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Original article

Evaluation of Early and Midterm Mitral Valve Repair Results in Consecutive Severe Mitral Regurgitation Patients

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Abstract. *Study Objectives*: Surgical valve repair for mitral regurgitation has significant advantages over valve replacement. In this study, we aimed to investigate the early and mid-term results of mitral valve repair using current techniques in order to find out independent risk factors affecting the early and mid-term outcomes. *Methods:* We retrospectively studied firstly 192 consecutive adult patients (mean age: 43.2±12.3; 120 females and 72 males) who underwent primary mitral valve repair between January 2012 and July 2018. Risk factors affecting the need for re-operations and late survival were determined via univariate and multivariate analyses. Actuarial survival and event-free curves were compared by linear regression analysis. *Results:* Operative mortality was 2.6% (5 deaths 0–30th. postoperative day (POD). Late mortality was 3.7% (7/187). Reoperation was required in 16 (8.3%) patients. Kaplan–Meier actuarial survival was 95.8%±2.3% at a mean of 43 months. Survival free from reoperation was 92.8%± 4.2% at 60 months. Multivariate analysis demonstrated that residual NYHA class III and IV, low preoperative ejection fraction, and ischemic MR were independent predictors of mortality. *Conclusion:* We concluded that mitral valve repair showed excellent survival (except ischemic MR), acceptable re-operation rate with satisfactory valve function in a mid-term follow-up period

Key words: Mitral valve repair, regurgitation, repair techniques

Introduction

Mitral valve (MV) repair in patients with mitral valve insufficiency (MVI) has been discussed extensively in the literature and the results of repair procedures are conflicting among different publications. Except for ischemic mitral regurgitation (MR), MV repair is preferred over replacement to treat MVI with improved short and long-term survival (1-5).

Moreover, repair rates seem to be increasing with time, as newer techniques such as artificial chordal replacement and autologous pericardial leaflet augmentations are being increasingly used (6,7). With the use of these techniques, up to 95% of degenerative MVI cases are successfully repaired (1-4, 8). Several studies showed excellent rates of freedom from reoperation after MV repair (3-5, 9).

The purpose of this study was to review our results of MV repair, particularly with respect to the recurrence of severe regurgitation, the re-operation, and survival rates.

Methods

Our study was designed as a retrospective study, including 192 consecutive patients, who underwent MV repair surgery, between January 2012 and July

2018 in Gaziantep Dr. Ersin Arslan Education and Research Hospital, Cardiovascular Surgery Clinic. After approval from the Institutional Review Board had been taken, all data were collected by reviewing medical records.

Operative Technique

All procedures were performed through a median sternotomy under cardiopulmonary bypass. Antegrade and retrograde cold blood cardioplegia was used for myocardial protection. When coronary artery bypass surgery was necessitated, and distal anastomosis was performed before the mitral procedure, tricuspid and aortic valve procedures were necessitated, carried out after the mitral procedure. The annulus, leaflets, and subvalvular apparatus were carefully evaluated with the aid of a saline injection test to determine the precise anatomy of the lesion and to choose the optimal method of repair. TEE was also used before CPB to evaluate the regurgitation mechanism to choose the right repair technique and to detect the regurgitation degree after cross-clamp.

Follow-Up

Clinical and echocardiographic follow-up was performed shortly before hospital discharge, at 1 month, and then every 6 months by the referring cardiologist. Survival, reoperation, cerebrovascular accidents, bleeding complications, anticoagulation therapy, NYHA functional class, and cardiac rhythm were recorded. On echocardiography, mitral regurgitation was classified from 1 to 4.

Statistical Analysis

The preoperative presence and severity of mitral insufficiency were determined by transthoracic and transesophageal echocardiography (TEE) according to current guidelines. Survival curves and event-free survival curves free from events were calculated by using the Kaplan-Meier method (10). Survival rates are presented as percentages of patients per year (% patient/year).

Results

The mean age of patients was 43.2±12.3 years (18-67 years), 62.5% (n=120) of them were female and %37.5 (n=72) were male. Demographic data and clinical characteristics of the patients are shown in Table 1.

Among the 192 patients, there were 5 in-hospital deaths and the operative mortality rate was 2.6%. Three patients died due to low cardiac output syndrome, 1 patient died from malign arrhythmias and 1 patient died from multi-organ failure. All patients who died in the early postoperative period had undergone re-operation with suspicion of acute mitral regurgitation clinic.

Multivariate analysis demonstrated that residual NYHA class III and IV (p=0.023, OR 2.53, 95% CI: 1.93–4.88), low preoperative ejection fraction (p=0.001, 0R 3.11, 95% CI: 1.82–5.66), and ischemic MR (p=0.01, OR 3.39, 95% CI: 1.29–4.37) were all independent predictors of mortality. Persistent mitral regurgitation at a third POD (p=0.001, OR 3.55, 95% CI: 1.55–5.5), and absence of prosthetic ring or band (p=0.001, OR 4.55, 95% CI: 1.58–7.18) were all independent risk factors for reoperation.

