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MANAGEMENT OF CHRONIC ISCHEMIC MITRAL REGURGITATION IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS GRAFTING: OUR EXPERIENCE

Cardiothoracis

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ABSTRACT

Aim: To observe the outcomes of patients with ischemic Mitral regurgitation (MR) undergoing isolated coronary artery bypass grafting (CABG). **Material and Methods:** An observational study was conducted at ABVIMS and DR RML Hospital, New Delhi from April 2022 to April 2024. Inclusion criteria were patients with moderate-to-severe ischemic MR, who were willing for CABG. Exclusion criteria was presence of acute severe MR, akinesia, reduced thickness, aneurysm, scar; absence of myocardial vitality at myocardial stress test of the left ventricular inferior-posterior-lateral wall; and MR following isolated coronary graft. Patients were followed up at 6 months and 1 year. The outcome measures were changes in ejection fraction (EF), New York Heart Association (NYHA) functional class, and the severity of their mitral regurgitation. **Results:** The study analyzed 37 patients with moderate-to-severe ischemic MR who underwent CABG. Preoperatively, 70.3% had moderate MR, and 29.7% had severe MR. History of myocardial infarction was present in 73%, while 13.5% had undergone prior treatment. The mean preoperative EF was 46.89±11.57%, and 75.7% were in NYHA Class II. Intraoperatively, 78.4% received three grafts, 83.8% were managed off-pump, and 8.1% required intra-aortic balloon pump support. At 6 months, EF improved to 51.35 ± 6.5%, with 10.8% showing no MR, 83.8% mild MR, and 5.4% moderate MR. At one year, EF increased to 54.05 ± 5.63%, with 54.1% having no MR and 45.9% mild MR (p=0.005). Functional improvement was observed in NYHA classification, with 64.9% achieving Class I status at one year. There were significant improvements in EF (p=0.005), NYHA scores (p<0.0001) and downgrading of severity of MR (p<0.0001) postoperatively in the follow up period. **Conclusion:** The study concluded that CABG in patients with ischemic MR significantly improves EF, severity of MR, and functional status as assessed by NYHA classification, resulting in a notable cardiac functional recovery. **Clinical Significance:** The present study results support the management with isolated CABG for managing moderate to severe ischemic MR.

KEYWORDS

Coronary Artery Bypass Grafting, Mitral Regurgitation, Myocardial Infarction, Outcomes

INTRODUCTION

Ischemic mitral regurgitation (MR) remains one of the common consequences of myocardial infarction and coronary artery disease.[1] The estimated incidence of ischemic MR is 11–59% following MI, with moderate to severe ischemic MR being seen in 6.3–12% of the cases.[2]

It results from the ventricular remodeling resulting in incompetence of the mitral valves (MV), pathophysiologically accounted by the imbalance of ventricular closing forces, annular dilatation and chordal tethering. [1,3]

It is significant because chronic MR paves the path for further derangement in the functional capacity and development of heart failure - with grave outcomes of increased mortality and decreased survival.[3]

Improving survival and decreasing mortality have been the target in management of coronary artery disease (CAD) patients. Coronary artery bypass grafts (CABG) remain a standard surgery for CAD patients while repair or replacement of the MV, remains a separate surgery. Previous studies [4-6] have adjudged the usefulness of CABG+MV repair/replacement against CABG alone but found no additional superiority. Moreover, higher incidence of arrhythmia and neurologic events were observed if both the surgeries are clubbed together. [4,5]

Even the American Heart Association/ American College of Cardiology (AHA/ACC) guidelines remain unclear on inculcating surgical MV repair in chronic moderate to severe ischemic MR in patients of CAD.[7] Owing to this and observing the increasing incidence of ischemic MR in long term patients of CAD, CABG-only approach has been favoured as depicted in the recent study by Seese L et al.[1] Our institution has also favoured CABG-only approach based on the suggestion that the enhancements in ventricular function that occur following revascularization adequately improve any persistent postoperative MR over time while avoiding the burden of a longer and more complex operation.[1] But data lacks on the fronts of outcomes of patients undergoing CABG-only approach for ischemic moderate to severe MR in India.

Thus, the present study was conducted where we evaluate and portray the longitudinal outcomes of isolated CABG in patient settings of moderate to severe ischemic MR.

