Journal of Medicine in Scientific Research

Volume 7 | Issue 4 Article 3

Subject Area: Cardiothoracic Surgery

Repair vs. Replacement for Chronic Ischemic Mitral Valve Regurgitation: A Retrospective Cohort Study.

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Recommended Citation

Faragalla, Ahmed A; Elshiemy, Ahmed M; Elhindawy, Sherif A; and Abedelhamid, Ahmed A. (2024) "Repair vs. Replacement for Chronic Ischemic Mitral Valve Regurgitation: A Retrospective Cohort Study.," *Journal of Medicine in Scientific Research*: Vol. 7: Iss. 4, Article 3.
DOI: https://doi.org/10.59299/2537-0928.1400

ORIGINAL STUDY

Repair versus replacement for chronic ischemic mitral valve regurgitation: A retrospective cohort study

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Abstract

Background: **Chronic ischemic mitral regurgitation (CIMR) presents a surgical dilemma: repair or replace the mitral valve during coronary artery bypass grafting.**

Aim: **This study investigates early outcomes following mitral valve repair versus replacement during coronary artery bypass grafting for CIMR patients.**

Patients and methods: **The study used a retrospective design, enrolling 100 patients who underwent coronary artery bypass grafting surgery with either mitral valve repair or replacement at the National Heart Institute. Patients were stratified into group I (repair) and group II (replacement). Further stratification within each group categorized patients by mitral regurgitation severity (moderately severe or severe).**

Results: **This analysis of mitral valve repair versus replacement during coronary artery bypass grafting for CIMR ($n = 100$) reveals tradeoffs. Younger patients opted for replacement ($P = 0.005$), which, though associated with lower postoperative ejection fraction ($P = 0.044$) and extended ICU ($P = 0.043$) and hospital stays ($P = 0.001$) for severe IMR, showed significant dyspnea improvement for most groups ($P < 0.012$). Repair, despite some early mortality (4 vs. 2), might be preferable in specific cases due to potential benefits for ejection fraction.**

Conclusions: **Mitral valve repair and replacement during coronary artery bypass grafting for CIMR seem viable options, but early outcomes suggest potential tradeoffs. Replacement in younger patients with severe CIMR might come with a lower postoperative ejection fraction and longer recovery times.**

Keywords: Coronary artery bypass graft, Ischemic mitral regurgitation, Mitral valve repair, and replacement

1. Introduction

In the context of ischemic heart disease, left ventricular (LV) remodeling can lead to a functional heart valve abnormality known as chronic ischemic mitral regurgitation (CIMR) [1]. Studies have shown a significant prevalence of CIMR, affecting up to 20% of patients following an acute myocardial infarction and reaching 50% in individuals with heart failure. While IMR is considered a secondary consequence of ventricular remodeling, research suggests that chronic stress on the mitral valve leaflets can induce structural changes, including enlargement and increased stiffness, further contributing to the regurgitant process [2]. This combination of CIMR and chronic coronary artery disease has been linked to a poorer prognosis compared with ischemic heart disease alone [3,4].

Management of CIMR depends on its severity. Severe cases require combined revascularization and valve intervention [5]. For moderate IMR, the optimal approach is debated [5,6]. Revascularization alone might sometimes improve outcomes, but it relies on viable heart muscle [7].

Mitral valve repair offers potential advantages over replacement, including avoiding long-term anticoagulation and complications from prosthetic valves. However, repair may lead to recurrent regurgitation and longer surgeries. Advancements in Mitral valve replacement techniques using tissue valves with preserved subvalvular structures achieve outcomes comparable to repair for IMR [8]. This study compares

Received 8 July 2024; accepted 14 August 2024.
Available online 4 October 2024

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https://doi.org/10.59299/2537-0928.1400

mitral valve repair versus replacement during coronary artery bypass grafting for IMR patients.

2. Patients and methods

This retrospective observational study compared the early postoperative clinical course of mitral valve repair versus replacement in 100 patients undergoing elective coronary artery bypass grafting for chronic, grade II, or higher IMR diagnosed by echocardiography. To ensure a homogeneous population, patients with acute IMR, emergency surgery needs, LV aneurysm, or ventricular septal rupture were excluded. The study included patients with preexisting valvular disease or prior mitral valve surgery. The Institutional Review Board approved this study (IHC00080).

2.1. Study data and outcomes

After obtaining a signed consent the baseline characteristics, comorbidities, and cardiac history were collected preoperatively. The preoperative assessment also included LV function evaluation and documentation of MR severity. The criteria for the diagnosis of CIMR have been followed as described before [9].

