The Heart Surgery Forum #2009-1056
12 (6), 2009 [Epub December 2009]
doi: 10.1532/HSF98.20091056

Online address: http://cardenjennings.metapress.com

Transaortic Repair of the Mitral Valve in Patients Undergoing Aortic Valve Replacement

Dr. Santana

Orlando Santana, MD,[1] Kshamaya B. Panchamukhi, MD,[2] Roberto Grana, MD,[2] Ernest A. Traad, MD[2]

[1]Echocardiography Laboratory, Mount Sinai Medical Center, Miami Beach, Florida; [2]Mount Sinai Medical Center, Miami Beach, Florida, USA

ABSTRACT

Objective: We retrospectively evaluated the results of edge-to-edge (Alfieri) repair of the mitral valve via a transaortic approach in patients undergoing aortic valve replacement (AVR) and who had significant mitral regurgitation (MR).

Methods: From July 2000 to June 2006, 13 patients underwent edge-to-edge repair of the mitral valve via a transaortic approach with concomitant AVR. Patients were considered eligible for the transaortic Alfieri repair if the preoperative transesophageal echocardiogram indicated that the MR jet originated in the middle portion (A2/P2 segments) of the mitral valve. A postoperative transesophageal echocardiogram and follow-up transthoracic echocardiograms were obtained.

Results: There was no operative mortality. There was a significant improvement in the median MR grade from 3 (interquartile range [IQR], 2-4) preoperatively to 1 (IQR, 1-1) postoperatively ($P < .0001$). The ejection fraction (EF) remained stable, with mean preoperative and postoperative EFs of 44.2% ± 14.9% and 46.27% ± 11.6%, respectively ($P = .4$). No mitral stenosis was noted in any of the patients following edge-to-edge repair. Follow-up transthoracic echocardiograms obtained at a mean of 12.5 months postoperatively (range, 1-34 months) showed a median MR grade of 1 (IQR, 1-2) with no worsening compared with immediately postoperatively ($P = .4$).

Conclusion: Transaortic edge-to-edge repair of the mitral valve in patients undergoing AVR is feasible. The postoperative improvement in MR was maintained at the midterm follow-up.

INTRODUCTION

Clinically significant mitral regurgitation (MR) is often found in conjunction with severe aortic stenosis or with severe aortic insufficiency. Although no clear guidelines yet exist, most would agree in performing the standard double-valve surgery (aortic valve replacement [AVR] with mitral valve replacement or repair) in patients who have severe aortic valve disease with severe MR; however, concurrent surgery of both valves is associated with higher mortality and morbidity [Galloway 1992; Mueller 1998]. Furthermore, many patients have comorbidities that make the risk of performing double-valve surgery prohibitive. In these cases, one would like to address the problems associated with both valves while keeping the operative risk to a minimum. One technique would be to perform an edge-to-edge repair of the mitral valve via a transaortic approach when the aortic valve is replaced.

The edge-to-edge repair of the mitral valve developed by Alfieri and associates is a simple, fast, and effective technique to correct MR [Maisano 1998]. Performing this technique via a transaortic approach reduces the cross-clamp time, pump time, and total operative time. It also avoids the need to perform an atriotomy, in contrast to the standard mitral valve repair. Such mitral valve procedures as posterior mitral annuloplasty [Matsumoto 2005] and mitral valve replacement [Najafi 1994; Crawford 1998] have been performed with this approach.

We report our experience with the transaortic edge-to-edge repair of the mitral valve in 13 patients who underwent AVR and who had significant MR that originated from the A2/P2 portion of the mitral valve.

PATIENTS AND METHODS

Thirteen patients (6 men and 7 women) who had undergone transaortic edge-to-edge repair of the mitral valve with concomitant AVR were evaluated retrospectively. The patients underwent their operations between July 2000 and June 2006. They had aortic valve disease with moderate or higher MR that led to dyspnea at rest (New York Heart Association heart failure class IV). The mean age (±SD) was 72.6 ± 14.2 years. Eight of the patients had severe aortic valve stenosis, and 5 had severe aortic insufficiency. In the patients with aortic valve stenosis, the mitral valve lesion was noted to be calcific degeneration that primarily affected the posterior mitral annulus. In the patients with aortic insufficiency and in those with ischemia, the MR was functional. None of the patients had myxomatous degeneration or rheumatic heart

Received April 9, 2009; received in revised form June 15, 2009; accepted July 10, 2009.

Correspondence: Orlando Santana, MD, Director, Echocardiography Laboratory, Mount Sinai Medical Center, 4300 Alton Rd, Miami Beach, Florida 33140, USA; 1-305-674-2168; fax: 1-305-674-2368 (e-mail: osantana@msmc.com).