Methods

An observational study was conducted at ABVIMS and DR RML Hospital, New Delhi from April 2022 to April 2024. The study population was CAD patients, based on the specific eligibility criteria.

Inclusion criteria were patients with moderate-to-severe ischemic MR, who were willing for CABG at our hospital. Exclusion criteria was presence of acute severe MR, akinesia, reduced thickness, aneurysm, scar; absence of myocardial vitality at myocardial stress test of the left ventricular inferior-posterior-lateral wall; and MR following isolated coronary graft.

Patients were explained about the study and a written informed consent was obtained from them.

Sample Size

The sample size was methodologically calculated by using the formula and values from the recent reference study (Bouchard et al).[8] The study observed a mean value of pre-op EF as 41.5 ± 17.4% and post-op EF as 52 ± 2%. Keeping 95% power of study and 5% level of significance, the formula application required a minimum of 19 patients for the observational study. To reduce margin of error and cover up for any patient follow up loss, 37 patients were enrolled during the study period.

Formula used:

For comparing mean of pre and post

$$N >= \frac{(\text{standard deviation})^2 * (Z_\alpha + Z_\beta)^2}{(\text{mean difference})^2}$$

Where Z_α is value of Z (normal variate) at two sided alpha error of 5% and Z_β is value of Z (normal variate) at power of 95% and mean difference is difference in mean values of pre and post.

Pooled standard deviation= $\sqrt{(S_1^2 + S_2^2)/2}$

Where S_1 is standard deviation of pre.

And S_2 is standard deviation of post.

Calculations:

Pooled standard deviation= $\sqrt{(17.4^2 + 2^2)/2}$

=12.38

$$N >= \frac{(12.38)^2 * (1.96 + 1.645)^2}{(10.5)^2}$$

>=18.08=19(approx.)

Methodology

Patient details noted were age, gender, and comorbidities. Preoperative clinical data was collected, which included number of vessels involved, grade of MR, history of myocardial infarction (MI), history of percutaneous transluminal coronary angioplasty (PTCA), mean preoperative EF, and preoperative NYHA class. The intraoperative data included number of grafts used and need of intra-aortic balloon pump (IABP).

Definitions and Standards

Ejection fraction (EF): EF defined by the ratio of end-systolic volume (ESV) and end-diastolic volume (EDV).

The MR grade was assessed using "the proximal isovelocity surface area method, effective regurgitant orifice area, color Doppler flow mapping, jet eccentricity, and integrating jet expansion within the left atrium (jet area to atrial area). The regurgitant volume, fraction, and orifice area were calculated via the volumetric or the proximal isovelocity surface area method". MR was classified into one of the following five categories: no MR (including trace MR); mild ischemic MR; moderate ischemic MR; severe ischemic MR; and flail mitral valve.

New York Heart Association (NYHA) functional class

The NYHA functional class is a subjective estimate of a patient's true functional ability. [10]

NYHA	
Class I	No limitations. Ordinary physical activity does not cause undue fatigue, dyspnea or palpitations (asymptomatic LV dysfunction).
Class II	Slight limitation of physical activity. Ordinary physical activity results in fatigue, palpitation, dyspnoea or angina pectoris (mild CHF).
Class III	Marked limitation of physical activity. Less than ordinary physical activity leads to symptoms (moderate CHF).
Class IV	Unable to carry on any physical activity without discomfort. Symptoms of CHF present at rest (severe CHF).

Follow up

Patients were followed up at 6 months and 1 year.

Outcomes

The outcome measures were changes in ejection fraction (EF), New York Heart Association (NYHA) functional class, and the severity of their mitral regurgitation.

Statistical Analysis

Categorical variables were presented as numbers and percentages, while quantitative data were expressed as means ± standard deviation (SD). The statistical analysis included:

1. Paired t-test for comparing quantitative variables.
2. Bhapkar test for analyzing qualitative variables.

Data entry was performed using Microsoft Excel, and the final analysis was conducted using SPSS software (version 25.0, IBM, Chicago, USA). A p-value below 0.05 was considered statistically significant.

RESULTS

The demographic characteristics of 37 study patients are shown in Table 1. The mean ± SD age of the study population was 59.56 ± 1.07 years. There were 31 (13.5%) males and 6 (16.2%) females. Comorbidities seen were diabetes mellitus in 5 (13.5%) cases, hypertension in 7 (18.9%) cases, both diabetes mellitus and hypertension in 17 (45.9%) cases, and diabetes mellitus, hypertension and hypothyroidism in 3 (8.1%) cases (Table 1, Figure 1).