Table 1. Comparison of the preoperative data between study groups.

	Group Ia ($N = 20$) [n (%)]	Group IIa ($N = 9$) [n (%)]	P value	Group Ib ($N = 30$) [n (%)]	Group IIb ($N = 41$) [n (%)]	P value
Male	15 (75.0)	6 (66.6)	0.667	20 (66.6)	27 (65.8)	0.667
Age (years)	54.25 ± 10.04	53.55 ± 8.88	0.858	60.65 ± 7.37	54.44 ± 10.18	**0.005**
Chest pain	12 (60.0)	5 (55.5)	0.821	9 (30.0)	15 (36.5)	0.562
Dyspnea	8 (40.0)	4 (44.4)		21 (70.0)	26 (63.4)	
Diabetes mellitus	14 (70.0)	6 (66.6)	0.858	23 (76.6)	23 (56.1)	0.073
Hypertension	13 (65.0)	8 (8.88)	0.183	23 (76.6)	27 (65.8)	0.324
Smoking	13 (65.0)	7 (77.7)	0.491	15 (50.0)	20 (48.7)	0.920
Height (cm)	172.85 ± 6.82	170.33 ± 4.00	0.314	170.4 ± 6.11	172.55 ± 4.61	0.095
Weight (kg)	86.05 ± 8.64	82.77 ± 6.66	0.322	79.35 ± 8.49	77.77 ± 7.12	0.397
BMI (kg/m^2)	28.85 ± 2.97	28.49 ± 1.39	0.733	27.38 ± 3.23	26.12 ± 2.22	0.055
CCS						
I	1 (5.0)	1 (11.1)	0.392	4 (13.3)	6 (14.6)	0.804
II	11 (55.0)	4 (44.4)		13 (43.3)	15 (36.5)	
III	8 (40.0)	4 (44.4)		13 (43.3)	19 (46.3)	
IV	0	0		0	1 (2.4)	
NYHA						
I	6 (30.0)	3 (33.3)	0.930	11 (36.6)	14 (34.1)	0.994
II	13 (65.0)	5 (55.5)		11 (36.6)	15 (36.5)	
III	1 (5.0)	1 (11.1)		8 (26.6)	12 (29.2)	
Previous MI	3 (15.0)	1 (11.1)	0.778	5 (16.6)	8 (19.5)	0.759
Previous PCI	5 (25.0)	3 (33.3)	0.642	5 (16.6)	8 (19.5)	0.759
Hb (mg/dl)	14.39 ± 1.17	13.41 ± 1.63	0.076	13.60 ± 0.95	14.04 ± 1.31	0.122
Creatinine (mg/dl)	0.91 ± 0.26	0.87 ± 0.19	0.683	0.79 ± 0.21	0.84 ± 0.10	0.186
Negative virology	19 (95.0)	8 (88.8)	0.547	27 (90.0)	35 (85.4)	0.562
HCV positive	1 (5.0)	1 (11.1)		3 (10.0)	6 (14.6)	
LVESD (cm)	5.75 ± 0.40	5.72 ± 0.80	0.892	6.05 ± 0.57	5.90 ± 0.49	0.238
LVEDD (cm)	4.04 ± 0.78	3.92 ± 1.06	0.734	4.50 ± 0.88	4.28 ± 0.62	0.220
EF (%)	50.65 ± 7.66	55.75 ± 10.49	0.151	46.95 ± 10.6	48.55 ± 11.08	0.537
LM	0	1 (1.11)	0.246	0	0	0.807
LAD	20 (100.0)	9 (100.0)		30 (100.0)	41 (100.0)	
Diagonal	0	1 (11.1)		0	1 (2.4)	
CA						
LCX	17 (85.0)	7 (77.7)		24 (80.0)	30 (73.1)	
OM	0	1 (11.1)		0	2 (4.8)	
RCA	13 (65.0)	4 (44.4)		20 (66.6)	28 (68.2)	
PDA	0	0		0	1 (2.4)	
PL	0	1 (11.1)		0	1 (2.4)	

CA, coronary angiography; CCS, Canadian Cardiovascular Society; EF, ejection fraction; Hb, hemoglobin; HCV, hepatitis C virus; LAD, left anterior descending; LCX, left circumflex artery; LM, left main; LVEDD, left ventricular end-diastolic diameter; LVESD, left ventricular end-systole diameter; MI, myocardial infarction; MR, mitral regurgitation; NYHA, New York Heart Association; OM, obtuse marginal artery; PCI, percutaneous coronary intervention; PDA, posterior descending artery; PL, posterolateral artery; RCA, right coronary artery.

