SURGICAL MANAGEMENT OF THE PATIENTS WITH MODERATE RHEUMATIC MITRAL AND AORTIC VALVE DISEASE

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Whether to perform double valve replacement in surgical management of moderate mitral and aortic valve disease is controversial. To investigate the long-term mortality and morbidity of combined valve repair and valve replacement, we analyzed the results obtained in 48 mitral-aortic reconstruction and in 45 mitral-aortic mechanical prostheses replacement.

48 patients with moderate rheumatic mitral and aortic valve disease (36 female and 12 male, mean age 32.6±5.8 years) underwent mitral and aortic valve reconstruction in association with tricuspid valve repair in 23 of them (Group A) and 45 patients with rheumatic valve disease (27 female and 18 male, mean age 48.8±7.3 years) underwent double valve replacement in association with tricuspid valve repair in 14 of them (Group B). The valve findings determined the type of reparative procedures. All mechanical valves were bileaflet prostheses. Patients with an aortic regurgitation over moderate level were excluded. Preoperatively, in Group A, 75% of the patients were in NYHA class II-III and in Group B, 80% of the patients were in NYHA class II-III.

Hospital mortality rate was 2.1% (1 patient) in Group A and 2.2% (1 patient) in Group B. The overall valve-related morbidity included 9 events (re-operation) out of 48 patients in Group A and 12 events (prosthetic valve endocarditis and/or paravalvular leak, thromboembolism, bleeding) out of 45 patients in Group B. At the last follow-up, 87% of the survivors were in NYHA class I-II in Group A and 86% of the survivors were in NYHA class I-II in Group B. The cumulative survival rate was 92.77±4.03% in Group A, and 88.65±6.40% in Group B in 7 years (log-rank; p=0.98). Actuarial freedom from valve-related morbidity was 75.12±7.32% in Group A, 82.84±7.53% in Group B in 6 years (log-rank; p=0.24). Actuarial freedom from re-operation was 92.57%±4.14% in Group A, and 88.65±6.40% in Group B in 7 years (log-rank; p=0.94). There were not any significant differences between cumulative survival actuarial freedom from

valve-related morbidity and actuarial freedom from re-operation in both of the groups in 7 years.
We concluded that valve repair for rheumatic mitral-aortic valve disease was associated with the same long-term survival and freedom from re-operation rates, as well as lower valve-related complications and cost compared to double valve replacement with mechanical prostheses.

Key words: Valve reconstruction, rheumatic valve disease, double valve replacement

In multivalvular disease most common association is mitral-aortic involvement and the most frequent combination is mitral stenosis with aortic regurgitation. Rheumatic fever is the predominant etiology of multivalvular lesions. The incidence of multivalvular disease has decreased in parallel with the decline in rheumatic fever (1). In spite of the progress made over the years in the field of cardiac surgery, mitral-aortic surgery involves complex procedures with substantial mortality and morbidity (2).
Whether to perform double valve replacement in the surgical management of moderate mitral and aortic valve disease is controversial. According to our institutional policy, if possible, valvuloplasty should be tried because of its physiological effects on left ventricular function and in order to avoid prosthetic valve complications. Unfortunately, no direct comparisons have been made between the performance of double valve reconstruction and double valve replacement in the mitral and aortic position. We attempted to carry out the study by retrospectively comparing our institution's experience with regard to both patient survival and valve related complications.
This study investigated the late results of mitral-aortic valve surgery in patients with moderate rheumatic mitral and aortic valve disease who have undergone either double valve repair or prosthetic valve replacement.

MATERIALS AND METHOD

48 patients with predominant rheumatic mitral and moderate aortic valve disease (36 female and 12 male, mean age 32.6±5.8 years) underwent mitral and aortic valve reconstruction (Group A) and 45 patients with rheumatic valve disease (27 female and 18 male, mean age 48.8±7.3 years) underwent double valve replacement (Group B).
The diagnosis was made by echocardiography in both groups, and frequently, cardiac catheterization was used as well.
Preoperatively, 75% of the patients were in NYHA class II-III in Group A and 80% of the patients were in NYHA class II-III in Group B. The main clinical characteristics of the patient population are shown in Table 1.