Table 1:- Demographic Data.

Demographic Data	n(%)	Mean + SD
Age (years)	-	59.56 + 1.07
Gender		
Male	31(13.5%)	-
Female	6(16.2%)	
Comorbidities		
Diabetes mellitus	5(13.5%)	-
Hypertension	7(18.9%)	-
Diabetes mellitus+Hypertension	17(45.9%)	-
Diabetes mellitus+Hypertension+ Hypothyroid	3(8.1%)	-

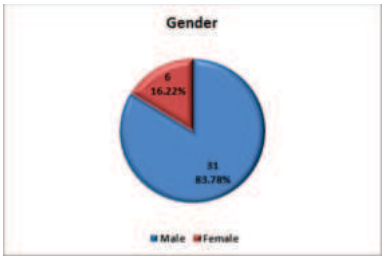

Figure 1:- Gender Distribution

The clinical characteristics of the study population in the pre-op stage is shown in Table 2. Among the study population, 6 (16.2%) cases had double vessel disease (DVD) and 31 (83.8%) had triple vessel disease (TVD). Grade of MR was moderate in 26 (70.3%) cases and severe in 11 (29.7%) cases. History of myocardial infarction (MI) was present in 27 (73%) cases. History of percutaneous transluminal coronary angioplasty (PTCA) was present in 5 (13.5%) cases. The mean preoperative EF was 46.89 (SD 11.57) %. The Preoperative NYHA classification was Grade II in 28 (75.7%) cases and Grade III in 9 (24.3%) cases (Table 2).

Table 2:- Pre Operative Clinical Data

Pre op data	n(%)	Mean + SD
Number of vessels		
DVD	6(16.2%)	-
TVD	31(83.8%)	
Grade of MR		
Moderate	26(70.3%)	-
Severe	11(29.7%)	
History of MI		
Present	27(73%)	-
Absent	10(27%)	
History of PTCA		
Present	5(13.5%)	-
Absent	32(86.5%)	
Pre OP EF	-	46.89 + 11.57
Pre Op NYHA		
Grade II	28(75.7%)	-
Grade III	9(24.3%)	

The intraoperative data is shown in Table 3. The number of grafts used were 2 in 8 (21.6%) cases and 3 in 29 (78.4%) cases. Intra-aortic balloon pump (IABP) was used in 3 (8.1%) cases. Cardiopulmonary bypass (CPB) was performed on-pump in 6 (16.2%) cases and off-pump in 31 (83.8%) cases (Table 3).

Table 3:- Intra Operative Data

Intra op data	n(%)
Number of grafts	
2	8(21.6%)
3	29(78.4%)
IABP used	3(8.1%)
CPB used	
ON Pump	6(16.2%)
OFF Pump	31(83.8%)

Follow up was done at 6 months and 1 year.(Table 4)

At 6 months, echocardiographic (ECHO) showed no MR in 4 (10.8%) cases, mild MR in 31 (83.8%) cases and moderate MR in 2 (5.4%) cases. Mean ± SD ICU stay was 2.97 ± 0.5 days and mean ± SD

hospital stay was 4.97 ± 0.6 days. Mean ± SD EF was 51.35 ± 6.5%. NYHA classification showed Class I in 22 (59.5%) cases and Class II in 15 (40.5%) cases.

At 1 year, ECHO showed no MR in 20 (54.1%) cases, mild MR in 17 (45.9%) cases and no cases of moderate MR. NYHA classification showed Class I in 24 (64.9%) cases and Class II in 13 (35.1%) cases (Table 4).