Both values are statistically significant and we use the bold style to differentiate them from the non statistically significant items.

Intraoperative data encompassed bypass and aortic clamp times, cardioplegia types, number of grafts, use of inotropes, and intra-aortic balloon pump utilization.

Postoperative outcomes assessed included reoperation for bleeding, inotropic support duration, stroke, surgical site infections, ventilator dependence time, ICU stay, and total hospital stay duration.

2.2. Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics, version 20 (IBM Corp., Armonk, New York, USA). Categorical and continuous variables were summarized using descriptive statistics, including frequencies, percentages, means, and SDs. χ^2 tests were used to evaluate associations between categorical variables. For continuous data, independent-sample t tests were used to compare groups, and the Wilcoxon signed-rank test was used to analyze paired ordinal data. A threshold of P value less than 0.05 was set to indicate statistical significance.

3. Results

3.1. Study groups

Patients were divided into four groups based on preoperative IMR severity (moderately severe or severe) and mitral valve intervention (repair or replacement). Group sizes were:

Group Ia (moderately severe IMR, repair) − $n = 20$.

Group Ib (severe IMR, repair) − $n = 30$.

Group IIa (moderately severe IMR, replacement) − $n = 9$.

Group IIb (severe IMR, replacement) − $n = 41$.

Subsequent analyses compared outcomes within each IMR severity category (moderately severe vs. severe) for repair and replacement strategies.

3.2. Preoperative data

Groups Ia/IIa (moderate CIMR) shared similar demographics, comorbidities, symptoms (chest pain, dyspnea), and low/comparable prior rates

Table 2. Comparison of the operative data between study groups.

	Group Ia ($N = 20$)	Group IIa ($N = 9$)	P value	Group Ib ($N = 30$)	Group IIb ($N = 41$)	P value
CPB time (min)	120.50 ± 31.86	133.44 ± 25.08	0.292	130.00 ± 40.06	127.77 ± 29.90	0.788
Ischemic time (min)	94.50 ± 29.28	107.22 ± 28.84	0.286	97.50 ± 31.22	98.88 ± 25.71	0.839
Warm cardioplegia	1 (16.0)	0	0.218	7 (23.3)	4 (9.7)	0.118
Brettschneider's solution	19 (84.0)	9 (100.0)		23 (86.7)	37 (92.3)	
Number of grafts						
1 graft	3 (15.0)	1 (11.1)	0.539	8 (26.6)	10 (24.3)	0.409
2 grafts	8 (40.0)	5 (55.5)		6 (20.0)	13 (31.7)	
3 grafts	4 (20.0)	3 (33.3)		10 (33.3)	15 (36.5)	
4 grafts	5 (25.0)	0		5 (16.6)	3 (7.3)	
5 grafts	0	0		1 (3.3)	0	
Intra-aortic balloon pump	1 (5.0)	0	0.494	5 (16.6)	2 (4.8)	0.099
Type of grafted coronaries						
LAD	20 (100.0)	9 (100.0)	0.056	30 (100.0)	41 (100.0)	0.029
Diagonal	0	4 (44.4)		11 (36.6)	12 (29.2)	
OM	15 (75.0)	7 (77.7)		18 (60.0)	24 (58.5)	
Ramus	3 (15.0)	0		3 (10.0)	1 (2.4)	
RCA	4 (20.0)	0		1 (3.3)	14 (34.1)	
PDA	4 (20.0)	1 (11.1)		11 (36.6)	6 (14.6)	
PL	0	0		0	1 (2.4)	
Mitral repair						
Ring	16 (80.0)	–	–	26 (86.7)	–	–
Dacron	4 (20.0)	–	–	4 (13.3)	–	–
Mitral replacement						
STJ 27	–	4 (4.44)	–	–	14 (34.1)	–
STJ 29	–	3 (33.3)	–	–	20 (48.7)	–
STJ 31	–	2 (2.2)	–	–	7 (17.0)	–
Difficult weaning	1 (5.0)	0	0.494	4 (13.3)	0	0.016

Data are presented as mean ± SD and n (%).

LAD, left anterior descending; LCX, left circumflex artery; OM, obtuse marginal artery; PDA, posterior descending artery; PL, posterolateral artery; RCA, right coronary artery; STJ, Saint Jude Medical valve.

of Myocardial Infarction/Percutaneous Coronary Intervention. Groups Ib/IIb (severe IMR) had similar findings except for age (group Ib older; $P = 0.005$). Chest pain and dyspnea were common in both severe IMR groups. Baseline laboratories (hemoglobin, creatinine) and cardiac function Left Ventricular Ejection Fraction, Left Ventricular End Diastolic Diameter, Left Ventricular End Systolic Diameter) showed no significant differences between severe IMR groups, nor in the extent of coronary artery disease (Table 1).

