Aortic Root Replacement with Cryopreserved Homograft for Aortic Valve Endocarditis

José Luis Navia, MD

Department of Thoracic and Cardiovascular Surgery, Cleveland Clinic Foundation, Cleveland, Ohio, USA

INTRODUCTION

Native aortic valve endocarditis is a serious and frequently fatal condition, particularly when it occurs on a prosthetic valve, and remains a great challenge to cardiac surgeons (11). The treatment of active endocarditis is in evolution, antibiotics have significantly improve survival rates, but in patient with more virulent forms of infection, may no respond to drug therapy or may have developed of complication, like congestive heart failure, uncontrolled sepsis, or vegetation embolization, and in this situations surgical intervention is required.

Homograft valve is increasingly used for aortic valve replacement in young patient as a first choice. They have several advantage compared with a mechanical valve, such as better hemodynamic function, avoidance of anticoagulation, freedom from thrombosis and have the greatest resistance to valve infection. Homografts also provide unique technique advantages for the setting aortic root destruction for aortic valve endocarditis (19,20). In this article we will describe the experience at the Cleveland Clinic with the use of homografts in the treatment of aortic valve endocarditis.

METHODS

Between July 1987 through July 1997, 112 patients with aortic valve endocarditis underwent homograph aortic root replacement. Mean age was 50.8 years with the ranges from 23 to 81 years. Male 89 patients (79.5%). Demographic analysis of preoperative risk factors include, hypertension was present in 60 patients (55.1%), 6 diabetic patients (5.4%), history of myocardial infarction 20 patients (17.9%), arrhythmia 44 patients (39.3), history of PVD 14 patients (12.5%), history of COPD 17 patients (15.2%) and history of renal disease 22 patients (19.6%). Twenty patients (17.9%) were in Function Class(FC) I, 40 patients (35.7%) in FC II, 37 patients (33.3%) FC III, and in FC IV, 15 patients (13.4%). Sixty-four patients (57.2%) had previous cardiac surgery. Total patients with preoperative endocarditis were 108 patients (96.4%). Positive blood cultures was present in 77 patients (68.8%), progressive congestive heart failure in 87 patients (78.4%), septic emboli preoperatively was only present in 22 patients (19.8%), history of continous high temperature before surgery was present in 77 patients (68.8%), dyspnea on exertion in 101 patients (91%). In terms of neurological symptoms before surgery, amaurosis was present in 5 patients (4.5%), TIA in 3 patients (2.7%), CVA-7 patients(6.3%) and septic emboly 7 patients (6.3%). All the patients had the same clinical deterioration with ongoing septic with the evidence by one or more following data: 1) New or worsen murmur of valve dysfunction. 2) New or progressive congestive heart failure related to the function of the native or prosthetic valve. 3) Persistent fever for greater than a week to 10 days. 4) Persistent positive blood culture despite antibiotic therapy. 5) New abnormal cardiac conduction. By far the most common organism present was the staphylococcus gram positive in 75 patients (67%), gram negative endocarditis was observed in 25% of the patients and 5% fungal endocarditis.

Active aortic valve endocarditis was present in 48 patients (42.9%); early prosthetic endocarditis defines occurring within 60 days of operation occurring 31 patients (27.7%). Late endocarditis more than 60 days after operation occurring in 33 patients (29.5%). Aortic valve endocarditis was diagnosed by Trans-thoracic echo in 108 patients (96.4%), TEE was diagnostic in 112 patients (100%), catheterization was

performed in 21 patients (19.1%), CT Scan in 7 (6.4%), and MRI in 1 pt. (0.9%).

It was noted that one or more abscess in the aortic valve annulus was present in 38 patients (69.6%). In terms of echocardiographic analysis of this patients, aortic insufficiency (AI) was observed in 91 patients (81.3%). Preoperative 1+ AI was in 5 patients (6.8%), 2+ AI was present in 10 patients (13.3%), as well as 3+AI 10 patient, and 4+ AI 46 patients (63.9%).

Preoperatively severe aortic stenosis was present in 21 patients (18.8%) and left ventricular function was normal in 56 patients (50%), mild 20 patients (17.8%), moderate 18 patients (16%) and severe 18 patient (16%). Nine patients underwent surgical procedure in an emergency situation (8%). In terms of the medical treatment of patient before surgery, there was a completed antibiotic therapy in 13 patients (11.6%), not completed in 78 patients (69.6%), and non-preoperative antibiotic 21 patients (18.8%).