Table 4:- Post Operative Data

Post op data	n(%)	Mean + SD
Post op data at 6 months		
ECHO (Grade of MR)		
No MR	4(10.8%)	-
Mild MR	31(83.8%)	
Moderate MR	2(5.4%)	
ICU stay (days)	-	2.97 + 0.5 days
Hospital stay (days)	-	4.97 + 0.6 days
EF(%)	-	51.35 + 6.5%
NYHA		
Class I	22(59.5%)	-
Class II	15(40.5%)	
Post op data at 1 year		
ECHO (Grade of MR)		
No MR	20(54.1%)	-
Mild MR	17(45.9%)	
Moderate MR	0(0%)	
NYHA		
Class I	24(64.9%)	-
Class II	13(35.1%)	

Outcomes

NYHA

Compared to preoperative period, proportion of patients in Class I was significantly higher at 6 months (59.5% vs. 0%) and at 1 year (64.9% vs. 0%) (preoperative vs. 6 months, p value < 0.0001; preoperative vs. 1 year, p value < 0.0001). Proportion of patients in Class II decreased from 75.7% preoperatively to 40.5% at 6 months and further to 35.1% at 1 year. Class III, which accounted for 24.3% preoperatively, was completely absent at 6 months and 1 year, with no cases in Class IV at any time point (Table 5).

Table 5:-Comparison of NYHA Class Between Pre-op and Follow Up.

NYHA	Pre op	6 months	1 year	P value
I	0(0%)	22(59.5%)	24(64.9%)	Pre op vs 6 months:<0.0001* Pre op vs 1 year:<0.0001*
II	28(75.7%)	15(40.5%)	13(35.1%)	
III	9(24.3%)	0(0%)	0(0%)	
IV	0(0%)	0(0%)	0(0%)	

*Bhapkar test

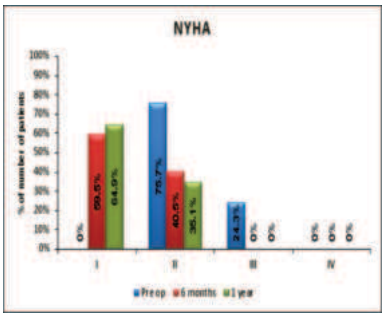

Figure 2:-Comparison of NYHA Class Between Pre-op and Follow up.

Grades of MR

Compared to preoperative period, grade of MR showed significant improvement at both 6 months and 1 year. Proportion of patients with no MR increased significantly at 6 months (10.81% vs. 0%) and further at 1 year (54.05% vs. 0%) (p< 0.0001). Mild MR, which was absent preoperatively, was present in 83.78% at 6 months and decreased to 45.95% at 1 year. Moderate MR, which was observed in 70.27% of cases preoperatively, decreased significantly to 5.41% at 6 months and was absent at 1 year. Severe MR, present in 29.73% preoperatively, was completely absent at both 6 months and 1 year (Table 6, Figure 3).

Table 6:-Comparison of Grades of MR Between Pre-op and Follow Up.

Grades of MR	Pre op	6 months	1 year	P value
No MR	0(0%)	4(10.81%)	20(54.05%)	Pre op vs 6 months:<0.0001* Pre op vs 1 year:<0.0001*
Mild MR	0(0%)	31(83.78%)	17(45.95%)	
Moderate MR	26(70.27%)	2(5.41%)	0(0%)	
Severe MR	11(29.73%)	0(0%)	0(0%)	

*Bhapkar test

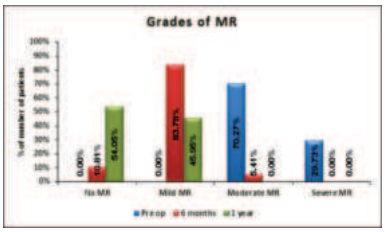

Figure 3:-Comparison of Grades of MR Between Pre-op and Follow Up.

EF

Compared to preoperative period, EF showed significant improvements at 6 months and 1 year. Mean ± SD EF increased significantly from 46.89 ± 11.56% preoperatively to 51.35 ± 6.52% at 6 months (p value = 0.005) and further to 54.05 ± 5.6% at 1 year (p value < 0.0001). (Figure 4)

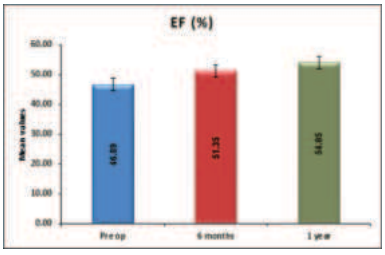

Figure 4:-Comparison of EF Between Pre-op And Follow Up.
Paired t test. Pre op vs 6 months:0.005, Pre op vs 1 year:<0.0001

DISCUSSION

The present study holds promise to the use of isolated CABG in patients with moderate to severe ischemic MR, as it provided significant improvements in NYHA class and EF, along with significant downgrading of severity of MR. Overall, a significant cardiac function recovery was observed in patients in the study.