OPERATIVE TECHNIQUE

All the operations in both groups were performed by standard cardiopulmonary bypass, with moderate hemodilution and moderate hypothermia (28°C). Continuous retrograde isothermic blood cardioplegia was used for myocardial protection.

Table 1: Patient characteristics

	Reconstruction	Replacement
Total	48	45
Age	32.6 (16-43)	48.8(23-61)
Sex		
Female	36 (75%)	27 (60%)
Male	12 (25%)	18 (40%)
Pathology		
Mitral		
Regurgitation	21	16
Stenosis	11	10
Mixed	16	19
Aortic		
Insufficiency	25	19
Stenosis	8	14
Mixed	14	12
Tricuspid		
Regurgitation	20	14
Stenosis	3	0
Rhythm		
Sinus	20 (41.7%)	16 (35.6%)
Atrial Fibrillation	28 (58.3%)	29 (64.4%)

Mitral and aortic valve disease was initially evaluated through a left atriotomy and J-shaped aortotomy incision. Reconstructive valve surgery was considered for the patients in whom the appropriate techniques would be able to be applied in accordance with the intraoperative findings. The influencing factors which changed the intention of valvuloplasty were severe chordal thickening, subvalvular apparatus funnel degeneration, destructive leaflet calcification, severe posterior leaflet retraction and nonpliable aortic cusps, irregular fibrotic thickening of the cusps, bicuspid aortic valve and laceration during unrolling of cusp edge. First, the mitral valve was repaired followed by the reconstruction of the aortic valve, and if necessary, tricuspid valve repair. Valve findings determined the type of reparative procedures. Most of the patients had more than one maneuver on each diseased valve to attain competence. With an average of 3.6 (1.7 for mitral valve, 1.9 for aortic valve), a total of 174 reconstructive procedures were required. Intraoperative testing of the repaired valves was made by transesophageal echocardiography (TEE).

Mitral valvuloplasty techniques were classified as annuloplasty, the augmentation of posterior leaflet by the extension of autologous pericardium, the release of retracted subvalvular apparatus and the restriction of increased mitral valve mobility by the quadrangular resection of the anterior leaflet, the shortening of the elongated chordae or chordaplasty. Aortic valvuloplasty techniques consisted of the resuspension of the cusps, the augmentation of the retracted or perforated cusps with the autologous pericardium, making the cusps thinner and the release of the commissures and restriction of cusp mobility by plication technique.

Simultaneous tricuspid valve surgery was required in 23 patients (47.9%) in group A and in 14 patients in group B (29.2%). The reconstructive procedures of mitral and aortic valve are shown in Table 2.

In Group B, mechanical prostheses were bileaflet type St. Jude medical valves and implanted using separated suture technique. Oral anticoagulation with warfarin was instituted 24 hours after the operation.

In Group A, the patients received low-dose aspirin therapy. Anticoagulation was used in 8 patients who had either left atrial thrombus and/or thromboembolic events or giant left atrium and atrial fibrillation before the operation.

All the patients were evaluated by transthoracic echocardiography (TTE) before discharge.