Table 1. Operative Data*

Case No.	Sex	Age, y	Aortic Valve Lesion	Operative Procedure	Aortic Prosthesis Size, mm	CPB Time, min	Aortic Cross-Clamp Time, min	Preop EF, %	Postop EF, %	Postop CO, L/min	Preop MR Grade†	Postop MR Grade‡	TTE MR Grade§	Hospital stay, d
1	F	77	Severe AS	AVR, CABG × 1, MP	21	171	142	50	50	5	4	1	1	19
2	F	39	Severe AI	AVR, MP	21	78	60	65	50	6.9	3	1	1	30
3	F	74	Severe AI	Redo AVR, MP	21	100	72	55	55	3.4	3	1	1	18
4	F	83	Severe AS	AVR, MP, TP	23	135	101	30	45	3.9	2	1	1	56
5	F	81	Severe AS	AVR, MP, CABG × 1	21	147	133	65	65	6.8	4	3	3	15
6	M	79	Moderate AS, moderate AI	AVR, MP, TP	23	109	71	55	55	3.4	1	1	1	45
7	M	58	Severe AS, severe AI	AVR, MP, TP, CABG × 2, SVR	23	214	157	15	25	4.5	3	1	1	24
8	M	63	Severe AI	AVR, MP	23	102	78	35	35	3.4	3	1	1	15
9	F	84	Severe AS	AVR, MP	19	136	115	40	50	2.8	3	1	1	51
10	M	81	Severe AI	AVR, MP, CABG × 3	23	138	124	45	45	6.1	2	1	1	14
11	M	52	Severe AI	AVR, MP, redo CABG × 1	25	152	120	25	30	4.4	4	1	1	13
12	F	85	Moderate AS	AVR, MP, CABG × 3	19	171	149	45	45	3.1	4	1	1	40
13	M	86	Severe AS	AVR, MP	23	142	104	50	60	4.8	2	1	1	240

*CPB indicates cardiopulmonary bypass; Preop, preoperative; Postop, postoperative; EF, ejection fraction; CO, cardiac output; MR, mitral regurgitation; TTE, transthoracic echocardiography; AS, aortic valve stenosis; AVR, aortic valve replacement; CABG, coronary artery bypass graft; MP, mitral plasty; AI, aortic insufficiency; TP, tricuspid plasty; SVR, ventricular reduction surgery.

†Preoperative MR grade by transesophageal echocardiography.

‡Postoperative grade by transesophageal echocardiography.

§MR grade by transthoracic echocardiography at 5 to 7 days postoperatively.

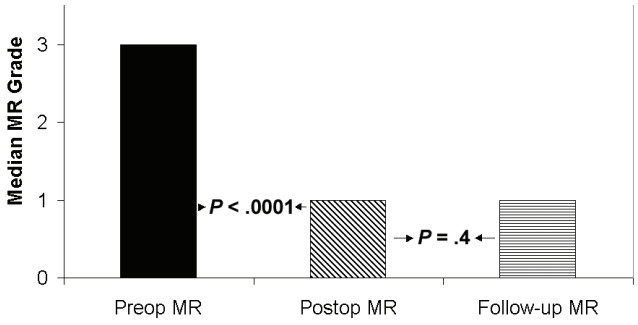
disease as the cause of their MR. Six of the patients underwent coronary artery bypass surgery in conjunction with their valve surgery, with 1 patient undergoing surgical ventricular restoration.

Technique

With the patient under general anesthesia, the mitral valve was evaluated by transesophageal echocardiography. The MR was graded as severe (4+), moderate to severe (3+), moderate (2+), or mild (1+). In the transgastric short-axis view of the left ventricle, the mitral valve was visualized *en face* to identify the origin of the jet of MR. If the jet originated in the middle portion (A2/P2) of the mitral valve, the patient was considered a candidate for an edge-to-edge repair of the mitral valve. A median sternotomy incision was made. Cardiopulmonary bypass was instituted with bicaval cannulation. The aorta was cross-clamped, and cold blood cardioplegia was given retrogradely. A transverse aortotomy was performed, and the aortic valve was inspected. After excision of the aortic valve and debridement of the aortic annulus, the mitral valve was inspected. The A2 and P2 segments of the mitral valve were identified with the aid of a retractor, and an edge-to-edge repair was carried out with a figure-of-eight suture of 4-0 Prolene. AVR and concomitant procedures were then completed in a routine fashion. After weaning from cardiopulmonary bypass, the patient was examined with postrepair transesophageal echocardiography to evaluate the adequacy of the repair, and the possible remaining MR was again graded. In addition, the gradient across the mitral valve was measured to evaluate for the possibility of stenosis. Before discharge, the patient underwent a transthoracic echocardiography analysis to again evaluate mitral valve function. Intraoperative data are presented in Table 1.

Statistical Methods

Continuous variables were expressed as the mean and SD, and ordinal variables (ie, MR grade) were expressed as the



Improvement in mitral regurgitation (MR) grade postoperatively (postop) and according to the follow-up echocardiogram. Preop indicates preoperatively.

median and interquartile range (IQR). The paired Student *t* test was used to compare repeated measurements. A *P* value <.05 was considered statistically significant.