Coronary artery disease has been increasing worldwide and in India, with prevalence rate of up to 4.24% in India.[12] Ischemic MR remains the common concern in long-term patients of CAD requiring surgery due to forward failure symptoms. In this regard, patients usually opt for CABG and the option that remains with it is valve repair. However, inculcating two surgeries in combination holds its own share of disadvantages. Thus, CABG alone surgery has been preferred and favored by some institutes. The present study shows that the outcomes remain favorable if CABG alone is used for managing such patients.

The study observed patients for follow-up period of 1 year. The patients population enrolled in the study were in their sixties with predominant males. Common comorbidities seen were diabetes mellitus and hypertension. Cases of only moderate to severe MR were included in the study with NYHA class or grade of II or III.

After undergoing CABG, it was found that NYHA class significantly improved over a period of 1 year, with P-value below 0.0001.

Likewise in the studies by Michler RE et al,[6] the NYHA III and IV class preoperatively was present in 67 (44.4%) patients out of 151 patients who underwent CABG alone; and compared to baseline, the increase of ≥1 NYHA class occurred in 9(7.7%) patients at 1 year, and in 14(14%) patients at follow-up of 2 years. Similarly, in the study by Khallaf et al [13], who conducted a study on 30 patients undergoing CABG alone with moderate ischemic MR, there was an improvement in NYHA class at follow-up of 4±1.3 years, from 2.6 to 1.72 (P = 0.07).

The present study results also showed that the grade of MR which was moderate to severe in the preoperative stage improved with 54.05% having no MR at 1 year and 45.95% having only mild MR, with P-value of less than 0.0001.

Likewise in the study by Seese et al, [1] conducted on 528 patients having moderate ischemic MR who underwent CABG, at the follow-up of 1 month, moderate MR was left in only 26% of patients.

In another study, Michler RE et al [6] followed patients with moderate ischemic mitral regurgitation, who underwent CABG alone. The presence of moderate or severe mitral regurgitation was noted in only 32.3% patients at 2 years follow-up. Khallaf et al [13] reported that there was an improvement in degree of mitral regurgitation in 22 (73%) patients at follow-up of 4±1.3 years. Moderate mitral regurgitation was left in 20% patients, and degree of regurgitation increased in one patient, from moderate to severe. The study results showed significant downgrading of MR grade with CABG alone.

Also, Functional EF improved from a mean value of 46.89% to 54.05% at 1 year with P-value of 0.0001 in our study. Likewise in the study by Michler RE et al, [6] the mean LVEF improved from preoperative value of 41.2 ± 11.6%, to 46.1±10.5% at follow-up of 2 years.

It was reasoned out that by treating the underlying cause, revascularization leads to reverse remodeling of the left ventricle which in turn decreases the tethering of the mitral valve leaflets and results in a reduction in regurgitation. [14]

Thus, overall it can be seen that CABG alone can improve the functional status of heart thereby allowing for significant improvement and better outcomes in the patients sparing them for mitral valve surgery.

Strengths of the Study

The findings of this study provide valuable information about outcomes of CABG alone in Indian patients with ischemic MR. The study used measurable clinical parameters, like EF, NYHA classification, and MR severity, for assessing the impact of CABG.

Limitations of the Study

The study included only 37 patients and conducted at a single center; thus its results cannot be generalized. The absence of a comparison group (such as patients undergoing CABG with concomitant mitral valve repair or replacement) limits the ability to determine whether CABG alone is the optimal intervention for ischemic MR. Last, the study primarily focuses on EF and NYHA classification without detailed analysis of long-term survival rates, quality of life, or major adverse cardiovascular events (MACE).

Future Recommendations

A multicentric study comprising adequate sample size can give more valuable findings. Future studies should include long follow-up periods for assessing the improvements in EF, NYHA class, and MR severity, as well as long-term survival and cardiac event rates. Quality of life should also be assessed.

CONCLUSION

The study concluded that CABG in patients with ischemic MR significantly improves EF, severity of MR, and functional status as assessed by NYHA classification, resulting in a notable cardiac functional recovery. Overall, isolated CABG holds promise for managing moderate to severe ischemic MR patients.

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