Table 1. Demographic variables and clinical characteristics of the patients

Associated techniques	**Patients (n)**	**Patients (%)**
Female	120	62.5
Male	72	37.5
Age (Mean±SD)	43.2±12.3 years	
Comorbid factors		
Hypertension	72	37.5
Atrial fibrillation	50	26
Diabetes	23	11.9
Coronary artery disease	18	9.3
Chronic renal failure	18	9.3
Chronic obstructive Pulmonary disease	8	4.1
Peripheral vascular disease	6	3.1

The rates of comorbid conditions were as follows; atrial fibrillation 26% (n=50), hypertension 37.5% (n=72), diabetes 11.9% (n=23), chronic renal failure 9.3% (n=18), chronic obstructive pulmonary disease 4.1% (n=8) and peripheral vascular disease 3.1% (n=6).

The cause of mitral regurgitation was primer in %90.6 (n=174) patients; (96 (50%) rheumatic, 54 (28.1%) myxomatous and 24 (12.5%) infective) and secondary to coronary artery disease in %9.3 (n=18) patients. Seventeen patients (8.8%) had coronary lesions requiring surgical correction. The most common non-mitral concomitant cardiac procedure was tricuspid valve repair (27.6%, n=53).

Various repair techniques (ring or band annuloplasty insertion, triangular or quadrangular resection, edge-to-edge repair) were used according to the functional and pathologic findings of MV (Table 2).

The preoperative clinical status of 157 patients (82%) were in NYHA functional class III-IV. At the end of the observation period, almost all 165/187 (88%) of the patients were in the NYHA functional class I. None of the patients were lost to follow-up. The mean follow-up period for the 187 discharged patients was 41±18 months. Sixteen patients (8.5%) required reoperation (Table 3) at a mean interval of 26.2±3.6 months, nine of whom (4.8%) were required MV replacement. The mortality rate in the re-operated group was 32% (5/16). Causes of most deaths were congestive heart failure. Diagnosis of mitral stenosis and persistent MVR on discharge (Mitral regurgitation grade≥3 or mitral stenosis with mean gradient ≥10mmHg) were significant risk factors for re-operation (p<0.05). The late mortality rate was 3.7% (7/187).

Table 2. Techniques associated with mitral valve repair (more than one procedure was applied in near all operations)

Associated techniques	Patients (n)	Patients (%)
Annuloplasty ring insertion	51	25.5
Annuloplasty band insertion	141	73.4
Edge-to-edge repair	45	23.4
Quadrangular resection	25	13
Triangular resection	15	7.8
Neochord insertion	14	7.3
Shortening of the chordea tendineae	14	7.3
Sliding of the posterior leaflet	13	23.4

Table 3. Causes of failed mitral valve repair

Cause of failed repair (n=16)	(n)	%
Valve related	10	62.5
Progressive disease	7	43.75
Endocarditis	3	18.75
Procedure-related	4	25
Ruptured chordae	3	18.75
Incomplete repair	1	6.25
Unknown	2	12.5

The actuarial survival was 95.8%±2.3% at a mean follow-up of 43 months (Figure 1). Survival free from re-operation was 92.8%± 4.2% at 60 months.

Discussion and Conclusion

Recurrence of MVI after MV reconstruction surgery is one of the major concerns of the surgeon. Doubts about repair exist as the advantage from the lesser requirement for anticoagulation may be overwhelmed by the shorter durability regarding the replacement. It has been shown that survival benefits of repair may be age-related, and elderly patients could benefit less from valve repair (11, 12).

Tissue valves are not suitable for the mitral position, but mechanical valves require life-long anticoagulation which is associated with the certain degree of morbidity and mortality. In addition, prosthetic heart valves have a higher risk of endocarditis compared to repair (13).

Repair and replacement may be much more convenient to different subsets of patients, however, the factors affecting the correct clinical decision are difficult to be found out from clinical experience alone. Especially in degenerative disease, it is unclear whether repair or replacement provides the best long-term outcomes in different patient subsets.

