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Results of Mitral Valve Repair in Rheumatic Mitral Lesions

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ABSTRACT

Background: We compared results for repairs of rheumatic pure mitral regurgitation (MR) and mixed mitral stenosis (MS) and MR during early and midterm time intervals.

Methods: We retrospectively analyzed 173 patients (mean age 47.6 ± 15.1 years; 64 males) who underwent surgery for rheumatic heart disease during the period from January 1998 to June 2008. According to transvalvular mitral gradient, 91 patients had pure MR (group MR) and 82 (47%) had mixed MS-MR (group MS/MR). Preoperative and operative characteristics, postoperative MR severity, operative mortality, and early and midterm survival were examined for each surgical group.

Results: Preoperativley 153 patients (90.7%) were in New York Heart Association class III or IV. The most frequent pathology was leaflet prolapse (147 patients, 85.0%) and the most commonly performed procedure was annuloplasty (162 patients, 93.6%). Early mortality was similar for both groups (3.2% versus 1.2%; $P = .621$). The average duration of follow-up was 4.0 ± 2.4 years (a total of 679.1 patient years). Logistic regression analysis results indicated that subvalvular repairs were related to mortality. There were no significant differences in early mortality rate, valve-related morbidity, or reoperations.

Conclusion: Group MS/MR had more postoperative MR severity, and higher New York Heart Association class, but both groups had similar mortality and morbidity at the midterm survival point. Our results suggest that combined MS and MR repair can be performed as safely as pure MR.

INTRODUCTION

During the past few decades mitral valve repair has become the procedure of choice for treatment of mitral regurgitation (MR) because of advantages such as low rates of thromboembolism, resistance to endocarditis, excellent late durability reported to be as long as 25 years, and no need for anticoagulation in the majority of patients [Fedak 2008]. Because of these advantages, the threshold for performing valve repair has been lowered to include even asymptomatic patients, given that successful repair is likely for a high percentage of patients [Bonow 2006; Fedak 2008]. Mitral valve repair in valves damaged by rheumatic heart disease (RHD) is a different situation, however. In rheumatic mitral valves, unlike ischemic and degenerative valves, mitral stenosis (MS) and MR are always associated with lesions on the affected valves. For this reason, rheumatic mitral valve repair is a technically demanding procedure [Duran 1991; Erez 2003]. Reports of mitral valve repair with acceptable results in RHD patients have been published, however [Choudhary 2001; Kumar 2006]. In some mitral valve lesions stenosis is more extensive than regurgitation, whereas in other lesions regurgitation is more extensive. Therefore we retrospectively investigated the results of mitral valve repairs in a population of RHD patients with pure regurgitation and mixed mitral valve lesions.

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PATIENTS AND METHODS

The study was approved by the institutional ethics committee. We retrospectively reviewed the charts of patients who underwent mitral valve procedures during the period of January 1998 through January 2008. A total of 173 patients with a definitive diagnosis of RHD were included in study. Patients who had undergone valve repair surgery, treatment for RHD in childhood, or received prophylactic antibiotic therapy for RHD up to the age of 21 years were included in the study. Patients without a history of RHD and consequent treatments were excluded.

The patients were grouped according to their mitral valve pathology. Preoperative transthoracic and transesophageal echocardiography examinations were performed on all patients. Patients were divided into 2 groups according to the transvalvular mitral gradient in the preoperative echocardiographic evaluation. The gradient was greater than 5 mm Hg in the MS/MR group and less than 5 mm Hg in the MR group. In the MS/MR group there were 82 patients with mixed MS and MR and the mean transvalvular mitral gradient in the preoperative echocardiography was 8.42 ± 2.14. In the MR group, 91 patients had pure mitral regurgitation and the mean transvalvular mitral gradient in preoperative echocardiography was 1.89 ± 1. Preoperative patient characteristics are listed in Table 1. The concomitant valvular pathologies are reported in Table 2. Data regarding structural deterioration, nonstructural dysfunction, valve thrombosis, embolism, bleeding events, prosthetic valve endocarditis, reoperation, and all valve-related morbidity and mortality were included in the study.