SURGICAL TECHNIQUE

The basic approach to surgical treatment of a patient with aortic valve endocarditis is radical resection of all infective tissue, reconstruction the holes of the heart and replace the valve.

When operating on a patient with active infection, it is important to avoid contamination in the instrument and drapes. The surgical instrument suction tips and surgeon gloves should be changed after the incision and removal of the infected valve and debridment of the surrounding infected tissue. Patient with aortic root abscess has the most destructive lesion and consequently need to have more extensive debridment and more surgical demanding reconstruction.

All operation were performed through median sternotomy, two-stage right atrial and ascending aorta cannulation were used as a standard technique. Cardiopulmonary bypass is established with a moderate systemic hypothermia at 28°C in most of the cases except where circulatory arrest required profound hypothermia, myocardial protection with a combination of antegrade and retrograde cold blood cardioplegia given every 15 or 20 minutes during the operation and with a warm reperfusate at the end of the procedure according to the Buckberg protocol is performed. Myocardial protection must be effective during the aortic valve replacement for endocarditis, because these are often long procedures, and retrograde cardioplegia delivery without interrupting the operation, has been a major adjunct to myocardial protection. The aortic root is exposured by transecting the aorta just above the sino-tubular junction, approximately 1cm above to the right coronary ostium and a right angle extension is then made into the noncoronary sinus. A stay suture is then placed over the comissures to display the root. The ascending aorta is retracted. The exposure is uniformly excellent regardless of the size of the aortic root. The homograft is prepared on the bench, the proximal muscle of the homograft is trimmed so that 3 to 4 mm extends below the valves cusps. Excess tissue is excised, if the allograft can be prepared early and checked, then the subsequent operative step of preparing the root with a coronary artery can be proceed. The aortic valve and the proximal aorta are excised, the coronary artery pedicles are prepared by leaving at least 5 mm of aortic wall around the coronary ostium, care is taking to create the aortic button around the right coronary artery always to include the coronary branch, with often has separate orifice. The coronary artery buttons are mobilized from the native aortic root and left in place for allograft implantation.

After the native aortic valve or prosthetic valve are excised, the aortic annulus is carefully inspected and any granular tissues has to be debrided until heavy tissue is encountered. When the abscess is limited to the aortic-ventricular junction, mostly along the noncoronary and partially left coronary sinuses, simple wide excision and reconstruction of the annular and subannular defect of the aortic annulus with autologous or glutaraldehyde-preserved pericardium is the correct procedure(14). The patch is secured with a heavy tissue around the defect with a 4-0 Polypropylene suture, and the homograft fixation sutures along this area are passing through the pericardial patch. An alternative to pericardium patch is to use the homograft to reconstruct the aortic root. Most cases of left aortoventricular discontinuity were repaired by reconstructing the annulus and implanting the homograft in a subannular position with reimplantation of

the coronary arteries. When feasible, the retained anterior leaflet of the mitral valve is used to repair periannular defects. Sometimes, it is possible to enlarge the aortic root and put directly the homograft in the aortic root. A ring of pericardium or a segment of saphenous vein is often used in between the homograph and the aortic annulus in order to help fill the annular defects and to ensure a secure seal at the reconstructed annulus. When the abscess has extended through the aortic wall into other tissue and cavities, a more extensive resection is performed and then the fistulas are closed either primarily or with autologous or bovine pericardium. In patient with abscess in the fiberskeleton between the aortic and mitral valve, the roof of the left atrium is open for radical resection of the abscess. The anterior leaflet of the mitral valve may need to be excised, depending on the extent of the infection process. When the anterior leaflet of the mitral valve has excised, the aortic and mitral annulus becomes a single orifice and reconstruction is performed with a triangle shape of bovine pericardial patch. After securing the mitral valve prosthesis to the mitral annulus and the pericardial patch to the roof of the left atrium, a separate patch of pericardium is used to reconstruct the out-flow tract in a reasonable size, and also give the support element to secure the aortic valve prosthesis to the aortic annulus. The allograft is implanted in anatomic position as a mini root. To ensure correct alignment of the graft, the proximal suture line of interrupted 4-0 prolene are placed at the aortic annular level, then the suture is passing the needle from inside to outside the allograft at the base of the commisure between the right and the left and then continues for the three commisures. Good bite on both host and allograft tissue are taken approximately 2 to 3mm apart. As soon as all 4-0 prolene suture are placed through the homograft, pieces of pericardium or pieces of vein are placed inside the suture line. Then, the homograft is seated, the suture tightened and cut.

