Minimally invasive access for off-pump HeartWare left ventricular assist device explantation

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Abstract

The implantation of a left ventricular assist device as a bridge to transplantation is a well-established treatment of end-stage heart failure in selected patients. Device-related infection is a well-known complication that may require the removal of the device. We describe a minimally invasive explantation approach with complete removal of all components of a HeartWare left ventricular assist device in a patient with persistent infection related to the device.

Keywords: Circulatory assist devices • Minimally invasive surgery • Off-pump surgery

INTRODUCTION

Long-term left ventricular assist devices (LVADs) are an effective, well-established therapeutic option for selected patients with end-stage heart failure as a bridge to transplantation. However, device-related infections and thrombotic complications [1] are relatively common and sometimes lead to necessity of the pump removal.

The classical explantation technique requires a full sternotomy, mobilization of the heart and cardiopulmonary bypass (CPB), with a high inherent risk of bleeding, which might also affect the left ventricular (LV) function. We describe a minimally invasive removal technique without using CPB in a patient with improved myocardial function, LVAD thrombosis and persistent signs of infection.

CASE REPORT

A 52-year-old male patient diagnosed with ischaemic cardiomyopathy and with LV ejection function <10% was implanted with a Heartware ventricular assist device (HVAD) (HeartWare Inc.) axial LVAD.

One year before the HVAD implantation, he underwent triple coronary artery bypass surgery (left internal thoracic artery to left anterior descending artery and two saphenous vein grafts to right coronary and circumflex arteries), but his LV function kept deteriorating. As part of the HVAD assessment, he had a computed tomography (CT) coronary angiogram that showed patent grafts and an old infarction in the inferior wall.

After two uneventful years on LVAD support, he presented with suddenly decreased flows in the HVAD due to a pump thrombosis related to suboptimal anticoagulation. After a few hours, the pump suddenly stopped, but the patient remained stable without any inotropic support, and echocardiography showed LV mild systolic dysfunction.

To prevent the potential risk for embolization and with the aim of avoiding extensive surgical intervention, we decided to leave the body of the device in situ and isolate the outflow graft from the ascending aorta. Through a 5-cm incision in the right second intercostal space, the outflow tract was dissected. The graft was then divided close to the aortic anastomosis. The proximal end of the graft and the distal stump were oversewn with a 3–0 continuous polypropylene suture in two layers. The postoperative course was uneventful.

One week after the surgery, the patient developed intermittent spikes of temperature and persistently elevated inflammatory markers; his C-reactive protein was up to 316 mg/l and his total white cell count up to 2410 × 10⁹/l with negative blood cultures. He also became hypotensive, requiring support with noradrenaline (0.1 μg/kg/min). A full-body CT scan was done, but no evidence of infection or embolism was found. When the patient’s condition was not improving despite intravenous antibiotic treatment with meropenem, teicoplanin and caspofungin for 3 weeks, it was decided to explant the HVAD.

The apex of heart was mobilized through a 10-cm left anterolateral thoracotomy, and an abscess was found around the HVAD device that was subsequently cleaned. The apex was exposed, and two pledgeted purse strings (polypropylene 2–0) were passed through the apex of the LV just below the sewing ring of the HVAD. With systolic blood pressure between 60–80 mmHg, the sutures securing the sewing ring were cut and the ring, along with the HVAD, was removed. The hole in the LV apex was closed.

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by placating previously passed purse-string sutures followed by reinforcement with a 2–0 continuous polypropylene suture in two layers (Fig. 1).

A 4-cm subxiphoid incision allowed dissection of the proximal outflow joints and the driveline, and they were disconnected from the body of the device (Fig. 2). The power cable driveline was also dissected through this incision and removed at the end of the procedure.

After the LVAD explantation, the patient had a cardiac output of 3.5–3.8 l/min/m² on 0.03 μg/kg/min of adrenaline and 0.1 μg/kg/min of noradrenaline. He had an uneventful postoperative course and was discharged from the intensive care unit on the first postoperative day.

The cultures from the samples obtained around the device were positive for meticillin-resistant Staphylococcus aureus, and the patient received intravenous antibiotic treatment for 4 weeks with teicoplanin and daptomycin.

The echocardiogram after 3 months showed mild LV systolic dysfunction and normal right ventricular function.

**DISCUSSION**

Left ventricular assist device explantation after pump failure with improved myocardial function via a full sternotomy with complete mobilization of the heart can be a high-risk procedure, because of the mediastinal adhesions, need for CPB and excessive bleeding. Furthermore, a heart with labile function could not tolerate the perioperative injury.

Our institution has previously reported minimally invasive techniques for removal of the HeartMate II ventricular assist device after myocardial recovery under CPB, with the aim of reducing the morbidity and mortality [2].

In this case, despite the ischaemic nature of cardiomyopathy, the improvement in the myocardial function could be justified due to the patency of the coronary grafts. After 2 years on HVAD support, we found mildly reduced LV function and full haemodynamic stability of our patient when the device failed due to a thrombosis. An initial decision made was to minimize the surgical intervention to outflow graft exclusion, in order to avoid any embolic complication. However, coexisting pocket infection pushed us towards a more aggressive solution. Using our previous experience, we decided to explant the HVAD not only through small incisions but also without CPB. In our view, the minimally invasive access was a better approach due to the coexisting infection and potentially very fragile haemodynamic stability.

The HVAD is an axial flow device with a rigid apical inflow ring that seems to facilitate pump exchange; it may make its explantation more complex. The use of handmade felt and custom-made titanium plugs for closure of the sewing ring, which has enabled off-pump explantation of the Heartmate II device, has been previously reported [3, 4]. However, in our case, owing to a pocket infection, only the complete removal of all components of the device, with direct closure of the apex, seemed to be appropriate.

This report is the first to describe a complete HVAD removal using a minimally invasive approach by direct closure of the defect in the ventricle. This procedure allows the complete explantation of all the HVAD components when it is necessary, reducing the risks associated with the classical approach.

**Conflict of interest:** none declared.

**REFERENCES**


