

Twenty-Eight-Year Survival of Stent-Mounted Aortic Homograft in the Mitral Position: Case Report

Ganapathy Subramaniam¹, Ujjwal K. Chowdhury¹, Sandeep Seth², Somnath Prusty¹, A. Sampath Kumar¹

Departments of ¹Cardiothoracic and Vascular Surgery and ²Cardiology, Cardiothoracic Centre, All India Institute of Medical Sciences, Ansari Nagar, New Delhi, India

The case is presented of a long-term survivor after bioprosthetic valve implantation. A stent-mounted aortic homograft had been implanted in the mitral position, and survived for 28 years before being removed due to a tear in the base of leaflet, resulting in mitral regurgitation. The technique was discontinued in the mid- 1970s following reports of detach-

Tissue valves have several advantages over mechanical prostheses, including low thrombogenicity without anticoagulation therapy, and an absence of noise. Their limited durability is a cause of major concern, however, and in fact few tissue valves survive as long as 20 years (1-3). These bioprostheses show earlier structural valve deterioration when compared to a prosthesis implanted in the aortic position. Recently, a patient was encountered with a stent-mounted aortic homograft in the mitral position, who presented for reoperation almost 28 years after the initial valve replacement.

Case report

This 58-year-old man underwent mitral valve replacement in March 1975, when aged 30 years, for rheumatic mitral stenosis. A stent-mounted, fresh, antibiotic-preserved aortic homograft was used. Subsequently, the patient was followed up at six-monthly intervals in the authors' outpatient clinic, and did well for almost 28 years. However, the patient recently presented with progressively increasing dyspnea over a period of six months. Clinically, he was in normal sinus rhythm and had cardiomegaly with a pansystolic murmur at the apex. Chest X-radiography revealed the presence of cardiomegaly, with a cardio-

ment of aortic valve cusps from the stent. The current case report may rekindle interest in the method, and also lead to an investigation of the factors that influence structural deterioration of bioprosthetic valves.

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thoracic ratio of 0.6, an enlarged left atrium, and evidence of pulmonary venous hypertension (Fig. 1).

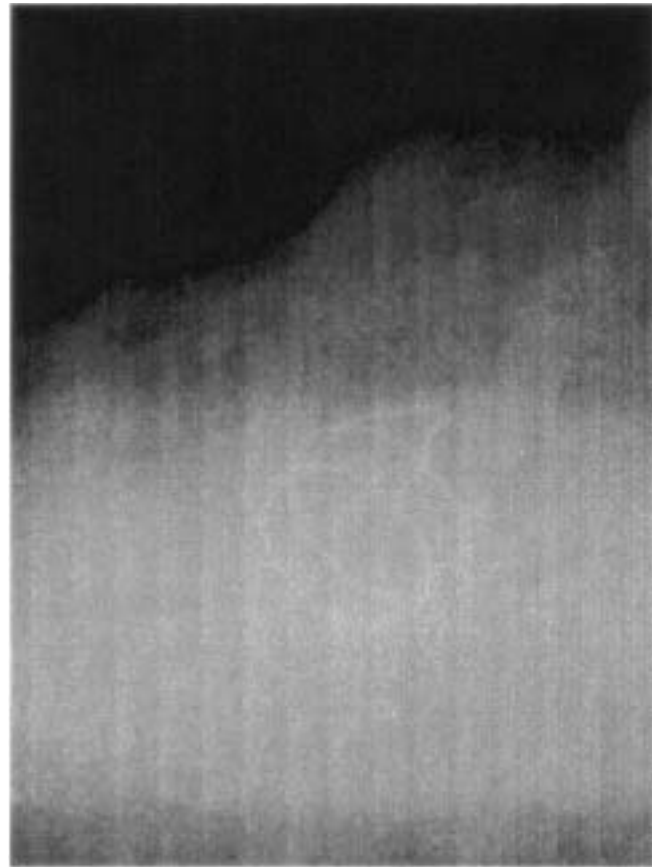


Figure 1: Chest X-radiograph showing the frame used for making the aortic homograft. The left atrium and left ventricle are also dilated.

Address for correspondence:

Dr. Ujjwal K. Chowdhury, Department of Cardiothoracic and Vascular Surgery, All India Institute of Medical Sciences, Ansari Nagar, New Delhi-110029, India
e-mail: ujjwalchow@rediffmail.com



Figure 2: The explanted valve, showing the tear at the base of one of the leaflets and scattered areas of calcification.



Figure 3: The explanted valve, showing the thickened leaflets and the tear at the base of the leaflet.

Two-dimensional echocardiography and color flow imaging (Ultramark-9; Advanced Technology Laboratories, New Delhi, India) showed mildly thickened mitral valve leaflets with specks of calcification. The mean instantaneous gradient across the mitral valve was 12 mmHg, and the mitral valve area was 1.2 cm². There was severe eccentric mitral regurgitation through the base of one of the leaflets, and there was also mild tricuspid regurgitation. The left atrium was enlarged, with no evidence of thrombus. Global ventricular dysfunction was also evident, with a left ventricular ejection fraction of 30%.

The patient underwent a detailed hemodynamic evaluation and angiography. The mean pulmonary artery pressure was 33 mmHg, the pulmonary artery wedge pressure 25 mmHg, and the left ventricular end-diastolic pressure 10 mmHg. The cardiac index was 3.9 l/min/m², with systemic and pulmonary vascular resistance indices of 17.2 and 2.0 Woods units, respectively. Angiography showed a poorly contracting, enlarged left ventricle and moderate mitral regurgitation.