Sometime the coronary button does not align easily with allograft coronary ostium. If such is the case, a new 5mm punch-hole is made in the proximal portion of the aortic allograft as a new coronary ostium. The coronary anastomosis is carried out with a continuous 5-0 prolene suture.

A simple forehand technique again is used for both the left and the right anastomosis running counter clock wise for the lower half, and clockwise for the upper half, suture spacing of 2-3 mm is critical. After this stage, it is possible to insert a cardioplegia line inside the homograph, and by the infusion of cardioplegia solution in the allograft root, can be determinated or checked at the same time, the present position of both coronary arteries, anastomotic patency, as well as the hemostasis of the proximal homograph anastomosis. The distal homograph anastomosis is performed to a complete transected aorta with a 4-0 prolene, a forehand continuous technique, beginning on the left side and proceeding counter clockwise posteriorly. The allograft is kept to length the entire diameter of the aorta. Some length of the ascending aorta is maintained to avoid tension of the anastomosis, the allograft aorta is quite elastic and can comfortable adapt with the native aorta. The heart is de-aired using standard techniques and the cross-clamp is removed. The patient is allowed to reperfuse and then weaned from cardiopulmonary bypass with low pre and afterload. Intraoperative TEE is performed in all patients, pre-pump study is used to evaluate the pathology of the aortic valve and in the search for abscesses, cavities, pseudoaneurysms, fistulas, and septum defects. The post-pump study is used to evaluate intracardiac air evacuation, success of repair of the defects, ventricular function, valve competency, homograft function and dimensions(15).

FOLLOW UP

Patients were examined or interviewed by phone, 1 and 6 month postoperatively and yearly thereafter. Postoperatively echocardiogram were noted as were any significant event such thromboembolism, endocarditis, or congestive heart failure. Follow-up was 97% complete at a mean of 2.2 ± 2.1 years. Two hundred forty patient-years of follow-up were available for analysis.

STATISTICAL ANALYSIS

Survival estimates and standard errors were computer using the Kaplan-Meier product-limit method.(4)

RESULTS: SURGICAL DATA

Aortic valve replacement with a homograft was performed in 66 patients (58.9%), aortic valve

homograft associated with another valve procedure was done in 29 patients (25.9%), aortic valve homograft plus CABG in 10 patients (8.9%), aortic homograft, cabg and another valve 7 patients (6.3%). All the patients underwent root replacement with the same homograft implantation technique above described. Seven patients (6.3%) had at least 2 patch repair, and 21 patients also had repaired the ascending aorta (18.8%). Repair of the aortic arch was required in only 4 patients (3.6%). In terms of cardiopulmonary bypass time the mean was 171 minutes +/- 63.9, and the mean total aortic occlusion time was 129 minutes +/- 51.1.

In terms of morbidity, eight patients underwent reoperation for bleeding (7.1%), there was no myocardial infarctions, 4 patients (3.6 %) developed renal failure and required chronic dialysis. Intra-aortic balloon pump was required in only 1 patient (0.9%), 5 patients developed sepsis (4.5%), respiratory failure was presented in 19 patients (17%), and CVA was presented in 2 patients (1.8%). Major wound infections just only 2 patients (1.8%), and 27 patients presented after surgery low cardiac output requiring prolongated, more than a week, inotropic support (24.4%). Twenty-five patients required permanent pacemaker implantation postoperatively for complete heart block or sick sinus syndrome (22.3%). There were two hospital death (both patients died in ongoing sepsis), for an overall mortality rate of 1.8%. Mean Hospital ICU length of stay was 3.7 ± 4.1 days (1 to 20 days), Hospital length of stay was 13.2 ± 9.2 days (4 to 66 days). There were 7 late death (6.4%), and the cause of late death was 4 patients cardiac related, 1 patient sepsis, and the rest non-cardiac related. Late homograft endocarditis was present in 7 patients (6.4%) 3 required homograph explantation. Late reoperation was required in 7 patients (6.4%). Postoperative survival and freedom from late recurrent endocarditis for all patients was 93%, 87%, and 85% at 6, 12, and 74 months respectively.