3.3. Operative data

Groups Ia/IIa displayed no significant differences in bypass times, aortic clamping duration, or cardioplegia type. All received left anterior descending (LAD) artery grafts. Group Ia repairs used rings (80%) or Dacron patches, while group IIa replacements used variously sized prostheses.

Groups Ib/IIb differed significantly ($P = 0.029$) in coronary artery bypasses. Group Ib received more diagonal and Posterior Descending Artery grafts. Bypass times, cardioplegia (mostly Bretschneider's solution), and LAD graft rates were similar across groups. Group Ib repairs were primarily ring-based (86.7%), while group IIb replacements used variously sized prostheses (Table 2).

3.4. Postoperative data

Group Ia achieved superior outcomes, exhibiting less postoperative mitral valve regurgitation and comparable improvements in heart function compared with Group IIa. Conversely, group Ib patients experienced more complications and a protracted recovery course relative to group IIb. Nevertheless, all groups demonstrated significant improvement in heart function following surgery (Tables 3 and 4).

Table 3. Comparison of the postoperative data between study groups.

	Group Ia ($N = 20$)	Group IIa ($N = 9$)	*P* value	Group Ib ($N = 30$)	Group IIb ($N = 41$)	*P* value
Ventilation duration (h)	10.78 ± 4.45	11.75 ± 2.71	0.552	11.89 ± 4.62	11.77 ± 3.34	0.899
Drainage (ml)	418.42 ± 221.24	494.44 ± 203.78	0.388	447.50 ± 184.58	511.11 ± 143.12	0.106
Adrenaline use	11 (55)	7 (77.7)	0.504	26 (86.6)	27 (65.8)	0.109
Dobutamine use	0	0		2 (6.6)	4 (9.7)	
IABP inserted in ICU	1 (5.0)	0	0.494	1 (3.3)	0	0.239
Bleeding	2 (10.0)	1 (11.1)	0.928	1 (3.3)	4 (9.7)	0.296
Reopening	1 (5.0)	1 (11.1)	0.547	1 (3.3)	2 (4.8)	0.749
Stroke	0	0	1.000	1 (3.3)	2 (4.8)	0.749
Chest infection	1 (5.0)	1 (11.1)	0.547	1 (3.3)	2 (4.8)	0.749
ICU stay (days)	20.94 ± 0.91	40.66 ± 3.93	0.070	3.05 ± 1.39	3.55 ± 0.72	0.043
Mortality	1 (5.0)	1 (11.1)	0.547	3 (10.0)	1 (2.4)	0.172
LVESD (cm)	5.67 ± 0.55	5.67 ± 0.42	>0.99	5.75 ± 0.68	5.74 ± 0.45	0.942
LVEDD (cm)	4.03 ± 0.84	4.55 ± 0.66	0.132	4.25 ± 0.77	4.44 ± 0.54	0.239
EF (%)	45.31 ± 5.74	40.42 ± 10.62	0.131	43.22 ± 9.27	38.66 ± 8.70	0.044
MR			<0.001			**<0.001**
No	0	8 (100)		6 (22.2)	40 (100)	
Trivial	0	0		2 (7.4)	0	
Mild	19 (100)	0		17 (62.9)	0	
Postoperative NYHA			0.116			0.633
I	19 (100)	7 (87.5)		16 (59.3)	26 (65)	
II	0	1 (12.5)		11 (40.7)	14 (35)	
Wound infection			0.290			0.108
No	16 (84.2)	6 (75)		27 (100)	34 (85)	
SWI	3 (15.8)	1 (12.5)		0	3 (7.5)	
DWI (Deep Wound Infection)	0	1 (12.5)		0	3 (7.5)	
Hospital stays (days)	10.52 ± 2.58	11.37 ± 4.50	0.538	9.73 ± 2.78	12.44 ± 1.66	**0.001**

Data are presented as mean ± SD and *n* (%).

DWI, deep wound infection; IABP, intra-aortic balloon pump; LVEDD, left ventricular end-diastolic diameter; LVESD, left ventricular end-systole diameter; MR, mitral regurgitation; MV, mechanical valve; PG, pressure gradient; SWI, superficial wound infection.