Table 1. Preoperative Characteristics*

	Group MR	Group MS/MR	*P*
Age, y	48.0 ± 17.7	47.1 ± 12.0	.690
Male/female, n	46/45	18/64	.0001†
Preoperative sPAP, mm Hg	46.7 ± 12.4	49.0 ± 13.6	.272
Preoperative ejection fraction, %	52.2 ± 11.6	57.8 ± 8.8	.0001†
Preoperative NYHA class			.056
Class II	8 (8.7%)	11 (13.4%)	
Class III	55(60.4%)	57 (69.5%)	
Class IV	28 (30.7%)	14 (17%)	
Preoperative MR			.0001†
Grade 1-2	—	45 (54.8%)	
Grade 3-4	91 (100%)	37 (45.1%)	
Preoperative MS			
None	91	0	.0001†
Grade 1-2	—	15 (21.2%)	
Grade 3-4	—	67 (88.8%)	

*MR indicates mitral regurgitation; MS, mitral stenosis; sPAP, systolic pulmonary artery pressure; NYHA, New York Heart Association.
†$P < .05$.

Table 2. Preoperative Valvular Lesions*

	Group MR	Group MS/MR	*P*
Preoperative tricuspid regurgitation			.128
None	49(53.8%)	28 (34.1%)	
Grade 1-2	26 (28.5%)	31 (37.8%)	
Grade 3-4	16 (17.5%)	22 (26.8%)	
Preoperative aortic regurgitation			.043†
None	66 (72.5%)	51 (62.1%)	
Grade 1-2	12 (13.1%)	22 (26.8%)	
Grade 3-4	13 (14.2%)	9 (10.9%)	
Preoperative aortic stenosis			.362
None	86 (94.5%)	71 (86.5%)	
Grade 1-2	1 (1.0%)	3 (3.5%)	
Grade 3-4	4 (4.3%)	8 (9.7%)	

*MR indicates mitral regurgitation; MS, mitral stenosis.
†$P < .05$.

Selection and Decision for Repair

Both preoperative echocardiographic examination results and intraoperative observations were used to determine the mitral valve repair procedure. In the preoperative echocardiographic examination, the pliability of leaflets and the amount of calcification and extent of valve involvement were used for patient selection for valve repair. The decision for repair surgery was conducted during surgery after visual inspection of the valve and subvalvular structures. During the surgery, the absence or presence of heavy fibrosis and calcification of the subannular chordal structure were used to determine whether to perform mitral valve repair or not.

Operative Techniques

All of the operations in both groups were performed while patients were on cardiopulmonary bypass with moderate hemodilution and moderate hypothermia (32°C). Continuous retrograde blood cardioplegia was used for myocardial protection. The mitral valve lesions and, if present, the tricuspid and/or aortic valve diseases were initially evaluated through a left and, if necessary, right atriotomy. A careful analysis of the anatomic and functional valvular lesions was completed to ensure that the decision for repair was correct. We attempted reconstruction if restoration of cusp mobility, shape, and central apposition was deemed feasible.

Factors that influenced the valvuloplasty procedures were severe chordal thickening, funnel degeneration of the subvalvular apparatus, destructive leaflet calcification, severe posterior leaflet retraction, nonpliable aortic cusps, irregular fibrotic thickening of cusps, bicuspid aortic valve, and laceration during unrolling of cusp edge. Appropriate reconstructive techniques were applied in accordance with the intraoperative findings. The mitral valve was repaired first and if necessary the repair was followed by reconstruction of the aortic valve and/or tricuspid valve repair.

Mitral valvuloplasty techniques included annuloplasty, augmentation of the posterior leaflet by extension with autologous pericardium, release of retracted subvalvular apparatus, and the restriction of increased mitral valve mobility by quadrangular resection of posterior leaflet, shortening of elongated chordae, or chordaplasty.

Mitral annuloplasty techniques consisted of prosthetic ring annuloplasty, Kay annuloplasty, Wooler and modified annuloplasty techniques (modified posterior suture annuloplasty similar to DeVega tricuspid annuloplasty). The mobilization of mitral leaflets was achieved by commissurotomy, fenestration of fused chordae, and chordal and/or papillary splitting. Retraction of the posterior leaflet was released by enlargement with a crescendate-shaped glutaraldehyde-treated pericardial patch. The excessive mobility of mitral leaflets was restricted with quadrangular resection and chordal transferring and shortening. Elongated chordae tendinae were buried into the tip of the papillary muscles with a pledgeted suture. Aortic valvuloplasty techniques were used in selected cases. Concomitant tricuspid valve surgery was required in 64 patients (37.0%) who had tricuspid insufficiency. The reconstructive procedures are shown in Table 3. The concomitant procedures are listed in Table 4.

