Original Article

Repair Versus Replacement for Ischemic Mitral Regurgitation

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Abstract

Background: *This study was undertaken to compare the outcome in patients with moderate to severe ischemic mitral regurgitation (IMR) undergoing coronary artery bypass grafting (CABG) with either mitral valve repair or mitral valve replacement.*

Methods: *Between March 2002 and February 2005, 49 consecutive patients (mean age: 62.84±8.42 years; mean EuroSCORE: 10.03±3.12) with coronary artery disease and moderate to severe IMR underwent CABG plus mitral valve replacement or mitral valve repair. The patients with annulus dilatation were more likely to undergo repair. The mean follow-up period was 18.89±2.1 months.*

Results: *40.8% of the patients underwent CABG plus mitral valve replacement, and 59.2% had CABG concomitant with mitral valve repair. The total rate of mortality in our population was 14.9% (7 patients) including 10.3% (3 patients) early mortalities; all the deceased patients were in the repair group. Both groups had a similar EuroSCORE, but more patients in the repair group had a recent episode of unstable angina (65.5% vs. 35.0%, respectively; P=0.035) and diabetes mellitus (44.8% vs. 10.0%, respectively; P=0.009). After the follow-up period, in the repair group, 11.5% had no features of Mitral regurgitation (MR); while 50% had mild MR, 23.1% moderate MR, 11.5% moderately severe MR, and 3.8% severe MR. Overall, 68.9% had no or mild MR, which we defined as successful repair, and 31.1% had moderate to severe MR. Success of repair and mortality were not statistically related to preoperative ejection fraction (39.2±7.8% vs. 32.5±8.5%; P=0.057).*

Conclusion: *Early mortality was higher in the repair group than that in the replacement group, but this may have been due to the higher frequency of diabetes mellitus and unstable angina in the former group. Future studies are required to determine the benefit of repair versus replacement concomitant with CABG in IMR patients.*

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Introduction

In moderate to severe ischemic mitral regurgitation (IMR), the use of mitral valve repair versus mitral valve replacement along with coronary artery bypass grafting (CABG) is controversial. Patients undergoing mitral valve repair may have a reduced incidence of thromboembolism and reduced necessity for anticoagulation compared with patients undergoing mitral valve replacemen.[1] Other advantages of mitral valve repair over replacement include greater freedom from endocarditis and better preservation of left ventricular function.[2] These advantages have been investigated when degenerative mitral valve disease exists in isolation. The use of mitral valve repair in ischemic mitral regurgitation (IMR) is, however, controversial. IMR is a disease of myocardium,[3] and while some authors believe that myocardial infarction

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(MI) always precedes IMR,[3] others believe that IMR is caused by coronary artery disease (CAD) and not necessarily by MI.[4] Surgical treatment of IMR is associated with a high operative mortality rate and poor long-term survival.[5] Choosing a most appropriate surgical treatment to maximize the survival for these patients is complicated by the inconsistent classification schemes and a paucity of long-term data to compare valve repair versus replacement in this group of patients.[5] In this study, we compare the mid-term outcome in patients with IMR undergoing CABG with either mitral valve repair or mitral valve replacement.

Methods

The present retrospective study was performed in the cardiothoracic surgery registry of Tehran Heart Center, which is a single-center registry containing demographic and clinical features, previous medical antecedents such as risk factors and procedural details, and follow-up data.

Between March 2002 and February 2005, 49 consecutive patients with moderate to severe Mitral regurgitation (MR) (2+ to 4+) and coronary artery disease (CAD) who underwent CABG plus mitral valve replacement or mitral valve repair were identified from the cardiothoracic surgery registry of Tehran Heart Center Surgery Data Base. Moderate to severe IMR was defined as MR grade II or IV on echocardiography or ventriculograghy. Mitral valve regurgitation due to rheumatism or myxomatous degenerative disease was excluded from the study population, but patients with IMR and concomitant senile calcification or prolapse or rupture of chordae secondary to MI were included. EuroSCORE was used before surgery to estimate the risk of mortality after CABG. The choice between mitral valve replacement and mitral valve repair was based on the surgeons' discretion; be that as it may, the patients with annulus dilatation were more likely to undergo repair (P=0.088). It is deserving of note that EuroSCORE is a simple, objective, and up-to-date system for assessing heart surgery, soundly based on one of the largest, most complete, and accurate databases in European cardiac surgical history.[6]

