Repair of pectus excavatum during HeartMate II left ventricular assist device placement

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Abstract

Pectus excavatum deformity often remains clinically asymptomatic even in cases of a severely diminished thoracic volume and frequently remains uncorrected. In the patient population that requires left ventricular assist device (LVAD) placement, a diminished thoracic volume can be problematic and lead to significant challenges in pump and outflow cannula positioning. Here we present a case of pectus excavatum correction during LVAD placement to show that this deformity can be successfully addressed with minimal, if any, additional operative risk at the time of LVAD implant.

Keywords: Pectus excavatum • Ventricular assist device

INTRODUCTION

Pectus excavatum deformity often remains clinically asymptomatic even in cases of a severely diminished volume of the thorax. Surgical intervention is indicated only if significant compromise in cardiopulmonary function or marked psychological impact on an adolescent can be demonstrated [1]. As such, this pathology frequently remains uncorrected.

CASE REPORT

A 70-year old Caucasian female with non-ischaemic cardiomyopathy and New York Heart Association class III was referred for left ventricular assist device (LVAD) placement. Preoperative work-up showed a pectus excavatum deformity of the anterior chest wall with the right ventricle (RV) in immediate proximity to the posterior sternal surface (Fig. 1A and B, Video 1).

The patient was taken to the operating room for HeartMate II LVAD implantation as a destination therapy. This pump was chosen due to its abdominal position as opposed to the apically placed pumps like HeartWare HVAD or HeartMate III LVAD where the pump is positioned within the chest cavity. Upon entering the chest, it was confirmed that this was a severe pectus excavatum that had actually deformed the RV. After implanting the HeartMate II LVAD in a standard fashion, the initial attempt to approximate the sternum caused compression in the outflow graft into the RV due to the pressure from the chest wall and a decrease in LV filling and LVAD outflow. For this reason, it was decided to proceed with correction of the pectus excavatum defect.

Costochondral junctions of the lower five ribs were transected bilaterally followed by a wedge resection of the anterior sternal table (Fig. 2A). The sternum then was elevated anteriorly, fracturing the posterior cortex as reported originally by Ravitch [2]. The wedge resection sites were reinforced with single stainless steel wires bilaterally, whereas the intercostal spaces above and below were approximated with a single wire in a figure-of-eight fashion (Fig. 2B). The remaining intercostal spaces were approximated in a routine fashion and the sternum was closed (Fig. 2C), remaining sufficiently elevated to accommodate the LVAD outflow graft without compression. The total pump time was 76 min, and the total operative time 232 min.

The early postoperative course was remarkable for atrial fibrillation with rapid ventricular response with some haemodynamic instability and an unsuccessful attempt of cardioversion; however, the patient converted to normal sinus rhythm by late postoperative day 2 with amiodarone. The patient had no issues with respiratory mechanics and was maintained on minimal ventilator settings with a positive end-expiratory pressure of 5 cmH₂O and a fraction of inspired oxygen 40% until postoperative day 3 when she was extubated. An early postoperative CT scan to evaluate the outflow graft showed that it was well positioned without compression (Fig. 1C and D, Video 2). The patient had an uneventful recovery and was discharged home on the 22nd postoperative day. The pump speed was maintained at 9000 revolutions per minute (RPM) during the entire hospital stay. The LVAD parameters upon
discharge were flow 7.1 l/min and power 6.3 Watts at 9000 rpm. One month later, the patient was seen in the outpatient Heart Failure and Transplant Clinic for routine follow-up and was found to be doing well.

**DISCUSSION**

In the patient population that requires LVAD placement, especially patients with a small body habitus, diminished thoracic volume can be problematic and lead to significant challenges in pump and outflow cannula positioning. From our past experience, concave chest deformities have resulted in compression on the outflow cannula and even physical displacement of the pump housing. In cases of severe deformities, diminished thoracic space does not at all provide enough space to accommodate the pump with its outflow cannula. This is a significant technical challenge given the fact that there are multiple patients with asymptomatic and uncorrected pectus excavatum.

Even though the optimal age for pectus excavatum repair is in the range of 12–16 years, successful intervention with adults in their 30s and 40s has been reported [3]. In LVAD patients—typically a much older population—full cosmetic repair of the deformity is not an end-point. Rather, enough space should be created to accommodate the pump and avoid compressing the outflow graft.

In terms of choice of the pump for a patient with a significant chest deformity, the two main options are implantable continuous-flow and paracorporeal LVADs. Owing to the high risk of adverse
events compared with implantable systems, paracorporeal LVADs are no longer an optimal choice. Among implantable LVADs, an abdominal location of HeartMate II LVAD is preferable over the intrathoracic location of pumps like HeartWare HVAD or HeartMate III LVAD given the potential for compression from the chest wall. On the other hand, the Jarvik 2000 FlowMaker LVAD should be an excellent option in pectus excavatum given its intraventricular location and the ability to anastomose the outflow graft to the descending thoracic aorta; however, this pump is not being routinely used in our centre at this time.

In summary, a pectus excavatum deformity can be successfully addressed at the time of LVAD implantation at minimal or no additional operative risk. Different available pump types with their advantages and disadvantages for this patient population should be factored into the decision-making process.

**Conflict of interest:** H. Todd Massey is a consultant and proctor for Thoratec Corporation.

**REFERENCES**