Both values are statistically significant and we use the bold style to differentiate them from the non statistically significant items.

Table 4. Comparison of the preoperative and postoperative NYHA classes.

	Preoperative [*n* (%)]	Postoperative [*n* (%)]	*P* value
NYHA Group Ia			
I	6 (30.0)	19 (100.0)	
II	13 (65.0)	0	<0.001
III	1 (5.0)	0	
NYHA Group IIa			
I	3 (33.3)	7 (87.5)	
II	5 (55.5)	1 (12.5)	0.733
III	1 (11.1)	0	
NYHA Group Ib			
I	11 (36.6)	16 (59.3)	
II	11 (36.6)	11 (40.7)	0.012
III	8 (26.6)	0	
NYHA Group IIb			
I	14 (34.1)	26 (65.0)	
II	15 (36.5)	14 (35.0)	<0.001
III	12 (29.2)	0	

4. Discussion

This study evaluated mitral valve surgery approaches in IMR. Mitral valve replacement in severe IMR resulted in longer ICU stays, hospital stays, and lower postoperative improvement in left ventricular ejection fraction (LVEF) compared with repair (all $P < 0.05$). Importantly, perioperative mortality and complication rates were similar between groups ($P > 0.05$). No significant difference in mortality was observed between repair (four deaths) and replacement (two deaths) ($P = 0.39$). Both groups achieved significant reductions in postoperative MR ($P < 0.001$). These findings suggest mitral valve repair might be preferable for severe IMR, offering comparable mortality and superior LVEF recovery despite slightly prolonged ICU/hospital stays with replacement.

Management of IMR exhibits substantial variability across cardiac centers, often reflecting surgeon experience and preference. However, for optimal outcomes, surgical strategies for IMR should be individualized based on patient-specific factors and the characteristics of the mitral valve itself. The most definitive treatment approach is reserved for severe IMR cases [10]. However, recommendations for either mitral valve repair or replacement are less definitive. Magne *et al*. [11] reported significantly lower operative mortality with mitral valve repair versus replacement (9.7 vs. 17.4%). This finding was confirmed in several studies, which reported higher mortality rates in mitral valve replacement patients [12,13]. Li and colleagues [12–15] reported similar mortality and morbidity rates between repair and replacement. They also reported longer aortic cross-clamp, cardiopulmonary bypass times, and the duration of ICU for mitral valve replacement, which agrees with our study.

However, Goldstein *et al*. [16] found that 59% of patients with mitral repair had moderate or severe regurgitation after a 2-year follow-up. Recurrence of MR predisposes to heart failure, arrhythmia, and the need for repeat intervention; therefore, it is a significant concern after mitral valve surgery [17–19].

Lorusso *et al*. [20] reported a high residual or recurrent MR rate following restrictive annuloplasty in CIMR, and the recurrence rate of moderate or severe MR was 33% after 6 months of follow-up. De Bonis *et al*. [21] reported that residual MR after a mitral repair was moderate to severe in 7.2% of patients, moderate in 14.4%, and mild in 78.3%. Moreover, Magne *et al*. [11] reported a 4% recurrence of moderate or higher MR after mitral valve replacement and 18% after repair. Our study could not present the data concerning the late recurrence rate of MR in both groups as the results were restricted to the in-hospital period. Therefore, a prospective study with early and late follow-up would have been more appropriate to compare it with the other studies.

4.1. Study limitations

This study has limitations inherent to its retrospective design. Selection bias is a concern, as preoperative patient allocation to repair or replacement might have been influenced by surgeon experience or preference. Moreover, limited transesophageal echocardiography availability for some patients may have further skewed surgical decision-making. The generalizability of the findings is also limited by the modest sample size and short follow-up period, which only extends to hospital discharge.

4.2. Conclusion

Our findings suggest that mitral valve repair might be preferable for severe CIMR, offering comparable mortality and superior LVEF recovery despite slightly prolonged ICU/hospital stays with replacement. However, the retrospective design and limitations inherent to this study, including selection bias and a modest sample size, restrict the generalizability of the results. Further investigation with a larger, prospective design is warranted to definitively determine the optimal surgical approach for CIMR patients.

Ethics information

The research has been reviewed and accepted by the institutional ethical committee.

Funding

None.

Author contribution

All authors have been actively participated in all aspect of the work including concept, design, literature search, clinical studies, data acquisition, data analysis, manuscript work.

Consent statement

Informed Consent for Participation in the Study has been taken from all participants.

Conflict of interest

There are no conflicts of interest.

Institutional Review Board (IRB) Approval Number

IHC00080.

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