A preoperative echocardiography was performed for all the patients. Transesophageal echocardiography (TEE) was employed to detect the severity and mechanism of MR when needed. The assessment of MR severity was based on a number of variables (Table 1). MR was defined as ischemic if associated with persistent wall motion abnormality and no significant organic mitral valve disease. IMR was further subdivided into four major mechanisms of regurgitation: 1- Annulus dilation, 2- Restriction of the posterior mitral leaflet, 3- Prolapse of each leaflet, and 4- Rupture of the cord. Post-pump intraoperative TEE was used in the repair group; and if there was more than mild to moderate MR, mitral valve replacement was performed. 93.2% of the study population had postoperative or follow-up echocardiography. The mean follow-up period was 18.89±2.1 months.

Table 1. Assessment of the mitral regurgitation severity

		RV (ml)	ERO (cm2)	MR jet (% LA)
I	Mild	<30	<0.2	<15
II		30-44	0.2-0.29	15-30
III		45-59	0.3-0.39	35-50
IV	Severe	≥60	>0.4	>50

RV, Regurgitation volume; ERO, Effective regurgitation orifice (cm^2); MR, Mitral regurgitation; % LA, percentage of left atrial area encompassed by the mitral regurgitation jet with color flow Doppler imaging

The preoperative, operative, and postoperative data were collected prospectively in the division's clinical database and confirmed by reviewing the actual medical records. Statistical analysis was performed with the SPSS statistical package (SPSS Version 13.0). All the continuous variables were expressed as mean±SD and the dichotomous variables as frequencies. The categorical variables were compared using the chi-square test, and the continuous variables were compared using Student's t-test. P values ≤0.05 were considered statistically significant. Also, the ordinal variables were compared using the nonparametric Mann-Whitney or Willcoxon signed ranks tests.

Results

The patient characteristics of the 49 participants undergoing mitral valve repair or replacement are depicted in Table 2. In our patients, the causal mechanisms of IMR consisted of the following conditions: annulus dilatation (66.7%), restriction of posterior mitral leaflet (40%), prolapse of both leaflets (11.1%), prolapse of anterior mitral leaflet or posterior mitral leaflet (6.7%), and rupture of cords (2.2%) (Table 3).

Table 2. Patients' characteristics*

	MVR (n=20)	MV Repair (n=29)	P value
Age (y) (mean±SD)	63.89±8.17	62.07±8.68	0.48
Female	7(35.0)	7(24.1)	0.41
Hypertension	4(20.0)	8(27.6)	0.54
Diabetes mellitus	2(10.0)	13(44.8)	0.009
Recent MI	2(10.0)	3(10.6)	0.96
Recent UA	7(35.0)	19(65.5)	0.035
CHF	4(20.0)	4(13.8)	0.56
Renal insufficiency (Cr>1.5 mg/dl)	3(15.0)	7(24.1)	0.43

*Numbers in parenthesis show the related percentages

MVR, Mitral valve replacement; MV, Mitral valve; MI, Myocardial infarction; UA, Unstable angina; CHF, Congestive heart failure; Cr, Creatinine

Table 3. Mechanism and etiology of mitral regurgitation*

	All Patients	MVR (n=20)	MV Repair (n=29)	P value
Annulus dilation	30(66.7)	10 (33.3)	20 (66.7)	0.088
Restriction of PML	18 (40)	7 (38.8)	11 (61.2)	0.71
Prolapse of AML	3(6.7)	1(33.3)	2 (66.7)	0.74
Prolapse of PML	3 (6.7)	1 (33.3)	2 (66.7)	0.74
Both leaflets prolapse	5 (11.1)	2 (40.0)	3 (60.0)	0.91
Posterior cordal rupture	1 (2.2)	1 (100)	0	-
Calcification of PML	1 (2.2)	1 (100)	0	-
Calcification of AML	1 (2.2)	-	1 (100)	-

*Numbers in parenthesis show the related percentages
MVR, Mitral valve replacement; MV, Mitral valve; PML, Posterior mitral leaflets; AML, Anterior mitral leaflets

