

Intracorporeal Biventricular Assist Device Therapy in an 8-Year-Old Child



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Ventricular assist device therapy in small children is challenging especially if biventricular support is required. Many centers have started to implant small intracorporeal continuous-flow pumps such as the HeartWare HVAD (HeartWare, Framingham, MA) in children for left ventricular support, with good results.^{1–4} This therapeutic option offers the possibility of discharge from the hospital while patients with a Berlin Heart EXCOR system (Berlin Heart GmbH, Berlin, Germany) are hospital bound. We report biventricular support employing the HeartWare HVAD in an 8-year-old boy.

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CASE REPORT

An 8-year-old child (weight 18.4 kg, body surface area of 0.81 m²) with confirmed diagnosis of dilated cardiomyopathy was admitted to the intensive care unit due to acute decompensation despite inotropic support. On admission, the transthoracic echocardiogram showed severely reduced biventricular function with LVEDD 61 mm, RVEDD 41 mm, R/L ratio 0.67, septum deviation to the right and evidence of congestion. There was severe mitral and moderate tricuspid valve regurgitation. Therefore he was transferred for ventricular assist device implantation.

He underwent implantation of a left ventricular assist device (LVAD) with the HeartWare HVAD via median sternotomy. The calculated flow was 1.8 L/min with 2500 rpm and 2.6 W. Within hours after surgery he showed signs of RV failure. Therefore, we implanted a CentriMag system for temporary RV support. Heparin was started according to hospital protocol. Nevertheless, there was early evidence of thrombus formation leading to thrombosis of the pulmonary artery and cannula. Therefore, a thrombectomy and exchange of the cannula and lines were indicated.

After 11 days of RV support there was no sign of recovery. Therefore, a second HeartWare HVAD pump was implanted as

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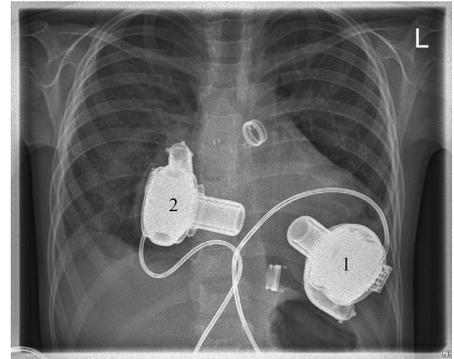
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Chest X-ray shows the position of the LVAD (1) and RVAD (2) in an 8-year-old boy.

Central Message

Intracorporeal BVAD therapy seems possible even in children with a weight less than 20 kg and might be an option for patients with secondary right heart failure after intracorporeal LVAD implantation.

a right ventricular assist device (RVAD) as described previously.⁵ Briefly, after re-sternotomy the right pleura was opened wide and the pericardium cut down on the right site under careful preservation of the phrenic nerve in order to accommodate the pump within the right chest cavity. A GoreTex membrane was sewn to the pericardium to protect the right lung from erosion. The patient was put on cardiopulmonary bypass. After the addition of spacers to the fixation ring, the ring was sutured to the lateral wall of the right atrium at the place chosen under echocardiographic guidance – as far as possible from the septum and toward the tricuspid valve. The outflow graft was connected to the pulmonary artery using a diamond-shaped anastomosis. Intraoperative echocardiography demonstrated good position of the inflow cannula pointing toward the tricuspid valve (Fig. 1). The outflow cannula of the RVAD was partially clipped. Due to diffuse bleeding the chest initially was left open, but could be closed without complications 2 days later. Postoperative course was protracted due to prolonged respiratory weaning. However, there were no signs of obstruction of the right lung by the pump. Initial episodes of suctioning were treated successfully with fluid substitution. The patient underwent tracheostomy for better weaning, followed by a prolonged but uneventful recovery. He was

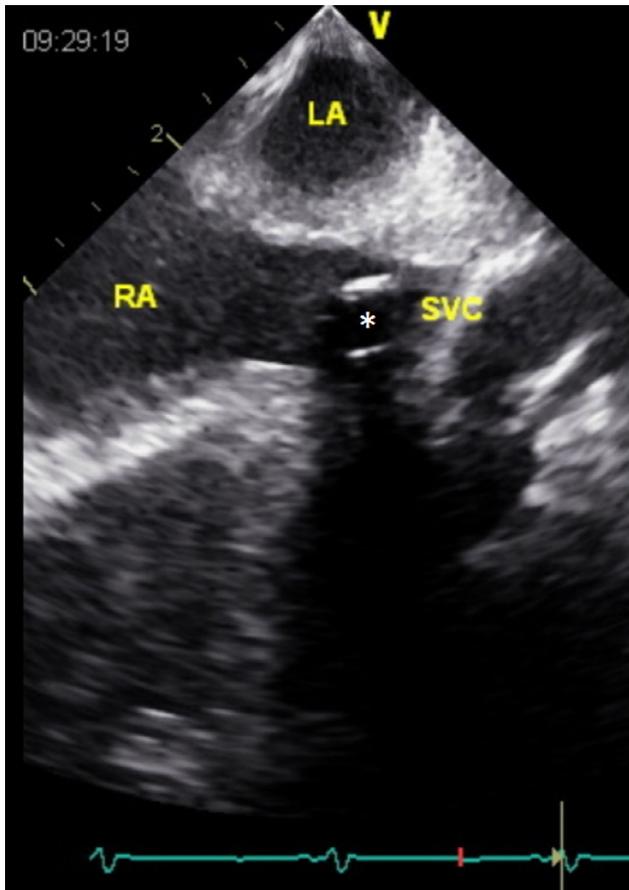


Figure 1. Intraoperative transesophageal echocardiography demonstrating the position of the inflow cannula (*) in the right atrium (RA). LA, left atrium; SVC, superior vena cava.

discharged home 60 days after BVAD implantation. So far follow-up time is 4.5 months after assist implantation and the patient is stable at home with continuously improving exercise capacity. He has not yet been transplanted. Follow-up visits in our clinic are scheduled every 6 weeks. There was one period of recurrent low flow alarm of the RVAD which could be solved by adjusting the alarm limit. Subsequently both pumps run stably with LVAD settings at 2500 rpm with 3.5 W and calculated flow of 4.0 L/min and RVAD set at 1800 rpm with 1.5 W and calculated flow of 3.6 L/min.

DISCUSSION

As the patient was in need of long-term right ventricular support, we discussed the option of implanting either a Berlin Heart EXCOR or a second HeartWare HVAD as bridge-to-transplant. Without the hope of recovery the implantation of an EXCOR meant that the patient would have to spend his waiting time in the hospital whereas with an HVAD he could be discharged home. However, it has to be noted that the HVAD is not approved in the US for RV support. After careful evaluation we decided to implant a second HVAD for biventricular support as there seemed to be enough space in the



Figure 2. Thoracic CT scan after implantation of the HeartWare LVAD with temporary support of the right ventricle: (1) right atrium; (2) inflow and outflow cannula of the CentriMag; (3) outflow graft of the LVAD.

chest to accommodate it (Fig. 2). Comment: During the further course and after acceptance of this report, the patient had an incident of pump thrombosis of the RVAD which required hospitalization and lysis therapy. He was discharged home after resolution of the thrombus. He was now transplanted after 275 days of BVAD support and is still recovering from surgery. There were severe adhesions around the VADs especially toward the diaphragm and pleura requiring extensive dissection which caused bilateral diaphragm paralysis.

Intracorporeal biventricular assist device therapy seems possible even in children with a weight less than 20 kg. It can be an option for patients with secondary right heart failure after implantation of an intracorporeal system for left ventricular support.

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