Table 2: Valvuloplasty procedures

Reconstructive Procedures of Mitral Valve	
Annular procedures	
Prosthetic ring annuloplasty	15
Kay annuloplasty	6
Wooler annuloplasty	3
Modified annuloplasty	6
Augmentation of leaflets	
Posterior leaflet extension	13
Release of subvalvular apparatus	
Commissurotomy	6
Splitting	
Papillary muscles	8
Chordae tendineae	6
Fenestration	4
Restriction of leaflet mobility	
Quadrangular resection	10
Shortening	4
Chordaplasty	2
Reconstructive procedures of aortic valve	
Annular procedures	
Resuspension	32
Augmentation of cusps	
Pericardial patch	26
Release of cusps	19
Thinning	9
Commissurotomy	8
Decalcification	2
Restriction of cusp mobility	
Plication	14

FOLLOW-UP

All the follow-up data were collected over a 6-month period. Contact was lost with 5 patients in Group A and 3 patients in Group B; a complete follow-up was possible in 89% and 93% of the patients, respectively. All traced patients were evaluated for valve-related

complications, re-operation and NYHA class during follow-up. Accurate valve analysis was achieved by TTE in all the patients, additionally by TEE in most of the patients.

In reconstruction group, echocardiographic assessment over 12 months after the operation demonstrated normal functioning mitral and aortic valve in 7 patients (14.58%), normal mitral valve and mild residual aortic insufficiency in 3 patients (6.25%), mild residual mitral insufficiency and normal aortic valve in 1 patient (2.08%), mild residual mitral and aortic insufficiency in 22 patients (45.83%), mild residual aortic insufficiency and mitral stenosis in 3 patients (6.25%). Moderate residual lesions were documented in 6 patients (12.50%) [regurgitation in 2; mix lesions in 6].

At the last follow-up, 87% of the survivors were in NYHA class I-II in Group A and 86% of the survivors were in NYHA class I-II in Group B. The functional status of a patient was evaluated by comparing pre- and postoperative values (Figure 1).

The data collection methodology and data analysis strategies for valve operations were applied according to Koşuyolu Heart and Research Hospital practice (3).

Patient events were tabulated according to the set of definitions provided in the "Guidelines for reporting morbidity and mortality after cardiac valvular operations" (4). Structural deterioration, nonstructural dysfunction, valve thrombosis, embolism, bleeding event, prosthetic valve endocarditis (PVE), re-operation, and all valve related morbidity and mortality were included in the statistical analysis. The different late valve-related events were expressed in linearized form (percent per patient-year) like all the other events. The occurrence of clinical outcomes during follow-up period was characterized by Kaplan-Meier survival curves. Univariate comparisons of the groups were made with the log-rank test.

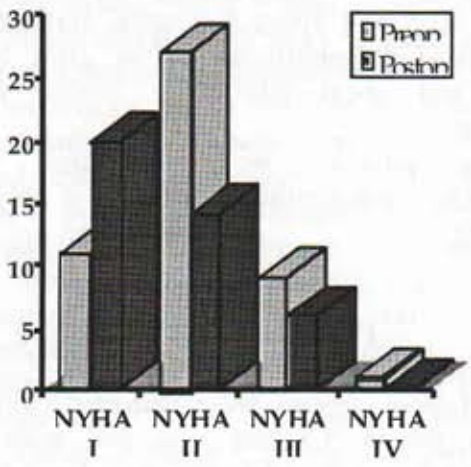
RESULTS

Overall hospital mortality was 2.1% in Group A due to severe pulmonary hypertension in one patient and 2.2% in Group B due to cerebrovascular complication in one patient (no significant difference).

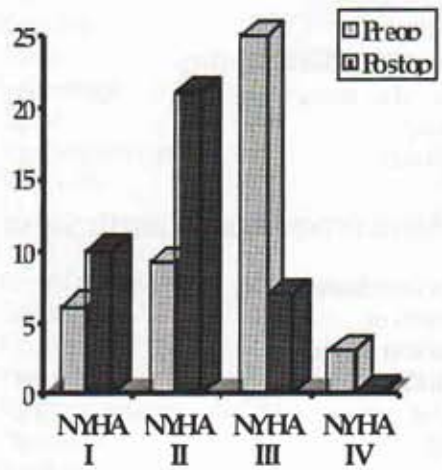
Mortality and morbidity rates are listed in Table 3.