Of these participants, 20 (40.8%) underwent mitral valve replacement and 29 (59.2%) underwent repair. In the repair group, 65.5% underwent annuloplasty, 27.6% other reconstruction techniques concomitant with annuloplasty, and 6.9% reconstruction techniques without annuloplasty. The mean age of the patients in both groups was similar (63.89±8.18 years in the replacement group vs. 62.11±8.68 years in the repair group; P=0.48), but there were more female patients undergoing mitral valve replacement. The proportions of female gender, history of prior MI, and hypertension were not significantly different between the two groups. More patients in the repair group had a recent episode of unstable angina (65.5% vs. 35.0%; P=0.035), and the frequency of diabetic patients was significantly higher among the patients undergoing repair (44.8% vs. 10.0%; P=0.009). More patients in the repair group suffered from annulus dilatation, but the number was not statistically significant (76.9% vs. 52.6%; P=0.088). The mean of left ventricular ejection fraction (LVEF) was not statistically significantly different between two groups (39.5±8.3 in the replacement group vs. 36.2±8.3 in the repair group; P=0.19).

The difference in EuroSCORE between mitral valve repair and mitral valve replacement was not statistically expressive (10.2±2.9 in the replacement group vs. 9.9±3.3 in the repair group; P=0.80). All the patients in both groups underwent concomitant CABG with a similar number of grafts (P=0.116) (Table 4).

Table 4. Severity of disease

	MVR (n=20)	MV Repair (n=29)	P value
Ejection Fraction (%)*	39.47±8.27	36.25±8.35	0.19
Concomitant CABG	20	29	
Number of grafts n (%)			0.11
0-1	4(22.3)	-	
2	-	2(7.4)	
3	8(44.4)	11(40.7)	
4	5(27.8)	9(33.3)	
5-6	1(5.6)	5(18.5)	
EuroSCORE*	10.16±2.88	9.93±3.33	0.80
DLVD (mm)*	53.51±13.61	56.13±15.17	0.56
SLVD (mm)*	42.53±9.44	40.48±13.54	0.63

*Data are presented as mean±SD
MVR, Mitral valve replacement; MV, Mitral valve; CABG, Coronary artery bypass grafting; DLVD, Diastolic left ventricle dimension; SLVD, Systolic left ventricle dimension

It must be noted that the perioperative use of intra-aortic balloon pump (IABP) was higher in the repair group, but it was only a trend (24.1% vs. 5.0%; P=0.075).

The total rate of mortality in our population was 14.9% (7 patients), including 10.3% (3 patients) early mortalities. All the deceased patients were among those in the repair group. It is noteworthy that 12 patients (25.5%) had EF≤30%, and 2 (18.2%) of these patients died. Mortality was not statistically related to preoperative EF (34.3±8.9% vs. 38.4±8.4%; P=0.24), diastolic LV dimensions (55.5±4.9 vs. 54.0±15.1 mm; P=0.84), and systolic LV dimensions (37.0±5.3 vs. 41.1±12.2 mm; P=0.51), and nor was it related to MR severity (P=0.23), postoperative MR in the repair group (P=0.58), and history of recent unstable angina (P=0.029). However, the deceased patients had lower LV ejection fraction in the follow-up period, but it must be considered as a trend (32.0±4.8% in the mortality group vs. 36.6±10.4% in the others; P=0.098). A history of preoperative use of IABP was more frequent in the deceased cases compared with the living patients (42.9% vs. 12.5%, respectively; P=0.049). EuroSCORE was not different between the deceased and the living (10.9±1.9 vs. 9.9±3.4; P=0.46). After the follow-up period, in the repair group, 11.5% had no features of MR, while 50% had mild MR, 23.1% moderate MR, 11.5% moderately severe MR, and 3.8% severe MR. There were only two crossovers from repair to replacement: one of them because of severe MR and the other because of severe mitral stenosis. Overall, 68.9% had no or mild MR, which we defined as successful repair and 31.1% had moderate to severe MR. MR severity and LVEF in postoperative and follow-up echocardiography are shown in Tables 5 and 6.