The patient underwent reoperation on January 30, 2003. The mitral valve was explanted and replaced using a 31 mm St. Jude Medical prosthesis (St. Jude Medical, Inc., St. Paul, Minnesota, USA). The patient had a uneventful postoperative course and was discharged on day 7 following reoperation. Currently, the

patient is doing well with regular anticoagulation, and did not exhibit dyspnea on exertion at one year after surgery.

Bioprosthesis preparation

The stent-mounted aortic homograft valve consisted of a fresh, antibiotic-preserved aortic valve mounted on a Dacron-covered stent constructed from 20-gauge, hard drawn, chemically polished, spot-welded, stainless steel wire. The valve was harvested from a cadaver donor within 24 h of death, and sterilized and preserved at 4°C in tissue culture solution to which was added 50 U penicillin, 1 mg streptomycin, and 25 U amphotericin per ml. After one week, the valve was transferred to fresh tissue culture medium without antibiotics. The valve was mounted onto a frame at the time of surgery. The valve was only used when the tissue culture medium was shown to be bacteriologically sterile. After mounting, the valve was tested for competence using a sterile condom filled with saline before implantation.

Pathology of the excised valve

On gross inspection of the excised valve, the aortic homograft was seen to be well opposed to the stent. The valve cusps showed a mild increase in thickness, with evidence of patchy areas of calcification, especially near the base where it was attached to the stent. One of the

cusps showed a tear at its base which arose from near an area of calcification, and was apparently responsible for the regurgitation. The remainder of the stent structure was well preserved, with no evidence of creep (Figs. 2 and 3). A histological examination of the valve showed no cellular infiltration and pronounced fibrous changes involving the three cusps. The cusps showed amorphous eosinophilic staining with areas of elastic fiber disintegration, and focal areas of calcification.

Discussion

The replacement of diseased heart valves with homografts was initiated by Lam et al. in 1952 (4), and by Murray in 1956 (5), both of whom used free aortic homografts implanted in various positions. Later, Lower et al. (6) reported the use of autologous pulmonary valve as a replacement for the mitral valve. These initial experiences were troubled by complications of stenosis of the homograft and left ventricular outflow obstruction, as well as frequent occurrences of valve deterioration (7). Problems with poor coaptation of the leaflets and commissural support, which caused severe mitral regurgitation, led to the introduction of a ring with struts to which the homograft was sutured prior to insertion (8,9). In 1969, the introduction of glutaraldehyde by Carpentier to process porcine aortic valves, together with the use of flexible stents for valve mounting, represented an important advance in cardiac valve surgery (10). The favorable results of homograft replacement of the aortic valve, along with experimental evidence of inherent strength and bulk of aortic valve cusps, encouraged many to use it as the tissue valve for mitral replacement (11,12).

Initial reports had indicated that fresh homograft replacement of the mitral valve provided good short- and medium-term clinical and hemodynamic benefits, with low operative mortality and freedom from complications of thromboembolism and risk of anticoagulation (13). Yacoub subsequently introduced the technique of suturing the aortic homografts into a Dacron conduit - which was called the 'top hat' graft - and, in 1972, reported satisfactory short-term results in a series of 191 patients undergoing mitral valve replacement (14).

Barratt-Boyes et al., in their study with stent-mounted aortic homograft mitral valve replacement in 129 patients followed over a period of five years, found a cumulative complication-free rate of only 37%, with detachment of the aortic wall from the rigid metallic stent occurring in 16% of patients. This high incidence of buttress detachment led to the discontinuation of the valve in 1976 (15). Angell et al. reported a 20-year follow up of patients undergoing mitral valve replacement using fresh and cryopreserved aortic homografts

used as a free-hand graft or in a premounted metal support. These authors reported an 8.6-year median period for valve failure in patients undergoing mitral valve replacement (16). The use of a pliable stent with acetal copolymer rather than rigid struts was also recommended (17).

Salles et al. (18), using flexible stent-mounted, glutaraldehyde-preserved aortic homografts in patients aged over 15 years, identified a 12-year actuarial freedom from primary valve failure of $81 \pm 15\%$ and an allobioprosthesis-related complication rate of $2.4 \pm 0.5\%$ per patient-year. These authors used the same technique of preservation as that used for porcine bioprostheses, and found a very low incidence of primary homograft failure in patients aged over 15 years undergoing mitral valve replacement. These results were also much superior to those obtained with porcine bioprostheses in the same age group (18).

Calcification is a common cause of degeneration in tissue valves, and the determinants of the process are still not completely understood (19). The prosthetic valve, when implanted in the mitral position, is placed under much greater hemodynamic stress as it must resist closing pressures equivalent to left ventricular systolic pressure. The stress of the cusps during closing and opening of the valve leaflets represents a critical issue in the mechanism of cusp rupture.

The prolonged valve survival in the present patient may have been due to the precise maintenance of geometric architecture of the valve during the mounting process. A gradual process of fibrocalcific degeneration may have occurred because of the rigid stent, and this finally led to the tear occurring in one cusp.

The present case highlights the fact that homograft valves have provided patients with a good quality of life, and with freedom from thromboembolic complications and anticoagulation-related hemorrhage. The structural valve degeneration occurs only gradually, and redo valve replacement can be performed electively for this complication. Moreover, these valves are economical, both initially and in the long term.

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