlapping stent was deployed and postdilated to address residual obstruction. Manual bilateral carotid occlusion was performed during stent delivery and balloon inflation to reduce the risk of cerebral embolization. LVAD flows immediately improved and completion angiography showed relief of cannula obstruction (Figure 2A). The patient tolerated the procedure well and was discharged 4 days later after reinstituting warfarin.

A follow-up computed tomography scan 1 month later showed only mild residual thrombus (Figure 2B) with well-positioned stents. Echocardiography with speed adjustment showed normal device function and closure of the aortic valve at 10000 rpms. The patient has had no further alarms and has returned to full physical activity.

Discussion
Thrombosis is increasingly recognized as a complication of continuous-flow LVADs. Outflow graft obstruction is readily diagnosed by computed tomography. Treatment guidelines recommend anticoagulation (heparin, thrombolytics, antiplatelet therapy) or surgery. Although endovascular stenting has previously been reported to treat outflow graft pseudoaneurysm, a rare complication, this report is the first to describe stenting to treat outflow graft thrombus. We hypothesize that with remodeling of the heart during LVAD support, the outflow graft became more angulated at its aortic anastomosis, causing low flow and thrombus formation.

Because of the increasing use of LVADs as destination therapy in patients in whom intensified anticoagulation or reoperation may pose considerable risk, a percutaneous approach may represent a safe alternative.

Disclosures
None.

References

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Figure 1. Thrombus formation (arrows) within the lumen of the left ventricular assist device outflow cannula proximal to a sharp bend visualized by computed tomography (A) and angiography (B).

Figure 2. Intraoperative completion angiography demonstrates improved flow through the outflow graft stent (A). Follow-up computed tomography at 1 month shows well-positioned, overlapping stents (B).
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