Case Reports

Bioprosthetic Aortic Valve Replacement in a Donor Heart

before Orthotopic Heart Transplantation

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Current criteria for donor hearts limit the number of hearts available for transplantation, despite an increasing number of recipients on waiting lists. We report the case of a patient with ischemic cardiomyopathy and refractory ventricular tachycardia who underwent successful orthotopic heart transplantation and concurrent aortic valve replacement with a donor heart that had displayed moderate aortic valve regurgitation.

The patient was a 71-year-old man with a history of advanced heart failure, 5-vessel coronary artery bypass grafting, and paroxysmal ventricular tachycardia. He was not a candidate for repeat revascularization or myocardial ablation, so he was placed on the heart-transplant list as status 1A. On intra-aortic balloon pump support, the patient waited 51 days for a donor match to be identified. Despite the donor heart's having moderate aortic valve regurgitation, the decision was made to use that heart. We performed a back-table aortic valve replacement with a 23-mm St. Jude Epic bioprosthesis, and then performed the orthotopic heart transplantation. The patient did well and was discharged from the hospital on postoperative day 11.

This case indicates that expanding donor criteria to include otherwise healthy hearts with certain aortic valve defects is feasible, if surgical experience and expertise permit.
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The strict criteria that define a heart ideal for transplantation have contributed to the severe shortage of donor organs. A large fraction of patients on the heart-transplant waiting list never receive one. This issue is exacerbated by the fact that one-year mortality rates without transplantation are 8.1%, 10.1%, and 14% for patients listed as United Network for Organ Sharing status 2, 1B, and 1A, respectively.[1] Historically, surgeons have used "non-ideal" donor hearts that do not meet all donor criteria.[2] The fact is that recent technical advances can support the relaxation of donor-heart criteria in certain circumstances. We report a successful instance of orthotopic heart transplantation (OHT) performed with concurrent bioprosthetic aortic valve replacement (AVR).

Case Report

The patient was a 71-year-old man with a history of type 2 diabetes mellitus, hypertension, 5-vessel coronary artery bypass grafting, paroxysmal ventricular tachycardia (VT), and the implantation of a cardioverter-defibrillator/biventricular pacemaker. He was admitted to our hospital for symptomatic recurrent VT and heart failure. Initially, right- and left-sided heart catheterization showed severely diminished left ventricular (LV) function with cardiac output of 2.3 L/min, elevated filling pressures, increased pulmonary artery pressure (74/46 mmHg), and diffuse coronary artery disease not amenable to repeat revascularization.

Because of the advanced heart failure and very high-risk nature of the alternative VT ablation, the patient was presented to the cardiac transplantation medical review board at our institution, where he was assigned 1A status for OHT. Until the donor heart became available, he was hospitalized for 51 days on intra-aortic balloon pump support with bumetanide, lidocaine, and procainamide drips.

A transthoracic echocardiographic report on the donor heart showed moderate aortic valve regurgitation. We discussed this finding with the patient and his family,

and explained that the aortic valve would need to be replaced before the donor heart was implanted, if indeed the patient consented to receiving the available heart. After the patient and his family accepted the donor heart, the transplant team carefully inspected it for other anomalies. Because there were no other anomalies found during cardiac harvesting, only a "back-table" AVR was planned before the heart implantation.

Donor Summary

The donor had been a 17-year-old Hispanic boy who, after an automobile–pedestrian collision, had arrived brain-dead (Glasgow Coma Scale 3) with a nonsurvivable head injury (right subdural hematoma, subarachnoid hemorrhage, and cerebral edema with impending herniation), together with grade 3 liver laceration and left-upper-lobe pulmonary contusion. The donor was on a regimen of levophed bitartrate (11.7–1.6 µg/min) and vasopressin (0.6–2.4 U/hr).