RESULTS

There were no operative mortalities. The mean cardiopulmonary bypass time was 133.2 ± 38.9 minutes, and the mean cross-clamp time was 106.6 ± 32.8 minutes. The mean cardiac output postoperatively was 4.6 ± 1.4 L/min. The mean length of hospital stay was 42.3 ± 58.8 days. Twelve patients underwent AVR with tissue valves (Carpentier-Edwards), and 1 patient had a mechanical valve (CarboMedics) implant.

The median grade of preoperative MR was 3 (IQR, 2-4). Postoperative transesophageal echocardiography evaluations revealed a significant improvement in MR grade (median, 1; IQR, 1-1; $P < .0001$) (Figure). The mean preoperative ejection fraction was 44.2% ± 14.9%, not significantly different from the mean postoperative ejection fraction (46.27% ± 11.6%; $P = .4$). No mitral stenosis was noted in any of the patients following edge-to-edge repair. Follow-up echocardiograms were obtained for 7 patients at a mean of 12.5 months after surgery (range, 1-34 months). The median MR grade at follow-up was 1 (IQR, 1-2) with no worsening compared to immediately postoperatively ($P = .4$; Table 2, Figure).

Table 2. Follow-up Data

Case No.	Time to Follow-up Echocardiogram, mo	Follow-up Mitral Regurgitation Grade
1	12	1
2	4	2
3	34	3
4	4	1
5	29	1
6	1	1
7	4	1

DISCUSSION

Varying degrees of MR can be found in up to 78% of the patients who undergo AVR [Moazami 2004]. Replacing the aortic valve may improve the MR in some, but many patients are left with significant residual MR. In a study of patients who had AVR, Brasch et al [2000] found no echocardiographic evidence of improvement in MR in more than half of the cases (52%). Another study showed that 38% of patients with functional MR continued to have moderate to severe MR postoperatively, with the survival being lower for patients with preoperative MR of grades 3 to 4+ [Moazami 2004]. In elderly patients (≥70 years of age) with moderate MR preoperatively and who underwent isolated AVR, the MR persisted or worsened in 65.4% of the patients with intrinsic mitral valve disease, and it was an independent risk factor affecting long-term survival [Barreiro 2005].

Our patients underwent AVR for aortic valve stenosis or insufficiency and had concomitant significant MR originating from the A2/P2 portion of the mitral valve. The technique is easy to perform, especially if the aortic annulus is relatively large, but it can be a bit more challenging in patients with a small, inelastic aortic annulus.

The published data on this procedure are limited to 2 reports of single cases and 2 small case series [Kavarana 2000; Källner 2001; Shanker 2005; Lozonschi 2007]. One of the case reports [Shanker 2005] involved an 80-year-old man who years prior had undergone a left pneumonectomy for bronchial carcinoma. He had severe aortic stenosis as well as severe MR secondary to a torn chordae on the posterior leaflet of the mitral valve, which was repaired with an Alfieri stitch. Another case report [Lozonschi 2007] was of a patient with severe aortic stenosis, moderate MR, and atrial fibrillation. These investigators used the transaortic approach to perform the Alfieri repair as well as a cryo-maze procedure for the atrial fibrillation. They passed a flexible cryosurgical probe through the aortic annulus and ablated the lesion connecting the mitral annulus to the pulmonary veins, along with placing epicardial ablations encircling the pulmonary veins. The patient's rhythm was restored to normal sinus rhythm, and the MR was reduced. A case series studied by Källner et al [2001] consisted of 4 patients who had aortic valve disease with MR secondary to left ventricular dysfunction. Postoperative transesophageal echocardiography evaluations showed that 3 of the patients had trace MR. The fourth patient had to undergo mitral valve replacement because of residual MR of grade 3+. It was felt that the Alfieri stitch did not work on this patient because the stitch had not been placed in its proper location. The second case series, done by Kavarana et al [2000], consisted of 6 patients. They showed a reduction of the mean preoperative MR grade of 3.2 ± 0.5 to a mean of 0.25 ± 0.5 postoperatively.

The concern regarding edge-to-edge repair is its durability. Maisano et al [2003] evaluated 81 patients who underwent edge-to-edge repair of the mitral valve without annuloplasty. At the 4-year follow-up, the investigators noted a

mean 89% ± 3.9% overall freedom from reoperation. The authors felt their results were suboptimal when annuloplasty was not added to the edge-to-edge repair. Our patients, with a mean follow-up of 12.5 months, experienced no change in the severity of the MR, compared with that indicated in the immediately postoperative transesophageal echocardiogram.

Limitations

The primary focus of this case series was to describe our results regarding the feasibility of the transaortic Alfieri procedure. Our study does not address the comparative safety or efficacy of this procedure, which would require prospective studies.

CONCLUSION

Transaortic edge-to-edge repair of the mitral valve is feasible in patients undergoing AVR. The postoperative improvement in MR was maintained at the midterm follow-up.

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