Mitral valve repair is becoming the preferred approach for most causes of MR. There are increasing data showing in-hospital and long-term survival advantages exist for MV repair over replacement (1-4)

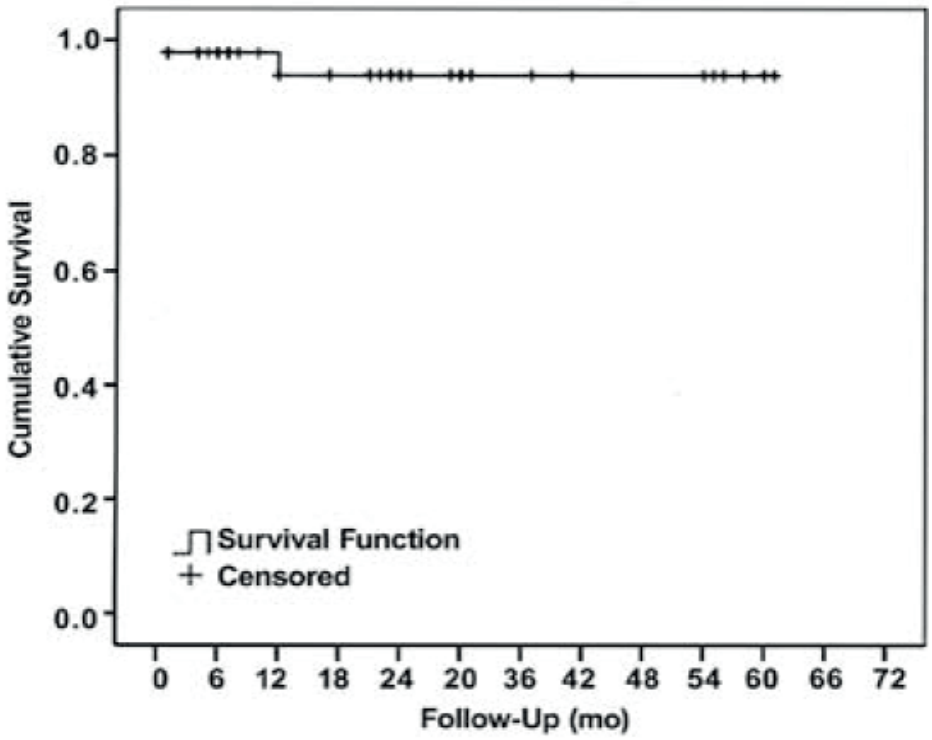

Figure 1. Survival actuarial curve during a 60-month follow-up

Enriquez-Sarano and associates reported significantly less hospital mortality with repair over replacement (2.6% versus 10.3%) (3). Ten year survival rate was better for repair than replacement (68%±6% versus 52%±4%; p=0.0001). Gillinov and colleagues supported long-term durability of MV repair for degenerative disease with ten year freedom from reoperation of %93 (2). Patients with ischemic MR have also seen benefits from valve repair (14). Our findings in regard to reoperation rates are similar to the literature (1-4, 8).

The concept of superiority of MV repair over replacement in ischemic MV regurgitation is controversial. The report by Thourani and associates documented equivalent survival with MV repair and replacement in patients requiring coronary bypass surgery (15). This finding is also supported by Gogbashian and colleagues (9). In contrast, Enriquez–Sarano and associates documented a survival benefit with MV repair over replacement in patients requiring concomitant CABG at 6 years (74%± 6% versus 34% ± 8%) (3). In multivariate analysis, Nagendran and coworkers documented CABG as an independent risk factor for mortality (16). Similarly, we also found that ischemic mitral regurgitation is an independent risk factor associated with mortality.

The techniques used for MV repair in our population include almost always (more than %95) full ring or band annuloplasty (Edwards Physio, Carpentier classic) along with appropriate leaflet or chordal procedures. Various combinations of leaflet and chordal procedures were used, depending on surgeons' preference, patho-anatomical variations, and evolution of techniques with time.

Recent advances in surgical technique allow repair of most mitral valves with degenerative disease. However, few long-term data exist to support the superiority of repair versus prosthetic valve replacement, and repair could be limited by late durability or other problems.

The durability of mitral repair also depends on the technique. After we learned that annular remodeling is very important in MV reconstruction, and prosthetic ring insertion became had excellent results, several surgeons think that a prosthetic ring should be applied to

all MV repairs (17-19). However; these rings may be associated with systolic anterior movement (SAM) of the MV (20, 21) which causes left ventricular outflow obstruction and residual mitral regurgitation. Selection of the correct ring size is necessary to avoid SAM, which usually appears when the ring is too small, a good correlation between the implanted ring size and body surface area (17, 22). Our results indicated that our choices of ring sizes were appropriate as there were no cases of SAM observed in our study population during follow-up.

Our study showed that the type of annuloplasty (Cosgrove-Edwards, Carpentier-Edwards, posterior pericardial plication) did not influence repair durability. We conclude that mitral valve repair, using current techniques, showed excellent survival, acceptable reoperation rate with satisfactory valve function at early and mid-term follow-up. Because it conserves the subvalvular apparatus and ventricular geometry which preserves left ventricular function and also causes less chronic anticoagulation requirement.

Finally, we feel that the most important point is a detailed examination of all valvular components during surgery and intraoperative echocardiographic guidance decreases the risk of late re-operation.

Conflicts of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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