Case Report

# Thoratec HeartMate II<sup>®</sup> Left Ventricular Assist Device Implantation in Patient with Patent Ventriculoperitoneal Shunt

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We report a case of HeartMate II® left ventricular assist device (LVAD) implantation as a destination therapy in a patient with a patent ventriculoperitoneal (VP) shunt after being suffered from subarachnoid hemorrhage. Because the patient's VP shunt was running through her right anterior chest and abdominal wall, a driveline exit site was selected in her left upper quadrant to avoid unnecessary perioperative complication in relation to the patent VP shunt tube. Tailored driveline placement was a key element of this LVAD implantation in this already sick patient with multiple comorbidities.

Keywords: ventricular assist device, destination therapy, comorbidities

# Introduction

With the continued shortage of available donor hearts and constantly increasing population of heart failure patients, an application of left ventricular assist device (LVAD) as a destination therapy became an important option for heart failure patients.<sup>1)</sup> With a miniatualization and an improving profile of the implantable LVADs, even patients with multiple comorbidities or social issues may become candidates to have these devices as a destination therapy. Once a destination therapy is selected to such patients, judicious strategy for device implantation should be made for individual patient's basis, since these patients are quite decompensated and carry high risk of postoperative complication. We report a case of LVAD implantation in a patient with a significant past medical history of

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intracranial bleeding and a patent ventriculoperitoneal (VP) shunt.

# **Case Presentation**

A 62-year-old female with a past medical history of type 2 diabetes mellitus, hypertension, who previously had undergone aortic valve replacement and mitral valve repair, developed non-ischemic cardiomyopathy, which was not amenable to outpatient management. The patient had multiple hospital admissions due to heart failure and treated with an inotrope support. Preoperative characteristics of the patient on home infusion therapy of 5 mcg/kg/min of dobutamine are shown in Table 1. She also has a significant history of a subarachnoid hemorrhage treated with coiling of an aneurysm in the brain and VP shunt placement. Of note, her VP shunt tube had malfunctioned once and caused her a temporary neurological issue and required revision in the past. However, the patient did not have any gross neurological deficit and lived independently at this point. Her social support was evaluated and thought to be inadequate for heart transplantation. Thus, LVAD implantation was offered as a destination therapy. The HeartMate II® LVAD (Thoratec Corporation, Pleasanton, CA, Fig. 1) is a continuous flow ventricular assist device approved for destination therapy by the federal

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Variable	
Height	165 cm
Weight	64.9 kg
Body surface area	$1.71 \text{ m}^2$
Heart rate	75 /min
Blood pressure	100/57 mmHg
Right heart catheterization	
Right atrium	a 12 / v 12 / mean 10 mmHg
Pulmonary artery	75/30 mmHg, mean 50 mmHg
Pulmonary capillary wedge pressure	a 27 / v 37 / mean 30 mmHg
Fick cardiac index	$3.0 \text{ L/min/m}^2$
Fick cardiac index (Before dobutamine infusion)	$2.0 \text{ L/min/m}^2$
Pulmonary vascular resistance index	6.7 Wood units
Right ventricular stroke work index	467 mmHg·mL/m <sup>2</sup>
Transthoracic echocardiogram	
Ejection fraction	15 %
Fractional shortening	6 %
Left ventricular internal diastolic diameter	78 mm
Left ventricular internal systolic diameter	73 mm

 Table 1
 Preoperative characteristics of the patient

Food and Drug Administration in 2010. Considering the patient's body size and recently proven advantages of continuous flow LVAD over pulsatile flow LVADs, regarding the reliability of the device, improved survival and quality of life of the patients,<sup>2</sup>) we selected the Heart-Mate II LVAD for this patient.