Table 5. Mitral regurgitation (MR) severity by Transthoracic echocardiography (TTE)*

Severity of MR	Preoperative	Postoperative TTE	Follow-up TTE
0	0	9.5	15.8
1+	0	52.4	47.4
2+	34.5	28.6	21.1
3+	62.1	9.5	10.5
4+	3.4	0	5.3

*Data are presented as percentage

Table 6. LVEF in postoperative and follow-up echocardiography*

	MVR(n=20)	MV repair(n=29)
Preoperative EF (%)	39.47±8.27	36.25±8.35
Postoperative EF (%)	36.56±10.60	36.14±11.75
Follow-up EF (%)	39.06±8.45	40.91±9.70

*Data are presented as mean±SD
LVEF, Left ventricular ejection fraction; MVR, Mitral valve replacement; MV, Mitral valve; EF, Ejection fraction

Preoperative LVEF was slightly higher in the successful repair cases; it was, however, not statistically significant (39.2±7.8% vs. 32.5±8.5%; P=0.057). Success of repair was not related to diastolic LV dimensions (58.9±8.5 vs. 54.1±24.2 mm; P=0.68), systolic LV dimensions (44.0±12.0 vs. 39.3±19.9 mm; P=0.63), severity of MR (P=0.65), and surgical methods of repair (P=0.31).

Discussion

Our early and total mortality rates, all of which occurred in the mitral valve repair group, were 10.3% and 14.9%, respectively. These mortality rates are comparable with those in other studies: 15% in the Tavakoli et al.,[7] 14.6% in the Dion et al.,[8] 9.3% in the Cohn et al.,[9] and 9.2% in the Hendren et al.[10] studies. Akins and colleagues[11] and Enriquez-Sarano and associates[12] found that repair was associated with reduced hospital mortality; nevertheless, the view was not corroborated by other authors.[2,13,14] In the Gillinov's study,[5] the 30-day and one-year mortality rates were 6% and 18% in the repair group and 19% and 44% in the replacement group in IMR patients, respectively. In contrast, the rate of mortality was higher in our repair group, which may have been secondary to the greater frequency of diabetes mellitus and unstable angina in the patients comprising this group, although the total mean EuroSCORE of both groups was similar. In addition, the etiology of MR in our patients was ischemia; and according to Gillinov et al., these patients had a poor prognosis.[5] We found that a history of preoperative use of IABP was a predictor of mortality. Hendren et al.[10] also reported that a preoperative use of IABP was associated with increased operative mortality. In the Tavakoli et al. study,[7] the only independent risk factors for early mortality were IABP and chronic obstructive pulmonary disease (COPD). In line with the Hausmann et al. study;[15] the postoperative LVEF during our follow-up period had a trend of being effective in mortality, and mortality was higher in patients with more severe LV dysfunction after surgery.

Repair was successful in 61.5% of our patients, and only 2 patients underwent reoperation. Our results indicated that the success of repair was not related to preoperative ejection fraction, severity of mitral valve regurgitation, techniques of repair, or diastolic and systolic LV dimensions. In another study by Gillinov et al., approximately 70% of the patients were predicted to benefit from repair; the benefit lessened or was negated if an internal thoracic artery graft was not used, if a lateral wall motion abnormality was present, or if the MR jet pattern was complex. Freedom from repair failure at 5 years in the said study was 91%.[5] Grossi EA et al. clearly presented lower short-term complications or death rates in patients with mitral valve reconstruction compared with mitral valve replacement patients, while noting that five-year complication-free survival rates were higher in patients undergoing mitral valve repair.[16]

We found that mortality in patients with severe LV systolic dysfunction (LVEF≤30%) and moderate to severe MR was about 18.2%. Similarly, Bishay et al. reported 11% one-year mortality and 14% two-year mortality rates for patients with LVEF<35% and MR for those who underwent mitral valve replacement or repair.[17] In our study, the patients with higher preoperative LVEF had slightly more successful repair; it was, however, not statistically significant (as a trend) and may have been due to the relatively small number of cases. We could not find any relationship between success of repair and diastolic and systolic LV dimensions, MR severity, and techniques of repair. Gillinov et al. reported that the benefit of repair was lessened in the presence of lateral wall motion abnormality or complex jets of MR.

Conclusion

Early mortality was higher in the repair group in spite of the similarity observed in the mean EuroSCORE of both repair and replacement groups. However, this high mortality in the repair group may have been due to the higher frequency of diabetes mellitus and unstable angina in its patients. Future studies are required to determine the benefit of repair versus replacement concomitant with CABG in IMR patients. Furthermore, future prospective randomized trials would help us to evaluate the success of mitral valve repair and factors influencing this success.

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