The patients were followed 182.4 patient-years (pt-yr) in Group A and 207 patient-years in Group B. The cumulative survival rate was 92.77±4.03% in Group A, 88.65±6.40% in Group B in 7 years [log-rank; p=0.98] (Figure 2).

There was not any thromboembolic and anticoagulant-related complication in Group A. In Group B, thromboembolism occurred as



Reconstruction



Replacement

Figure 1. The patients' functional status pre- and post-operatively according to NYHA.

Table 3: Mortality and valve-related morbidity

	Reconstruction	Replacement
Hospital mortality	1 (2.1%)	1 (2.2%)
Morbidity	9 (18.7%)	6 (13.3%)
Structural deterioration	9 (18.7%)	-
Nonstructural deterioration	-	3 (6.7%)
Thromboembolism	-	1 (2.2%)
Bleeding	-	1 (2.2%)
Prosthetic valve endocarditis	-	3 (6.7%)
Re-operation	9 (18.7%)	4 (8.9%)
Late mortality	2 (4.2%)	3 (6.7%)

Table 4: Re-operation variables

	Reconstruction	Replacement
Total	9 (18.7%)	4 (8.9%)
Re-ope. interval	2.3 years	6.2 years
Emergency re-ope.	-	2 (50%)
Early re-ope.	1 (2.1%)	0
Late mortality	2 (22.2%)	3 (75%)
Morbidity	2 (22.2%)	2 (50%)

stroke in one patient in the second postoperative month and anticoagulant-related bleeding in one who was receiving irregular anticoagulant therapy in the third postoperative year. The linearized rates for thromboembolism and bleeding were 0.49% pt-yr and 0.50% pt-yr, respectively.

Nonstructural dysfunction occurred in 3 patients. One patient presented with moderate mitral paravalvular leak (PVL) and one patient presented with severe aortic PVL, while the third one presented with mitral PVL which was diagnosed as a technical failure during the operation. The linearized rate for nonstructural dysfunction was 1.45% pt-yr.

No cases of early PVE was present but late PVE developed in 3 patients. The agents of PVE were identified as *Staphylococcus aureus* in 2 patients, but in the third one, the culture was negative. All patients received an 8-week course of antibiotic therapy. The linearized rate for prosthetic valve endocarditis was 1.48% pt-yr.

Nine patients required re-operation in Group A due to increasing insufficiency and/or restenosis and 4 patients required re-operation due to PVL and/or PVE with vegetation in Group B. Variables of the both groups are listed in Table 4. Re-operation was necessary because of predominant mitral valve dysfunction in 1 patient, predominant aortic valve dysfunction in 5 patients, and double valve dysfunction in 3 patients. Predominant aortic regurgitation was the cause of re-operation in 8 patients out of nine. Of all of the 9 patients re-operated because of structural deterioration, none of patients were re-operated within the first postoperative year. In all re-operations, double prosthetic valve replacement was performed. The linearized rate for re-operation was 4.93% pt-yr in Group A and 1.93% pt-yr in Group B. Actuarial freedom from re-operation was 92.57±4.14% in Group A, 88.65±6.40% in Group B in 7 years [log-rank; p=0.94] (Figure 3).

Overall valve-related morbidity included 9 events (re-operation) in Group A and 12 events (prosthetic valve endocarditis and/or paravalvular leak, thromboembolism, bleeding) in Group B.