Table 3. Reconstruction Procedures*

	Group MR	Group MS/MR	*P*
Mitral procedures			
Valvular reconstruction	81 (89.0%)	74 (90.2%)	.972
Posterior leaflet repair	66 (72.5%)	46 (19.5%)	.004*
Anterior leaflet repair	19 (20.8%)	16 (19.5%)	.854
Commissurotomy, single	16 (17.5%)	62(75.6%)	.0001*
Commissurotomy, both	7 (7.6%)	46 (54.0%)	.0001*
Annuloplasty	67 (73.6%)	58 (70.7%)	.556
Ring annuloplasty	56 (61.5%)	14 (17.0%)	.0001*
Plication	45 (49.4%)	16 (19.5%)	.0001*
Cleft repair	11 (12.0%)	2 (2.4%)	.008*
Alfieri repair	12 (13.1%)	1 (1.2%)	.001*
Subvalvular reconstruction	30 (32.9%)	32 (39.0%)	.824
Chordal repair	22 (24.5%)	4 (4.8%)	.0001*
Papillary splitting	9 (8.89%)	29 (35.3%)	.0001*
Aortic procedures			
Aortic valve replacement	13 (14.2%)	12 (14.6%)	1.000
Aortic reconstruction	4 (4.3%)	7 (8.5%)	.495
Tricuspid procedures			
Tricuspid De Vega annuloplasty without ring	5 (5.4%)	8 (9.7%)	1.000
Tricuspid De Vega annuloplasty with ring	11 (12.0%)	11 (13.4%)	.324
Commissurotomy	1 (1.1%)	3 (3.6%)	.362
Bicuspidization	0	3 (3.6%)	.116

*MR indicates mitral regurgitation; MS, mitral stenosis.

†$P < .05$.

Patient Follow-up

All of the patients were evaluated with transthoracic echocardiography before they were discharged. Patient follow-up was performed in our outpatient clinic and with phone interviews. During the follow-up of patients, valve-related complications, reoperation, and New York Heart Association (NYHA) class were evaluated. Accurate valve analysis was achieved by transthoracic echocardiography in all patients. All of the patients received low-dose aspirin therapy postoperatively. Anticoagulation with warfarin was used in 66 patients who had left atrial thrombus and/or thromboembolic events, giant left atrium and atrial fibrillation, or aortic valve replacement with a prosthetic valve.

Statistical Methods

The occurrence of clinical outcomes during follow-up period was characterized by Kaplan-Meier survival curves.

Results are presented as mean ± standard deviation. To analyze the results of the valvular reconstruction procedures, we used a *t*-test for independent samples for continuous variables and χ^2 or Fisher's Exact test for discrete variables. Preoperative variables were group MR or group MS/MR, age, sex, NYHA class, ejection fraction, and valvular pathologies; operative variables were performed reconstruction methods; and postoperative variables were morbidity, mortality, cardiac rhythm, need for inotropic support, postoperative mitral regurgitation, and need for early or late reoperation. $P < .005$ was accepted as significant. Analysis as independent variables was performed for the preoperative variables age, sex, advanced heart failure (preoperative NYHA functional class III or IV), and indications for procedures (group MR or group MS/MR, advanced mitral regurgitation [grade 3 or 4], advanced mitral stenosis [grade 3 or 4], advanced tricuspid regurgitation [grade 3 or 4], advanced aortic regurgitation or stenosis [grade 3 or 4], pulmonary hypertension [pulmonary artery pressure ≥40 mm Hg], left ventricular dysfunction [ejection fraction ≤40%]); the operative variables valvular or subvalvular reconstruction and use of an annuloplasty ring; and the postoperative variables morbidity and need for inotropic support. A *P* value ≤.05 was considered statistically significant for all comparisons. A commercial statistical software package (SPSS for Windows, version 17.0, SPSS, Chicago, IL, USA) was used for data analysis.

RESULTS

In our institution, during the period of 1998 through 2008, 2745 mitral valve operations were performed. During the same period, 1654 patients had mitral valve replacement secondary to rheumatic heart disease, and a total of 529 patients had reconstruction surgery. In this study, data files for 173 patients with rheumatic mitral valve disease who had reconstructive surgery were thoroughly evaluated.

Overall hospital mortality was 2.3% (4 patients; 3 in group MR and 1 in group MS/MR). The reasons of mortality were failure of reconstruction and early reoperation in 3 patients and development of low cardiac output in 1 patient. The mortality and postoperative follow-up parameters are summarized in Table 4.

The total follow-up time was 4.0 ± 2.4 years (range 0.1-10.7 years). There was no significant difference between the follow-up durations of the groups (3.7 ± 2.5 years in group MR and 4.4 ± 2.3 years in group MS/MR; $P = .056$). The cumulative survival rates were 96.6% ± 1.9%, 93.3% ± 3.0%, and 93.3% ± 3.0% for 1, 5, and 10 years, respectively, in group MR and 97.6% ± 1.6%, 97.6% ± 1.6%, and 94.4% ± 3.6% in group MS/MR (log rank; $P = .422$) (Figure 1).

