Reduction Aortoplasty of Donor Ascending Aorta Aneurysm During Heart Transplant: A Case Report

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Reduction aortoplasty is safe technique to manage donor ascending aortic aneurysm with a minimal increase in allograft ischemic time and reducing the risk of future dilatation.

Illustration depicts the technique of reduction aortoplasty of donor ascending aorta.
Glossary of used abbreviations in the manuscript.

OHT - Orthotopic heart transplant

RAA - Reduction ascending aortoplasty

CPB - Cardiopulmonary bypass

POD - Postoperative day
Introduction.

Literature on managing significant aortic size mismatch between donor and recipient during orthotopic heart transplant (OHT) due to aneurysms is limited. One technique involves replacing the dilated aorta with a prosthetic graft,\(^1\) while an alternative approach is Reduction Ascending Aortoplasty (RAA), which avoids prosthetic materials by resecting a portion of the aortic wall and primary closure.\(^2\) RAA has been reported in recipient’s but not donor’s aortas. Herein, we present a successful case of RAA performed on the donor's ascending aorta due to an aneurysm.

Case Description.

A 23-year-old man with dilated cardiomyopathy underwent an OHT in April 2023. The donor was a young woman with history of hypertension. There was a donor ascending aortic aneurysm (40 mm in diameter; Figure-1A), resulting in a large discrepancy between the donor’s and recipient’s aortas. RAA of the donor ascending aorta was performed by excising a hemi-oval section of the right lateral wall of the donor aorta with the vertex of hemi-oval at the sino-tubular junction and the center at the free edge (central picture-B). The diameter of hemi-oval excised was calculated as below.

\[
\text{Diameter of semi-oval (mm) = } [\pi D_D - \pi D_R] - 4
\]

\(D = \text{diameter}, \pi = 3.14, \pi D_D = \text{Circumference of donor aorta}, \pi D_R = \text{Circumference of recipient aorta}\)

We subtracted 4 mm from the expected width of the aorta to be excised to account for the 2 mm margin of the aorta consumed by both the suturing margins. In our patient, the difference in circumference was almost 24 mm. We excised a hemi-oval aorta with a 20 mm diameter to effectively reduce the donor aorta to 30 mm. The aorta was closed in two-layer 4-0
Polypropylene, with the initial horizontal mattress suture taking 2 millimeters from each cutting edge. RAA added an extra five minutes to aortic end-to-end anastomosis. The rest of the procedure was uneventful. He was extubated 4 hours after OHT, transferred to the floor on postoperative day (POD) 4, and discharged home with good biventricular function on POD 10. Chest contrast-enhanced computerized tomogram (CT) performed before discharge demonstrated uniform size ascending aorta (27mm; Figure-1B). Five months after OHT, the patient was doing well, NYHA class I, with no rejection episode. Left ventricular ejection fraction on echocardiography was 59%.

The patient provided written informed consent for publication data, and institutional review board approval was not required.

**Discussion:**

In heart transplantation, especially in pediatric population, discrepancy between donor and recipient aortic sizes is common. Table-1 shows techniques that can be used to address this problem, and their pros and cons.\(^1\)\(^-\)\(^2\) Smaller discrepancies are managed by adjusting the suture placement during anastomosis. However, larger discrepancies, resulting from donor or recipient aortic aneurysm, necessitate aortic replacement, or aortoplasty. Published experience with either technique in heart transplant patients is limited. Aortic replacement with Dacron graft effectively reduces aortic size, and eliminates the risk of future dilatation, but prolongs the donor heart's ischemia time and exposed to graft infection,\(^3\) especially in immunosuppressed patients. In case of discrepancies due to aortic aneurysms <50 mm, RAA offers a viable alternative with minimal impact on donor heart ischemia time.\(^2\)
RAA on recipient’s aortas during OHT has been reported in five patients. Ours is the only reported instance of RAA performed on the donor aorta. Published data on RAA for ascending aortic aneurysms in elderly patients, and in patients with significant co-morbidities who undergo concurrent procedures show benefits, including shorter intensive care stay, reduced perioperative and long-term mortality and only 3-6% incidence of aortic re-dilatation. Furthermore, reduction in aortic diameter to <35mm with RAA significantly reduces the aortic wall stress and long-term risk of re-dilatation.

As reference points, a chest CT scan before discharge is crucial for distinguishing between residual and recurrent aortic aneurysms in the future. Recurrent ascending aortic aneurysms have been observed in the recipient aorta, not the donor aorta, suggesting a genetic rather than a biologic cause (see supplement). This, coupled with a low recurrence rate after RAA, emphasizes the importance of continued monitoring for redilatation with echocardiography or chest CT.

In conclusion, RAA is a viable alternative to aortic replacement for moderate ascending aortic aneurysm during OHT. It reduces aortic wall tension, thus lowering the risk of future aneurysm development, and minimizes donor heart ischemic time and perioperative bleeding. Long-term monitoring with echocardiography and/or chest CT scan is crucial for ensuring sustained positive outcomes.
References:


Table 1: Techniques for management of aortic size discrepancy during orthotopic heart transplant and their pros and cons.\textsuperscript{1-2}

<table>
<thead>
<tr>
<th>Techniques</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unequal distribution of stitches to align donor/recipient aortic margins</td>
<td>Technically simple</td>
<td>Minimal increase in risk of bleeding from suture line.</td>
</tr>
<tr>
<td></td>
<td>No additional increase in allograft ischemia and surgery time</td>
<td>Useful only when size discrepancy is &lt;20%.</td>
</tr>
<tr>
<td></td>
<td>No increase in infection risk</td>
<td></td>
</tr>
<tr>
<td>Replacement of ascending Aorta with a Dacron graft</td>
<td>Size of ascending aorta can be reduced to desired size.</td>
<td>Additional increase in allograft ischemia and surgery time</td>
</tr>
<tr>
<td></td>
<td>Useful for any size discrepancy.</td>
<td>Increased risk of graft infection in immuno-compromised patient.</td>
</tr>
<tr>
<td></td>
<td>No risk of future dilatation.</td>
<td>Increased risk of bleeding.</td>
</tr>
<tr>
<td>Reduction aortoplasty</td>
<td>The size of ascending aorta can be reduced to desired size.</td>
<td>Increased risk of bleeding from additional longitudinal incision.</td>
</tr>
<tr>
<td></td>
<td>Minimal risk of future dilatation.</td>
<td>Recommend for ascending aneurysm &lt;5cm</td>
</tr>
<tr>
<td></td>
<td>No increase in infection risk</td>
<td>Contraindicated in Marfan syndrome, collagen vascular disease, and cystic medial necrosis.</td>
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Figure Legends

Figure-1: A: Operative photograph of donor heart showing ascending aortic diameter of approximately 4cm. Posttransplant contrast-enhanced computed tomography of the chest showing donor (B1) and recipient (B2) aortic diameters. White arrow pointing at the site of anastomosis.