Overall, 9 patients had 9 valve-related events and subsequently 9 patients were re-operated for structural deterioration in Group A. 6 patients had 12 valve-related events and subsequently 4 patients were re-operated for nonstructural dysfunction in Group B. The linearized rate for valve-related morbidity was 4.93% pt-yr in Group

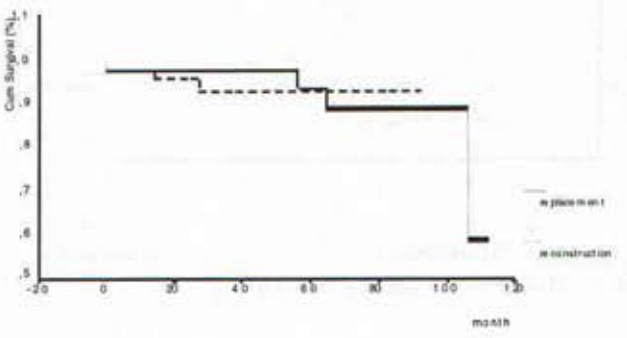


Figure 2. Cumulative survival (log-rank p=0,98).

A and 6.12% pt-yr in Group B. Actuarial freedom from valve-related morbidity was 75.12±7.32% in Group A, 82.84%±7.53 in Group B in 6 years [log-rank; p=0.24] (Figure 4).

Late mortality rate was 4.2% (2 patients) in Group A, 4.4% (3 patients) in Group B. Late mortality occurred after re-operation, caused by delayed cardiopulmonary bypass time and multiorgan failure in 2 patients in Group A, and low cardiac output in 1 patient, sepsis and multiorgan failure in 1 and cerebral embolus in 1 in Group B. Hospital mortality for valve-related re-operation was 22.2% (2 of 9) in Group A and 75% (3 of 4) in Group B.

DISCUSSION

Despite many significant improvements in cardiac surgical techniques, the operative risk for combined mitral and aortic valve surgery remains over 5% (2).

The use of any mechanical valve exposes the patient to an incremental risk of thromboembolism and anticoagulant-related complications. In addition, in moderate valve disease associated with predominant other valve disease, prophylactic valve replacement does not seem logical (5). Among valve-related complications, thromboembolism and bleeding were reported as most frequent complications. Overall linearized rate for embolism in the published series has been ranging from 0.5% to 3.5 (6-8). It was reported that late mortality and morbidity in combined mitral and aortic valve surgery continued to have cardiac causes or were related to anticoagulant therapy (9).

In young patients and particularly in women of child-bearing age, prosthetic valve replacement still presents a serious problem in terms of anticoagulation (10). Bioprosthetic heart valves have a lower risk of thromboembolism and thus a limited requirement for anticoagulation, but they suffer from predictable structural deterioration as an age-related phenomenon (11-12). In the present study, the reconstruction group consisted of predominantly young females.

Valvuloplasty has clear advantages over prosthetic replacement. All repair procedures carry a low operative risk (13). The advantages of mitral reconstruction with the reduced need for an anticoagulant regimen could well outweigh considerations based on the low durability of valvuloplasty in patients with rheumatic mitral-aortic valve disease (14-15).

The presence of severe left ventricular dysfunction did not preclude valvuloplasty where subvalvular mechanism is preserved (16). Most patients undergoing double valve replacement have reduced myocardial capacity. On the other hand, poor left ventricular function increases the likelihood of embolism from the prosthetic valve (17-18).

Beyond all the recognized benefits of valve

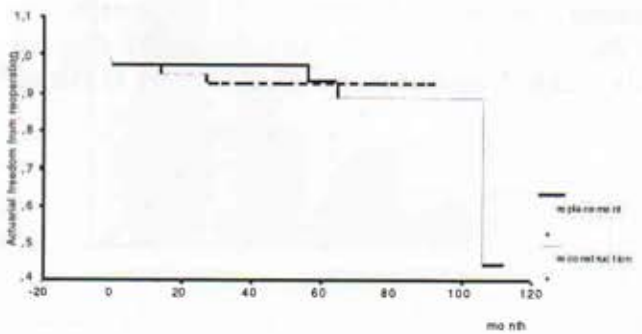


Figure 3. Actuarial freedom from reoperation (log-rank p=0,94).

