Capping off ventricular assist

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Left ventricular pressure and volume unloading with left ventricular assist devices (LVADs) have been shown to induce structural and functional reverse remodeling in a subset of patients with end-stage heart failure.1 Select LVAD recipients have sufficient improvement in myocardial function with prolonged mechanical unloading to allow for device removal. The first such case of LVAD explant after ventricular recovery was reported in 1996 in a 19-year-old man with idiopathic cardiomyopathy after 183 days of HeartMate (Abbott, Abbot Park, Ill) support, originally intended as a bridge to heart transplant.2 Subsequently, several groups have described bridge-to-recovery (BTR) strategies to identify and increase myocardial recovery with varying levels of success.3,4

A wide variety of surgical techniques have been described for LVAD explant. Traditionally, a median sternotomy approach with cardiopulmonary bypass (CPB) without arrest is used to completely remove the pump, fixation ring, outflow graft, and driveline. The apical ventricular defect is then closed primarily or with patch exclusion. On the opposite end of the spectrum, the outflow graft can be divided just distal to the pump and driveline transected underneath the skin, allowing for off-pump, minimally invasive termination of device support. In this approach, the pump and outflow graft are left in situ to thrombose.3 Cohn and colleagues5 described the use of an intraoperatively fashioned felt plug to facilitate explant of a HeartMate II. Peripheral CPB was used, and, via a subcostal incision, the pump was removed, the outflow graft was oversewn, and the felt plug was inserted and sutured to the sewing ring.6 Leaving the sewing ring intact prevents additional ventricular muscle damage, preserves apical geometry, and facilitates LVAD reimplantation should severe heart failure recur.

Since Cohn and colleagues’ felt plug, titanium plugs have been developed that custom fit the HeartMate II7 and HeartWare HVAD (Framingham, Mass).8 These plugs obviate the need for intraoperative felt plug construction and hermetically seal the ventricle preventing pericardial effusion or ventricular pseudoaneurysm, which may theoretically result from an inadequately sealed felt plug. These plugs are sintered with titanium spheres to promote endothelialization and reduce thrombus formation. As the field of myocardial recovery continues to advance, standardized devices to appropriately facilitate LVAD explant are critical.

In this issue of the Journal, Mulzer and colleagues9 describe the first clinical use of a novel specialized titanium recovery plug designed for the HeartMate 3. Two explants were performed on CPB in young women who had ventricular recovery after peripartum cardiomyopathy. The third case was performed off-pump in a 55-year-old man. Each patient was anticoagulated for 6 months with a vitamin K antagonist to allow sufficient time for tissue overgrowth of the plug. The plug is innovative and provides promise for ease of explant with the growing interest in LVAD-mediated myocardial recovery.

Although only 1.3% of all LVAD recipients registered in the Interagency Registry for Mechanically Assisted Circulatory Support between 2006 and 2015 underwent device removal or deactivation, this figure was increased approximately 10-fold with an a priori BTR strategy.10 Preliminary results from the REMission From Stage D Heart Failure study showed an explant rate of 36% with standardized pharmacotherapy and regular low-speed screening echocardiograms.11 There is growing national interest in myocardial recovery, with the best example involving the Phase...
II trial of the CTSnet evaluating myocardial regeneration and recovery with mesenchymal stem cell therapy.

As more clinical focus is applied to BTR strategies, the number of explanted LVADs is likely to increase. Certainly the titanium recovery plug pioneered by Mulzer and colleagues will have an impact in the field. We applaud the authors on their innovative development of the recovery plug. Continued interest and enthusiasm for myocardial recovery on a cellular and clinical basis are warranted and hold promise for the future.

References


