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Autograft Aortic Root replacement on Allograft during Heart Transplantation

Running head: Autograft Aortic Root on Allograft

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ABSTRACT

We present a case of a successful heart transplantation using a donor heart with bicuspid aortic valve complicated by moderate aortic insufficiency (AI) by replacing the aortic root with the recipient autograft during the back bench preparation.
The gold standard treatment for end-stage heart failure remains heart transplantation. However, the number of heart transplantation is limited due to the donor shortage. It is important to maximize the donor availability and effectively expand the donor pool. We report a case of a successful heart transplantation utilizing a donor heart with bicuspid aortic valve and moderate aortic insufficiency (AI) where we performed an aortic root replacement on the donor heart using the recipient autograft in the back bench preparation.

**TECHNIQUE**

A 58-year-old male suffered from non-ischemic cardiomyopathy was listed for heart transplantation as Status 2. He had been requiring continuous intravenous milrinone and subclavian intra-aortic balloon pump (IABP) to stabilize cardiogenic shock for 10 days. His recent left ventricular ejection fraction (LVEF) was at 15.6 %.

A donor heart from a young donor became available. The transthoracic echocardiogram (TTE) revealed moderate AI with eccentric jet, preserved biventricular function without LV dilatation or LV hypertrophy. The LV end-diastolic diameter was 5.3 cm, and the systolic diameter was 3.5 cm, intraventricular septum (IVS) was 1.0 cm, posterior wall was 0.7 cm with LVEF of 55.7 %. As a further evaluation, a transesophageal echocardiogram (TEE) was obtained, which showed moderate AI, bicuspid aortic valve with fused the right and left coronary cusp. (Figure 1A). After a discussion, it was decided to accept the heart.

During the donor heart recovery, the venting technique through the inferior vena cava and the left atrial appendage was used. Care was taken to avoid extensive distension of the LV cavity by applying external manual massages during cardioplegic delivery. University of Wisconsin (UW) preservation solution (initial dose 1000 ml) was used. Cardiac arrest was obtained in a reasonable time range. Otherwise the standard surgical techniques were used for the donor heart procurement. An additional dose of UW solution (500
ml) was administered in the back bench using the selective antegrade technique to secure the myocardial preservation.

For the recipient operation, a median sternotomy was performed. Bicaval venous drainage and aortic arch cannulation was used to establish cardiopulmonary bypass. The intraoperative TEE showed normal aortic morphology. The recipient cardiotomy was performed in the routine fashion. Then recipient’s aortic root was excised and saved as an autograft (Figure 2A).

After the arrival of the donor heart, the donor heart was investigated in the back bench. It showed a bicuspid valve without any calcification. The right and left coronary cusp were fused (Figure 1B). The donor’s aortic root was resected leaving the coronary buttons (Figure 2B). The recipient autograft was sawn onto the donor’s aortic annulus using 4-0 Prolene interrupted multiple stitches as well as 4-0 Prolene over and over suture for a reinforcement (Figure 2C, 2D). The coronary buttons were then anastomosed to the autograft in the anatomical position using 5-0 Prolene continuous sutures (Figure 2E). Myocardial protection during the back-bench root replacement was done by administering the conventional cold blood cardioplegia through the retrograde fashion every 20 min as well as topical cooling with ice slush. After back-bench preparation, we confirmed there was no bleeding and no aortic insufficiency by pressuring the aortic root with an antegrade cardioplegia.

Upon the completion of the back-bench root replacement, orthotopic heart transplantation was performed using the bicaval technique was performed (Figure 2F). The total ischemic time of the donor heart was 305 min. the approximate back bench preparation time was 150 min.

The postoperative course was uneventful. The postoperative TTE showed good biventricular function without AI with mean pressure gradient across the new aortic valve 4.1 mmHg, LVEF 56.3 %. He was discharged home on postoperative day #10.
COMMENT

The presence of structural valve abnormalities has been considered as contraindicated for heart transplant donors. However, the persistent donor shortage has led us to consider the effective use of marginal donor hearts. While it depends on case-by-case basis and/or institutions, it is generally accepted to expand donor-heart eligibility for ones with mild-to-moderate mitral/tricuspid regurgitation or normally functioning bicuspid aortic valves.\(^1\)

Several investigators have reported concomitant aortic valve repair or replacement during orthotopic heart transplantation including 3 cases of back-bench aortic valve replacement for aortic stenosis with bicuspid aortic valves.\(^2\)-\(^4\) The present study demonstrated the feasibility of the back-bench aortic root replacement using a recipient autograft during heart transplantation. However, a number of considerations should be involved. A significant trade-off is a prolonged ischemic time due to the back-bench procedure. In this particular case, the donor hospital was located 20 miles away from our institution and the expected transportation time was 30 min by ambulance. It took about 150 min for the back-bench procedure and the total donor ischemic time ended up 305 min. We believe that young donor age and the short transportation time made this case feasible without any major complication, which is supported by the report that showed high tolerance of young donor heart to prolonged ischemic time with fewer adverse postoperative cardiac event.\(^5\)

Aortic valve replacement/repair during the back-bench preparation would have been an alternative. However, there are a number of concerns related with prosthetic valves or repaired bicuspid valves including durability, infection, the use of life-long antiplatelet agent/anticoagulation, and future aortic/root expansion due to the inherent nature of the bicuspid aortic valve pathology.

UNOS data show that of 80,782 donor hearts in 2005–2014 (10 years), 38,877 hearts were rejected. Poor cardiac function was the reason for 14,347 (37%) of them\(^6\). The University of Vienna and Eurotransplant centers reported that 5.9% of donor hearts were rejected due to valve dysfunction\(^7\). Furthermore, in valve
dysfunction, the rate of aortic valve abnormality is reported to be 45.2%. Therefore, as a rough estimate, about 5.9% of the 14,347 patients, about 846, may have gotten declined due to valve abnormalities. Among 45.2% of them, approximately 382, may have had their hearts rejected due to aortic valve abnormalities over the past 10 years. Therefore, an average of about 38 people per year who may have been rejected due to aortic valve abnormalities could be considered as potential donors with the presented technique.

In conclusion, the back-bench aortic root replacement using a recipient autograft during heart transplantation is feasible in a selected condition. Comprehensive assessments including appropriate donor/recipient selection as well as geometrical factors would be the key to success for this technique. Nevertheless, a long term follow up would be warranted. While applying this technique would require a number of conditions including the recipient/donor/surgeon factors as well as geographic factors, it would potentially contribute to increasing the donor pool in a limited way.
REFERENCES


FIGURE LEGENDS

Figure 1. A: Donor TEE showed Bicuspid Aortic valve with right-left fusion. B: Donor Heart showed bicuspid aortic valve with right-left fusion.