There were no thromboembolic or anticoagulant-related complications in both groups except for 1 patient. In group MR, a patient with history of mitral valve replacement underwent surgery 6 months later, developed infective endocarditis, and subsequently died from embolic stroke.

Reoperation was required in 11 (12.08%; 6 early and 5 late) patients in group MR and in 8 patients in group MS/MR (9.7%; 7 early and 1 late), and the difference was not significant ($P = .685$). Variables in both groups are listed in Table 4.

Aortic valve replacement was performed on 25 patients (Table 3). As shown in Table 3, 4 patients in group MR and

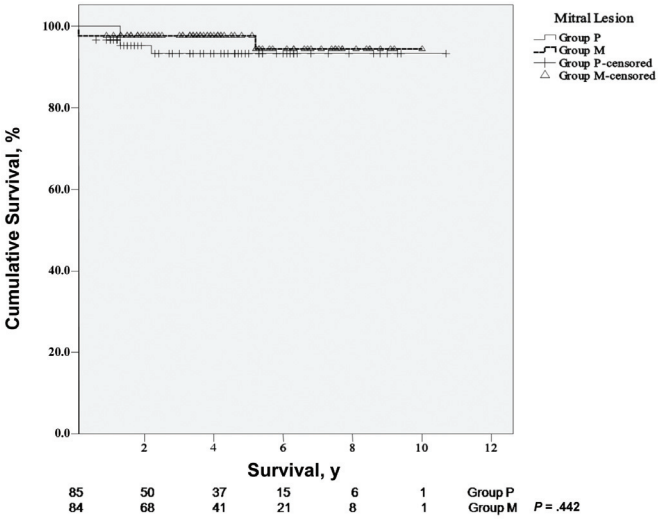

Figure 1. Survival curves for both groups. Group P, pure mitral regurgitation (MR) (group MR). Group M, mixed MR and mitral stenosis (MS) (group MS/MR).

7 patients in group MS/MR required aortic reconstruction along with aortic valve replacement. One patient in group MR required a flanged modification of a Bentall de Bono procedure for ascending aortic aneurysm and aortic regurgitation. Concomitant procedures were coronary artery bypass graft in 11 patients (6.4%), radiofrequency ablation in 6 (3.5%), patent foramen ovale closure in 3 (1.7%), primary atrial-septal defect repair in 2 (1.1%), flanged Bentall de Bono procedure in 1 (0.6%), left anterior descending branch of left coronary artery–pulmonary artery fistula repair in 1 (0.6%), and ecorticationsof the right pleura in 1 (0.6%).

Freedom from reoperation was 92.0% ± 2.9% and 85.4% ± 4.2% at the first and fifth years in group MR and 91.8% ± 0.3% and 90.6 ± 3.2% in group MS/MR (log-rank; $P = .464$) (Figure 2).

The late mortality rate was 2.1% (in 2 patients) in group MR and 2.4% (in 2 patients) in group MS/MR. The causes of late mortality included heart failure in 1 patient and stroke in 1 patient in group MR and mediastinitis in 1 patient and sepsis and multiorgan failure in 1 patient in group MS/MR.

DISCUSSION

Repair of the mitral valve is well known for its efficacy, durability, and avoidance of many complications [Kumar 1995]. As experience grows in this field, surgeons try to repair more valves in RHD patients. Our study evaluates our 10 years of experience and results on mixed valve pathologies, which have not previously been studied extensively.

Choudhary and colleagues, who have published one of the biggest series in RHD patients, analyzed RHD patients who have had mitral repairs. They investigated mitral pathologies (including chordal elongation and annular dilatation) along with isolated and mixed valve lesions [Choudhary 2001]. Unlike Choudhary et al, we used valvular and subvalvular

Table 4. Postoperative Parameters*

	Group MR	Group MS/MR	*P*
Electrocardiogram			.264
Sinus	73 (80.2%)	18 (19.7%)	
Atrial fibrillation	61 (74.3%)	21 (30.4%)	
Need for inotropic support	43 (47.2%)	29 (35.3%)	.049*
Postoperative mitral regurgitation			.621
None or mild	78 (85.7%)	72 (84.1%)	
Grade 3/4	13 (14.2%)	13 (15.8%)	
New York Heart Association class			.941
Class I	53 (61.5%)	53(64.6%)	
Class II	19 (20.8%)	11 (13.4%)	
Class III	9 (9.89%)	13 (15.8%)	
Class IV	7 (7.69%)	5 (6.0%)	
Morbidity	18 (19.7%)	17 (20.7%)	.960
Hospital mortality	3 (3.2%)	1 (1.2%)	.685
Early reoperation	6 (6.5%)	7 (8.5%)	.870
Late reoperation	5 (5.4%)	1 (1.2%)	.211

*MR indicates mitral regurgitation; MS, mitral stenosis.
†$P < .05$..

procedures as explanatory variables to investigate their effects on patient outcomes.

