

A minimally invasive right ventricular assist device insertion late after a continuous-flow left ventricular assist device implantation

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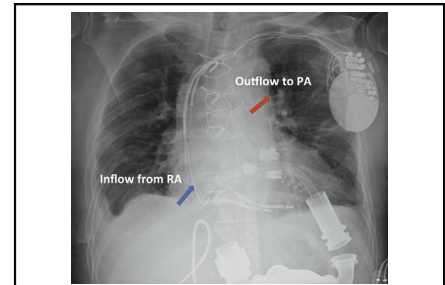
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▶ Video clip is available online.

Right heart failure (RHF) after left ventricular assist device (LVAD) implantation is an unresolved issue associated with mortality and morbidity.¹ Although temporary right ventricular assist devices (RVADs) are useful for severe RHF in the acute phase, recent studies raise issues in RVAD for late RHF. Redo sternotomy often is too invasive for particularly sick patients with chronic venous congestion. Technology has enabled us to apply percutaneous RVADs via the internal jugular vein (IJV) or femoral vein; however, these options are limited for patients' motility and access issues, such as thrombosis or obstruction. This report presents our unique RVAD through a minithoracotomy in patients with late RHF.

A 61-year-old man with a history of hypertension, diabetes, and chronic kidney disease on hemodialysis, and who received coronary artery bypass grafting underwent HeartMate II (Thoratec Corporation, Pleasanton, Calif) implantation at an outside hospital. The patient had RHF postoperatively, requiring long-standing inotropic therapy. Two months after LVAD, the patient again developed severe RHF with a central venous pressure of 36 mm Hg and acute kidney injury. He was initially placed on a percutaneous RVAD using a dual-lumen cannula through IJV² and continuous veno-veno hemofiltration (CVVH). After 9 days, superior vena cava syndrome developed, and the percutaneous RVAD had to be removed. He was transferred to our institution for further management. At admission, his central venous pressure was 23 mm Hg with a wedge pressure of 19 mm Hg. He was receiving dual inotropes and CVVH. Ultrasound revealed an occlusion of bilateral



X-ray at transplant. Blue: Inflow. Red: Outflow.

Central Message

We report our unique mini-RVAD after a continuous-flow LVAD. This technique achieved sufficient and durable support with minimally invasive incision, keeping patient mobility after the procedure.

See Editorial Commentary page XXX.

IJVs. For his RHF, an Impella RP (Abiomed, Danvers, Mass) was inserted from the femoral vein. One day later, he was weaned from CVVH (Figure 1). After multiple failures of weaning from the Impella device, we decided

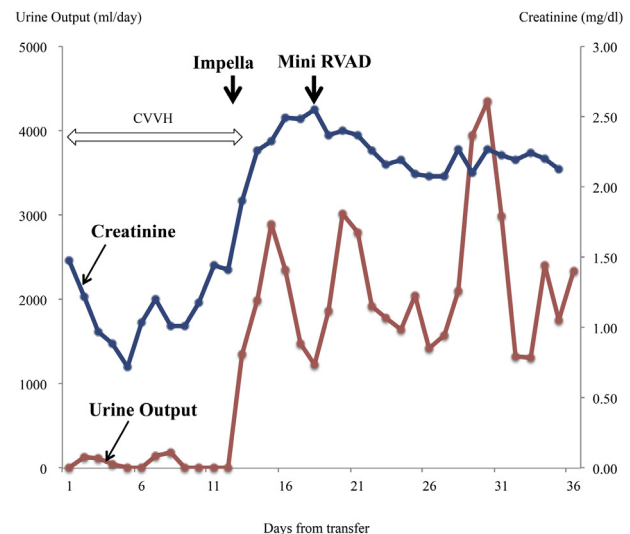


FIGURE 1. Renal functions from the day of transfer. CVVH, Continuous veno-venous hemofiltration; mini-RVAD, minimally invasive right ventricular assist device.