Preoperative computed tomography scan of her chest and abdomen showed the VP shunt tube running in the subcutaneous tissue of the right anterior chest and abdomen. The tube runs about 3 cm lateral to the midline, and then it enters into the peritoneal cavity at the right upper quadrant. A redo sternotomy was performed after the exposure of the right femoral artery. Adhesions were taken down and a pocket for the HeartMate II LVAD was created in the standard manner. Then the driveline was tunneled to make a gentle curve and to exit to the left upper quadrant. An extreme care was taken not to get too close to the VP shunt tube, while the length of the subcutaneous tunnel to be as long as possible to cover the velour part of the driveline (Figs. 2 and 3). The outflow graft was sewn on the ascending aorta under a partial clamping. The right femoral artery was cannulated and the patient was placed on the cardiopulmonary bypass (CPB). The inflow of the LVAD was placed into the apical sawing cuff, and after deairing, the LVAD was started and then the patient was weaned off from CPB. Postoperatively, the patient became oliguric and required a 6-day course of a continuous venovenous hemodialysis. Because of significant coagulopathy, her chest was closed on the postoperative day 4. Due to her inability to be weaned



Fig. 1 HeartMate II® continuous flow left ventricular assist device (Figure courtesy of Thoratec Corp).
\*This figure is reprinted from the HeartMate II operating manual. ©Thoratec Corp.

from the ventilator, a tracheostomy and percutaneous endoscopic gastrostomy (PEG) tube were placed on the postoperative day 12. Her tracheostomy tube and PEG tube was decannulated successfully on the postoperative days 48 and 55, respectively, before being discharged to home on postoperative day 60. The patient is currently functionally independent with her activities of daily life and competent with all aspects of HeartMate II LVAD operation.

LVAD with a Patent Ventriculoperitoneal Shunt



Fig. 2 Computed tomography of the abdomen showing generous distance between the ventriculoperitoneal shunt tube (arrowhead) and the driveline of the ventricular assist device (arrow).



Fig. 3 Chest X-ray showing a gentle curve of the subcutaneous driveline alignment.

# Discussion

Although the newer generation of implantable, continuous flow devices has accomplished to lower the perioperative complication rate than that of the pulsatile flow devices, major complications such as bleeding, infection, thromboembolism, and gastrointestinal tract bleeding are still considerable complications in the continuous flow devices.<sup>3)</sup> Because patients undergoing destination LVAD placement carry high likelihood of suffering from postoperative complications, diligent efforts to reduce the postoperative complication are required to improve the outcome.

Our patient already had a history of revision of the VP shunt tube previously. The use of electrocautery close to a driveline of the LVAD is strongly discouraged, because energy force can injure the driveline and cause malfunction of the implantable LVAD. If, in the future, this patient does require revision of the VP shunt, the proximity of the LVAD driveline to the VP shunt should be avoided to minimize the risk of inadvertent injury of the driveline from an electrocautery or surgical instruments. If a patient has known intra-abdominal disease such as cholecystolithiasis, and there is a possibility of future requirement of an invasive treatment, a prophylactic treatment may be considered. Similarly, the PEG tube placement in our patient was carefully performed not to injure the driveline of the LVAD.

Infection rate of the driveline has been reported as 12.5%-17.3%<sup>3,4)</sup> In our patient, infection of either the

driveline or the VP shut tube could affect each other, and may lead to a devastating central nervous system infection or mediastinitis. An appropriate alignment of the driveline will contribute to reduce the chance of driveline and device infection or the driveline related device malfunction.<sup>5)</sup> The considerations for selecting a driveline exit site before operative planning should include: (i) an enough length of the subcutaneous tunnel; (ii) no kinking or sharp bending in the entire length of the drive line; (iii) not to compromise the patients' clothing; and, (iv) ease of the exit site care by patients and their caregivers. In our patient, any inadvertent injury of the VP shunt tube could cause neurological or other complications, so we decided to place the driveline exit site far from the VP shunt and in her left upper quadrant.

Although our patient recovered from multiple postoperative complications, any additional complication might further compromise her postoperative course or might even cause mortality. The meticulous surgical strategy of device implantation is important for heart failure patients who are already sick enough from preoperative comorbidities and decompensated cardiac function.

# **Disclosure Statement**

The authors have nothing to disclose.

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