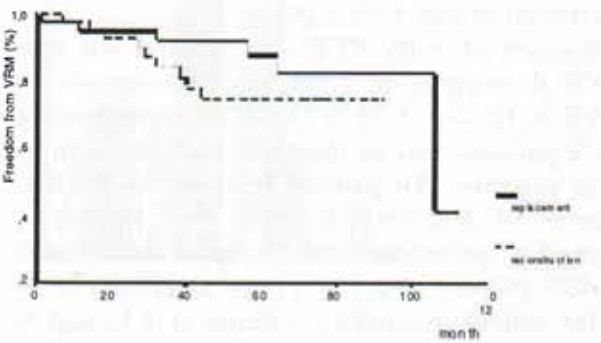


Figure 4. Actuarial freedom from valve-related complications (log-rank p=0,24).

reconstruction, the economic advantage of valvuloplasty for patients and payers was pointed out as well (19). Being cost-effective is an important factor for the countries that import prosthetic heart valve for replacement. The total cost of double mechanical valve replacement was approximately $8,000 in Turkey. Although no significant differences were observed between the two groups in preoperative variables that have been known to affect cost and resource utilization, it was calculated that the reconstruction group's cost was 50% less than that of the double valve replacement group.

Numerous long-term studies have substantiated the durability and freedom from structural degeneration and valve-related complications provided by mitral and aortic valve reconstruction (20-25). The incidence of failure in valvuloplasty and its causes vary according to the cause of valve disease. Prior reports have documented that patients with isolated rheumatic mitral or aortic disease do not obtain as much long-term benefit from reconstruction as patients with non-rheumatic disease (26-29). Rheumatic valve disease possesses special problems due to deformity of the valve, presence of combined lesions and restricted valve mobility (1). The persistence or recurrence of rheumatic activity distorts the valve structures resulting in regurgitation. The progression of disease is the most important risk factor for re-operation. Early failure of valvuloplasty is probably due to technical factors.

The repair procedures in rheumatic valvular disease are technically more difficult and less stable than those in degenerative lesions due to the complex nature of the rheumatic valve disease which involves all the parts of the valve structures (14, 21, 22, 30). It was reported in different series that the possibility of successful repair in rheumatic valve disease did not exceed 85% (10, 24). But some results on mitral repair in rheumatic valve disease have been encouraging with an acceptable re-operation rate (5.98%) (14). The long-term effects of double valve repair in patients with combined rheumatic aortic and mitral valve disease have not been reported previously.

Our institution is a reference cardiovascular surgery center throughout Turkey in performing reconstructive and minimally invasive valve surgery. Koşuyolu Heart and Research Hospital has reported preliminary data on mitral valvuloplasty in 1991 (31). In later years, more mitral valvuloplasty results were reported with the application of fundamental reconstruction techniques (32, 33). The mitral-aortic valve reconstruction results of our clinic showed that double valve reconstruction can be performed as a safe alternative for surgical replacement strategy in rheumatic valve disease. We found no statistically significant difference in early and late mortality rates between the two groups. Overall linearized rates for thromboembolism, bleeding events, prosthetic valve endocarditis was almost nil in the reconstruction group. There was not any statistically significant difference between cumulative survival and actuarial freedom from re-operation rates.

As for the major limitations of the present study, the most of the information was collected retrospectively and contact with patients was not achieved completely. We cannot be certain that all patients undergoing re-operation have returned to our clinic. Another limitation was the inclusion of patients who have undergone different reparatory procedures according to various valve findings.

CONCLUSION

The results suggested that in patients with moderate rheumatic mitral and aortic valve disease, repair procedures offered better freedom from valve-related complications and cost effectiveness with good long-term results. Reconstructive valve surgery should be considered for patients in whom the appropriate techniques were able to be applied in accordance with the intraoperative findings. We concluded that valve repair for rheumatic mitral-aortic valve disease is associated with the same long-term survival and freedom from re-operation rates with double valve replacement with the mechanical prostheses, as well as having lower valve-related complications and being cost-effective.

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