Mitral-valve replacement for a severely calcified mitral annulus: a simple and novel technique

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Abstract

Systemic calcifications are often seen in patients with end-stage renal failure, who need long-term hemodialysis. When patients with severe calcification of the mitral-valve annulus undergo mitral-valve replacement (MVR), complete debridement of the calcified tissues may result in fatal complications such as rupture of the left ventricle or injury to the coronary artery. We describe a novel technique of MVR for a severely calcified mitral annulus and leaflet, in which only the anterior leaflet is excised, preserving the posterior leaflet to prevent fatal complications. We passed 2/0 polyester mattress sutures through the mitral annulus from the left ventricle to the left atrium and fixed the preserved posterior leaflet to the posterior mitral annulus and prosthetic valve. The mitral valve was replaced using a St. Jude Medical mechanical heart valve with a specific structure and a hinge that shifts to the left atrial side and most of the leaflet moves within its housing. This structure enables this procedure to be performed without the excision of a severely calcified posterior mitral leaflet and annulus. Our technique may prevent the fatal complications that can be caused by debridement or excision of severely calcified mitral apparatus.

Keywords: Mitral stenosis; Mitral-valve replacement; Calcification; Prosthetic valve

1. Introduction

Surgery for extensive calcification of the mitral-valve annulus and leaflet extending to the underlying myocardium is a major technical challenge, which carries a high perioperative risk. Aggressive debridement may result in fatal complications, such as rupture of the left ventricle or injury to the coronary artery. We describe our simple and novel technique of mitral-valve replacement (MVR) using a St. Jude Medical mechanical (SJM) heart valve (St. Jude Medical, St. Paul, MN, USA), for extensively calcified mitral-valve leaflets and annuli.

2. Technique

Patients underwent MVR for mitral-valve stenosis through a standard median sternotomy. Under conventional cardiopulmonary bypass, the left atrium was accessed through the interatrial groove.

We excised only the anterior leaflet, preserving the posterior leaflet, to prevent the potentially fatal complications of debridement of the calcification. We passed 2/0Ethibond Excel pledgeted mattress sutures (ETHICON, Somerville, MA, USA) through the mitral annulus from the left ventricle to the left atrium on the anterior leaflet side, and into the free edge of the posterior leaflet, outside the posterior annulus. Although the mitral annulus appeared to be severely calcified on the preoperative CT scan image, some of these areas were, in fact, fibrous. By searching the fibrous areas carefully with the tip of the needle, we were able to pass the sutures through the mitral annulus. When calcified areas were likely to become disrupted or break off, we placed some mattress sutures with large pledget felt (10 mm x 7 mm) to avoid the disrupting the calcified tissues.

After excising the anterior leaflet, we confirmed that the 21 mm ball-size could pass through the mitral annulus to cordon at least 3.5 cm² of the mitral annular area. Finally, we implanted a SJM mechanical heart valve in the supra-annular position with anti-anatomical orientation, fixing the preserved posterior leaflet to the posterior mitral annulus and prosthetic valve (Fig. 1). Transesophageal echocardiogram showed no dysfunction of the mitral prosthesis valve when the patient was weaned off cardiopulmonary bypass.

3. Clinical profiles

We performed our procedure on six patients with mitral stenosis. All the patients were females, with a mean age of
60.5 ± 10.3 years (range, 44–76 years) and a preoperative mitral-valve pressure gradient of 9.0 ± 3.0 (range, 6.75–14 mm Hg) mm Hg. Five of the six patients were on chronic hemodialysis treatment. Concomitant procedures were performed in five patients, namely aortic-valve replacement for aortic stenosis in two, ascending aorta replacement for a severely diseased aorta in three, tricuspid valve ring annuloplasty for tricuspid regurgitation in one and a maze procedure for atrial fibrillation in one.

4. Results

There were no hospital deaths or potentially fatal complications. Postoperative echocardiogram revealed no evidence of paravalvular leakage, stuck valve or valve dehiscence. The postoperative mitral-valve pressure gradient was 4.6 ± 0.7 (range, 4–5.5 mm Hg) mm Hg. All patients had an uneventful postoperative course and were discharged home. The follow-up period was 47.3 ± 33.8 months (range, 3.6–88.3 months). There were two late non-cardiac deaths: one of fungal pneumonia, 13 months after the operation and one of hemorrhagic stroke, 8 months after the operation.

5. Discussion

Surgery for heavily calcified mitral annuli has evolved gradually. The bulky calcium may interfere with suture placement and proper insertion of prosthesis and increase the risk of paravalvular leakage and valvular dehiscence [1]. To avoid this, various surgical techniques have been reported, including mitral annuloplasty using autologous or bovine pericardium after complete debridement of calcification. It has also been reported that aggressive annular debridement may cause fatal complications, such as atrioventricular groove rupture, left ventricular rupture and injury to the coronary artery [2,3]. Nataf et al. described how intra-atrial insertion of the mitral prosthesis can prevent extensive mitral annular calcification [4,5]. The prosthesis used in their method is modified by enlarging the circumference of the sawing ring with a Dacron collar, to attach it to the atrial wall. However, this procedure may have adverse sequelae, caused by the transfer of high left ventricular pressure into the left atrium, resulting in severe hemorrhage from a tear of the atrial wall or valve dehiscence.

We devised our method to prevent the reported major surgical complications, focusing on the specific structure of the SJM mechanical heart valve to achieve this goal. The SJM mechanical heart valve has a specific structure, with a hinge that shifts to the left atrial side, and most of the leaflet moves within its housing (Fig. 2). This structure allows us to perform the procedure without excising the severely calcified posterior mitral leaflet and annulus. However, this technique is limited in that it would probably not be suitable for a massively calcified posterior leaflet protruding into the left atrium, as the protruding calcification may disturb the
opening of the prosthetic leaflet. None of the patients in our series had this mitral pathology.

Although there were two late non-cardiac deaths, the prosthetic valve continued to function well in all our patients. Neither intraoperative fetal complications nor postoperative sequelae, such as paravalvular leakage, a stuck valve or valve dehiscence, were seen. Our procedure seems to be superior to other reported modified procedures in terms of technical ease and adverse sequelae.

6. Conclusion

Our procedure was completed successfully in six patients, with excellent clinical outcomes. This procedure is simple and safe for MVR in patients with an extensively calcified mitral annulus and leaflets.

References