The postoperative mortality in our study was similar to that reported for other studies [Choudhary 2001; Kumar 2006]. Choudhary and colleagues [Choudhary 2001] reported their experience on 818 patients and their finding that left ventricular disease, preoperative congestive heart failure, and NYHA class IV are risk factors for mortality. In our analysis, we found only subvalvular reconstructions to be related to mortality. This difference can be explained by the more aggressive nature of the disease in our patients, who may have had more advanced disease.

Despite many significant improvements in cardiac surgical techniques, the operative risk for combined aortic and mitral valve surgery is still more than 5% [Bozbuga 2003]. Use of any mechanical valve exposes the patient to an incremental risk of thromboembolism and anticoagulantion-related complications. In addition, prophylactic valve replacement should not be the treatment of choice for moderate valve disease, especially in patients with other predominant valve diseases [Bernal 1998]. Thromboembolism and bleeding are the most frequently reported valve-related complications. The overall linearized rate for embolism in published series has ranged from 0.5% to 3.5% [Erez 2003]. Valvuloplasty has clear advantages over prosthetic replacement. All repair procedures carry a low operative risk [Bozbuga 2003]. The advantages of valve reconstruction include reduced need for an anticoagulant regimen.

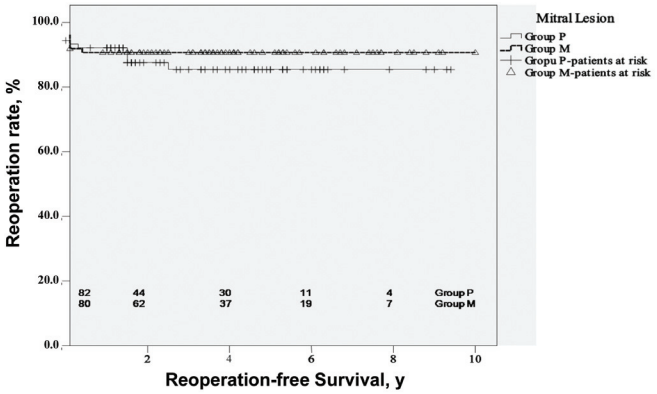

Figure 2. Survival free from reoperation for both groups. Group P, pure mitral regurgitation (MR) (group MR). Group M, mixed MR and mitral stenosis (MS) (group MS/MR).

In patients with rheumatic mitral-aortic valve disease, the procedure of valvuloplasty might have less durability however, because the need for an anticoagulation regimen is reduced [Bozbuga 1997; Bozbuga 2003; Kumar 2006].

Progression of disease is the most important risk factor for reoperation. Early failure of the valvuloplasty is often attributable to technical factors. In an editorial paper by Adams and Anyanwu, the authors discuss the recurrent regurgitation [Adams 2006]. In the transesophageal echocardiography study performed after surgery, the surgeon should confirm competent valve function; residual failure may lead to a progressive valvular failure and then to ventricular dysfunction. We had about 85% success postoperatively in both groups, and 13 patients from each group had grade 3 or 4 regurgitation. Thirteen patients (6 in group MR and 7 in group MS/MR) underwent reoperation before discharge. The higher use of inotropes in group MS/MR may be explained by the lower preoperative ejection fractions in this group (Table 1).

Valvular repair procedures may not fully restore valve competence. Even though we confirmed valvular competence with transesophageal echocardiography after surgery, we observed relatively high regurgitation degrees and reoperation rates. Kumar and colleagues successfully performed valve repair in RHD patients [Kumar 2006]. Our study demonstrated similar rates of procedures (annuloplasty, commissurotomies) and high success rates in this population of patients. One of the major findings of our study is the fact that mixed lesions of the mitral valve may be repaired as efficiently as purely regurgitant valves, with similar postoperative success rates. In our study, both patient groups had low morbidity and mortality, and reoperation rates did not differ.

The major limitation of the present study is that most of the information was collected retrospectively. Another limitation was the inclusion of the patients who underwent various reparative procedures due to the various intraoperative findings. This is a common problem for surgical studies because randomization is a hard goal to achieve.

In conclusion, we demonstrated that valve repair can be performed for mixed MS/MR patients with results similar to those in pure MR patients. The postoperative MR, reoperation, and mortality rates were similar. The type of mitral valve pathology does not affect postoperative mortality or morbidity.

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