CONCLUSION

Allograft aortic root replacement was introduced for the treatment of extensive aortic valve annular destruction by endocarditis (3,5), ascending aorta aneurysm, or aortic dilatation with associated valve incompetence, and also left ventricular out-flow tract stenosis (6,7). Aortic valve replacement with aortic root homograft is considered the best technique for the treatment of aortic valve endocarditis for many reasons: The homograft offers distinct anatomic advantages (1,2). A soft annulus with muscular cuff can fill annular and subannular defects and help restore aortoventricular continuity. The attached anterior leaflet of the mitral valve can be used to close ventricular septal defects, subannular abscess, and aorto-right atrial fistula (13). The cylinder homograft root insertion technique, especially in the setting of destructive root infection with unpredictable anatomy, results in more reliable reconstruction procedure and better valve function (12). Also the standard root replacement is unlikely to be distorted compared to the free-hand insertion technique. The asymmetrical for the host annulus, often seen in the congenital bicuspid lesion, becomes less important with the aortic root replacement, because the flexibility of the homograft annulus can accommodate with minimally distortion in the root anatomy, and with a minimally effect of valve function, as well as the match in the allograft size to the host annulus becomes less critical. Aortic valve replacement with a human aortic allograft has become more prevalent because of the obvious benefits with this material. Allograft provides superior hemodynamic function, less embolic event, and infection complications. Allografts do not require anticoagulation, which makes it particular attractive for use in childrens and young adults, also with patients with endocarditis.

The homograft valve is proven to have increased resistance to infection when compared with a mechanical or prosthetic tissue valve and satisfactory durability (8,9,10). The technical advantage associated with its flexible root, additional periannular tissue, and contiguous aortic segment may be used not only to fill irregular defect but also to reconstruct extensive destroyed root or replace of the infected valve conduit (16,17,18). In conclusion, we are encouraged by our surgical and clinical results, and we find the homograft root replacement uniquely well suited technically to situation that require extensive debridment and aortic annulus reconstruction. The relative easy implantation technique for the surgeon, as well as the low morbidity and mortality rate associated with the use of the homograft for aortic valve endocarditis, make this substitute the first Cleveland Clinic surgical choice especially for aortic root replacement and reconstruction in the setting of aortic valve endocarditis.

ABSTRACT
Aortic valve endocarditis is a serious and frequently devastated clinical condition. Despite advances in the early diagnosis and antibiotic treatment, more frequently aortic valve endocarditis required a combination of medical and surgical therapy in order to obtain successfully result and improve the short and long-term patient clinical outcomes The surgical treatment of active endocarditis is in evolution, and homograft valve is increasingly used for aortic valve replacement, based on the evidence that aortic homografts offers more advantages in reducing the risk of valve reinfection than bioprosthesis and mechanical valves, and also homografts provide better surgical reconstructive tissue properties in the setting of aortic root destruction for aortic valve endocarditis. Between 1987 and 1997, we reviewed a group of 112 patients who underwent homograph aortic root replacement for native aortic and prosthetic valve endocarditis. Active endocarditis was present in 79 patients(70.5%).
Endocarditis in the native valve was present in 48 patients (42.9%) and early prosthetic valve endocarditis was in 31 patients (27.7%) and late prosthetic endocarditis was present in 33 patients (29.5%). All patients had root replacement and 6.3% of the patients has also pericardial patch repair of the annulus abscess, repair of the ascending aorta was performed in 21 patient (18.8%) and repair aortic arch was in 4 patients (3.6%). In terms of type of procedure involved only aortic valve in 66 patients (58.9%) and associated with CABG in 10 patients (8.9%), other surgeries in 29 patients (25.9%). The homograph provides versatile in allowing various techniques for aortic reconstruction. All patients survived the operation. Two late hospital deaths accounted for hospital mortality rate 1.8%. Follow up was 97% complete, at a mean of 2.2 + 2.1 years. Two hundred forty patient-years of follow-up were available for analysis. We conclude that the use of aortic homograph in the setting of aortic valve endocarditis offers a low risk in early and mid-term reinfection, low morbidity and mortality rates, technical surgical advantages, as well as satisfactory durability and hemodynamics. So we consider the use of aortic homografts as a first choice for the treatment of aortic valve endocarditis.

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