Case Report



FIGURE 2. Chest computed tomography. White arrow indicates the approach. LV, Left ventricle; RV, right ventricle.

to advance support using the CentriMag device (Thoratec Corporation). To avoid redo sternotomy and overcome access issues, we applied an RVAD insertion via the right ventricular (RV) surface. Chest computed tomography was useful for planning (Figure 2, Video 1).

With single-lumen intubation, a 4-cm incision was made above the fourth intercostal space. The right ventricle outflow was exposed, and 2 sets of 3-0 double mattress sutures with bovine pericardium pledgets were placed on the RV. A guidewire was introduced into the main pulmonary artery under fluoroscopy. Another guidewire was introduced into the inferior vena cava. A 17F Biomedicus (Medtronic, Dublin, Ireland) arterial cannula was inserted into the PA, and a 23F Biomedicus arterial cannula was inserted into the right atrium (Figure 3). Both cannulas were connected, and the RVAD was actuated. Four liters of flow were obtained. The Impella device was removed. Postoperatively, he was weaned from CVVH and inotropes. He recovered until he could walk with this



VIDEO 1. Chest computed tomography.

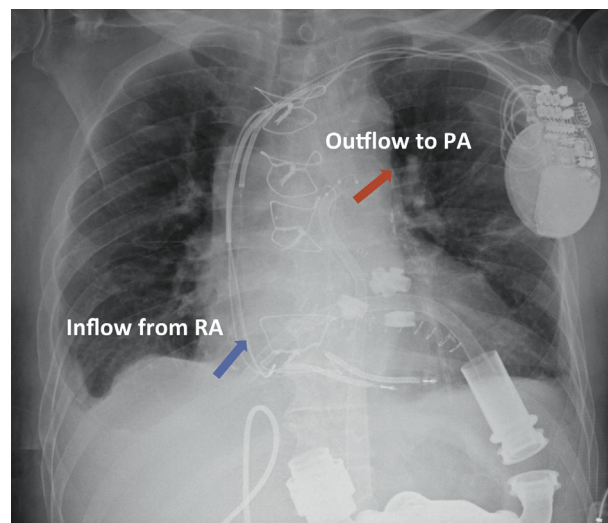


FIGURE 3. X-ray at transplant. Blue: Inflow. Red: Outflow. RA, Right atrium; PA, pulmonary artery.

biventricular support. Figure 1 shows his renal function recovery. Three months after this RVAD implantation, he underwent transplantation. During dissection, we confirmed that both cannulas were securely attached to the right ventricle with no signs of infection or dislodgement.

This is a report of our unique mini-RVAD for a patient with severe late RHF. We were able to safely bridge the patient until transplantation, and our attempt not only achieved abundant flow to allow weaning from CVVH and inotropes but also kept the patient's mobility in preparation for transplant, with minimal invasion.

We previously reported late RHF occurrence after LVAD insertion is 11%, and 10% of those who had late RHF eventually required RVAD.³ However, even today, there is no standard approach for late RHF occurring later than 4 weeks after LVAD. Our goals of mechanical support for late RHF would be sufficient flow, minimal invasion, and patient mobility, and there are few options. Central cannulation with redo sternotomy always is the choice but could be too invasive, particularly in patients with long-standing venous congestion. Percutaneous RVAD would be another option after LVAD. We currently use the Tandem heart with a Protek-Duo cannula (CardiacAssist Inc, Pittsburgh, Pa) through the IJV,² but for this patient that option was not feasible because of the superior vena cava syndrome. The Impella RP is another noninvasive option,⁴ but patient motility and durability of support are obvious issues. In this sense, our mini-RVAD is a useful option for patients requiring sufficient and durable support and mobilization after the procedure. With appropriate guidewire techniques under fluoroscopy, cannulation from the right ventricle under limited exposure was safe and smooth. Our initial concern was an adhesion during transplant, which was not as tight as expected.

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