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Title: Clinical and Echocardiographic Findings of Intraoperative Inferior Vena Cava Obstruction Following Orthotopic Heart Transplantation

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Central message: This case report aims to describe a baffle obstruction between the recipient and donor IVC in a patient with complex systemic venous anatomy during orthotopic heart transplantation.

Image legend: Pressure at the IVC-RA anastomosis drops from a 5 to 1 mmHg on retracting the diaphragm.

Background

Acute intraoperative obstruction of the inferior vena cava (IVC) is an uncommon complication in congenital heart surgery. Diagnosis requires a high index of suspicion and is facilitated by imaging. The case presented here was first diagnosed by imaging, but in retrospect, could have been suspected based on the procedure being performed and the clinical signs that were present. The goal of this case report is to describe these clinical signs and their procedural context such they may be recognized and considered earlier in similar patients.

The Institutional Review Board (IRB) did not approve this study since there was no clinical ethical concerns and we used anonymized data. The subject provided informed written consent for the publication of the study data.

Case Description

The child was a 9-month-old male presenting for orthotopic heart transplant with complex native anatomy: heterotaxy, right ventricle-dominant atrioventricular septal defect (AVSD), pulmonary atresia, discontinuous pulmonary arteries supplied by
bilateral patent ductus arteriosus (BDA), single right superior vena cava (SVC), and left-sided inferior vena cava (IVC). Following palliation with a right modified Blalock-Thomas-Taussig shunt and centralization of the pulmonary arteries, he was bridged to transplant with a Berlin Heart® Ventricle Assist Device for right ventricle (RV) dysfunction and severe ativoventricular valve regurgitation.

Due to his native anatomy with a right-sided pulmonary venous confluence and a left-sided IVC, implantation of the donor heart was challenging. A donor pericardial patch was used to bridge the distance between the right-sided donor IVC and the left-sided native IVC. Care was taken to ensure that this long cuff would not be twisted. On separation from bypass, hemodynamics were notable for hypotension requiring volume and uptitration of vasoactives. Transesophageal echocardiography (TEE) revealed a hyperdynamic, underfilled RV. Central venous pressure (CVP) via the internal jugular vein measured 12-17mmHg and cerebral NIRS were acutely decreased to the 30s (previously 60s). Left atrial pressures were low at 5-6mmHg. Suspecting potential SVC stenosis, direct pressure measurement revealed no gradient across the SVC anastomosis. Other potential diagnoses included elevated pulmonary vascular resistance or bleeding, but neither explained all of the above findings. TEE assessment of the IVC thereafter revealed a 5mmHg gradient. On retracting the diaphragm downwards, the obstruction was instantly relieved, with a normalization in hemodynamics and a decreased gradient on TEE. This suggested the cause of obstruction to be compression of the reconstructed IVC cuff by the RV inferior wall and the diaphragm. The diaphragm was thereafter tacked down with a heavy silk suture which improved hemodynamics significantly. Cerebral near-infrared spectroscopy (cNIRS) subsequently returned to baseline while the CVP normalized to single digits.
Acute obstruction of the IVC during heart transplant is a very rare complication. It has been infrequently reported in the literature, usually in the adult setting in which obstruction at the IVC-right atrial anastomosis occurs due to a large donor Eustachian valve restricting flow. Prompt reoperation and resection of the Eustachian valve released the obstruction. To our knowledge, there are no reports describing heart transplant complicated by IVC obstruction in the pediatric population. We hope this report will facilitate early recognition of IVC obstruction in patients with complex systemic venous anatomy. In the most recent echocardiography, eight months after surgery, the patient had no findings of IVC obstruction and had preserved biventricular function.

**Conclusion**

Baffle obstruction between the recipient and donor IVC was identified in this child with TEE and was easily resolved with simple stitches to tack down the diaphragm. In the setting of complex systemic venous anatomy, IVC obstruction may be considered as a potential cause of unexplained hemodynamic instability.

Supplementary figure 1 footnote: **PRE:** The left IVC had been baffled from left to right (dotted arrows) and its anastomosis with the right atrium (arrowheads) is obstructed (mean gradient 5 mmHg)
Supplementary figure 2 footnote: **POST:** The left IVC had been baffled from left to right (dotted arrows) and its anastomosis with the right atrium (arrowheads) is now unobstructed (mean gradient 1 mmHg)

**Reference:**


SVC, superior vena cava; IVC, inferior vena cava; LUPV, left upper pulmonary vein; RUPV, right upper pulmonary vein
POST: The left IVC had been baffled from left to right (dotted arrows) and its anastomosis with the right atrium (arrowheads) is now unobstructed (mean gradient 1 mmHg)
**PRE:** The left IVC had been baffled from left to right (dotted arrows) and its anastomosis with the right atrium (arrowheads) is obstructed (mean gradient 5 mmHg)