A transesophageal echocardiogram of the donor heart revealed normal LV size and function (LV ejection fraction, 0.40–0.45). Right ventricular size and function were normal. The aortic valve was bicuspid, with moderate aortic regurgitation. Otherwise, there was a trace of mitral, a trace of tricuspid, and no pulmonary regurgitation. The interventricular septal diameter was 0.7 cm; the LV posterior-wall diameter, 0.9 cm; the aortic root diameter, 2.6 cm; and the ascending aortic diameter, 2.7 cm.

At the time of harvest, the donor heart was without trauma, and the aortic valve had mildly thickened leaflets.

On the back table in the operating room, the donor heart was again physically examined and judged unfit for simple aortic repair. While the donor heart was maintained in a cold saline solution at a temperature of 4 °C, a transverse aortotomy was extended to the noncoronary sinus. The left coronary cusp of the aortic valve was found to be smaller and thickened—most likely a contributor to the aortic regurgitation. The aortic leaflets were excised, and the aortic valve was replaced with a 23-mm Epic™ bioprosthetic aortic valve (St. Jude Medical, Inc.; St. Paul, Minn). The valve was well seated, the sutures were tied, and the patency of the coronary ostia was visually confirmed. The aortotomy was closed with running 5-0 Prolene suture. The recipient heart was then implanted by means of standard bicaval anastomosis. The total donor ischemic time was 165 min, and the cardiopulmonary bypass time was 91 min.

Postoperatively, the standard induction immunosuppressive agents were used: basiliximab, tacrolimus, mycophenolate, and prednisone. The patient had an uncomplicated recovery. He was discharged from the hospital on postoperative day 11 with initial right-sided heart biopsy specimens negative for rejection, a pathology-based antibody-mediated rejection score of 0, and a rejection grade of 0.

The recipient's transthoracic echocardiograms before hospital discharge, at 1 year after treatment, and then at 2 years, showed a well-seated and functioning aortic valve bioprosthesis with mean gradients of 23, 28, and 23 mmHg, respectively.

Discussion

According to the latest data from the Organ Procurement and Transplantation Network, the number of candidates added to the waiting list for heart transplants ranges from 3,400 to 3,600 per year.[3] Disproportionately, the number of hearts recovered annually has consistently ranged from 2,200 to 2,400 per year.[3] The lack of suitable donor hearts is the primary factor restricting the number of annual OHTs. There is a developing trend in Europe to use a broader spectrum of donor hearts, including hearts from older donors, but this practice is not frequent in the United States.[4] In the U.S., any echocardiographic valvular abnormality is typically considered a contraindication to donation.[5] However, the consensus is now to widen donor-heart eligibility, to include hearts with mild-to-moderate valvular abnormalities of the mitral and tricuspid valves and with normally functioning bicuspid aortic valves.[6] In the past, donors older than 55 years of age or weighing less than 50% of the recipient's body weight have been accepted only for critically ill patients.[2] Expanding these suitability criteria increased the number of transplantations without significantly changing recipient outcomes.[7]

A few case reports have described valve repairs in conjunction with coronary artery bypass grafting in donor hearts.[8,9] Two cases of back-table AVR for moderate-to-severe aortic regurgitation and aortic stenosis with OHT have been reported as well.[10,11] Reforms such as the use of "alternative-list" criteria versus the "standard list" extend the availability of heart transplantation to patients who would otherwise be deprived of this therapy, but they also lead to a multitude of ethical questions. Whereas the alternative-list approach is feasible for appropriately selected recipients and donors, its limitations include prolonged surgical time, which could increase overall ischemic time and the risk of bioprosthetic valve failure necessitating future valve replacements. However, transcatheter AVR could be a solution in such cases. Although the use of alternative criteria is associated with higher morbidity and mortality rates, it improves overall survival rates when compared with the natural history of end-stage heart failure and of destination LV assistance.[12]

In conclusion, our experience shows that expanding heart-donor criteria to include otherwise healthy hearts with aortic valve pathologic conditions is feasible. However, these donor hearts must be evaluated

case-by-case, in consideration of local needs and of local expertise to carry out repair or replacement at the time of the OHT.

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