Short Term Outcome of Combined CABG and Mitral Repair by Posterior Annuloplasty with Flexible Band Versus Coronary Revascularization Only in Moderate Ischemic Mitral Regurgitation.

Sobhy Abouramadan[1], Ehab Elshihy[1], Mohamed Sewielam[1], Fouad Rasekh[1] and Ahmed Essam[1]

[1]Department of Cardiothoracic Surgery, Cairo University, Egypt

SobhyAbouramadansobhy.abouramadan@gmail.com

Mohamed.I.Sewielammsewielam@kasralainy.edu.eg

Ehab.M.ElShihyehabelshihy@hotmail.com

Fouad.M.Rasekhfrassekh@yahoo.com

Corresponding author: Ahmed.M.Essam

Email: ahmedessamhamada@gmail.com

Abstract

Background: The optimal treatment of moderate ischemic MR is a matter of debate. Some authors advocate for isolated coronary artery bypass grafting (CABG), aiming that reverse ventricular remodeling will reduce MR grade, while others argue that a concomitant mitral valve repair (MVR) or replacement gives better results.**Objectives**: In this study, we compare the short-term outcomes of repairing moderate ischemic mitral regurgitation by posterior annuloplasty with flexible band versus coronary revascularization alone.**Patients and Methods:** In the period between April 2019 and May 2020, 40 patients with moderate ischaemic mitral regurgitation (IMR) were divided in 2 groups and underwent open heart surgery at Cairo university hospitals. Group (A) had CABG surgery combined with MV repair by posterior annuloplasty with flexible band, while group (B) underwent CABG surgery alone. The preoperative, operative, postoperative, and 6 months follow up data of both groups were studied. Particular attention was paid to clinical findings of presence of mitral regurgitation, its nature and degree through pre- and postoperative echocardiography.

Results: There was no statistically significant difference between both groups with respect to age, gender, baseline New York Heart Association class, ejection fraction, number of bypass grafts and operative times. The CABG and mitral repair group had larger preoperative LV dimensions than the CABG without mitral repair group (Mean LVEDD 5.8 vs. 5.4 (P=0.039), mean LESD 4.25 vs. 3.77 (p=0.04)). Lengths of mechanical ventilation period, ICU and hospital stay were significantly higher in the CABG without mitral repair group (P<0.05). Overall, in-hospital mortality was 7.5% (3 patients). One (5%) patient died in the CABG plus mitral repair group, and 2 (10%) patients died in the CABG group. At follow-up after 6 months, patients who had mitral repair had significant improvement in NYHA class (p=0.041), more significant reduction in LV dimensions (p<0.001), improvement in LV EF (p<0.001) and more significant improvement in the degree of MR (P<0.001).

Conclusion: In patients with moderate ischaemic mitral regurge, adding mitral annuloplasty with flexible band to CABG offers improvement in mitral valve leaflet mobility and reduces mitral regurgitation recurrence. This is evidenced clinically by improvement in NYHA class.

Keywords:Moderate, Ischemic Mitral Regurgitation, CABG, Mitral Valve Repair, flexible band, posterior annuloplasty, recurrence.

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repair by posterior annuloplasty with flexible band, while Group (B) underwent CABG surgery alone to assess the early post-operative results among patient groups. The preoperative, operative, postoperative, and follow up data of both groups were studied. Particular attention was paid to clinical findings of presence of mitral regurgitation, its nature and degree, pre- and postoperative echocardiographic findings of mitral regurgitation, postoperative ICU events including the ICU stay and hospital stay.

Surgical techniques

All operations were performed through a full median sternotomy on normo-thermic cardiopulmonary bypass (CPB) with intermittent ante-grade warm blood cardioplegia delivered to the aortic root. CABG was done using the left internal mammary artery (LIMA) pedicle graft to the left anterior descending (LAD) coronary artery, and saphenous vein grafts for other coronary arteries. In patients having concomitant Mitral valve repair, posterior mitral annuloplasty was done through a left atriotomy using a downsized flexible band (double layered GORE-TEX patch, 4-5 cm in length and about 0.5 cm in width) after measuring the intertrigonal distance.

Statistical methods:

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired t test in normally distributed quantitative variables while non-parametric Mann-Whitney test was used for non-normally distributed quantitative variables. Comparison

Background: Ischemic mitral regurgitation (MR) is a common occurrence following myocardial infarction and its presence is associated with poor outcomes. The optimal treatment of ischemic MR is a matter of debate, especially for patients with moderate MR severity. Some authors advocate for isolated coronary artery bypass grafting (CABG) for patients with moderate MR, maintaining that reverse ventricular remodeling will reduce MR grade and its associated mortality risk, while others argue that a concomitant mitral valve repair (MVR) or replacement is superior.

Proponents of combined CABG and mitral valve surgery argue that the success of isolated revascularization depends on the extent of viable myocardium. Therefore, sufficient ventricular remodeling may not occur with isolated CABG in the presence of scar, thus necessitating concomitant mitral valve repair (MVR) or replacement. Supporting this argument, Penicka et al. demonstrated that improvement in MR in patients with moderate mitral regurgitation (MMR) who underwent an isolated CABG was limited to patients who had viable myocardium and an absence of dyssynchrony between papillary muscles. In addition, Aklog et al. demonstrated that roughly 40% of patients continued to have moderate MR following isolated CABG for moderate MR. Conversely, concomitant mitral surgery has been associated with increased operative mortality when compared to CABG alone.

Patients and Methods: In the period between April 2019 and May 2020, 40 patients with moderate ischaemic mitral regurgitation (IMR) divided in 2 equal groups underwent open heart surgery at Cairo university hospitals. Group (A) had both CABG surgery associated with MV

test was used instead when the expected frequency is less than 5 (Chan, 2003b). P-values less than 0.05 were considered as statistically significant.

between pre and post in each group was done using paired t test (Chan, 2003a). For comparing categorical data, Chi square ($\chi 2$) test was performed. Exact

Results

A. Preoperative Data:

There were 10 males (50%) in group (A) and 10 females (50%) as compared to 10 (50%) males and 10 (50 %) females in group (B) (p=NS). The mean age for group (A) was 57.5 and for group (B) 56.6 (p=NS).

Demographic data of the two studied groups:

Table (1): Comparison of gender and age among different study groups.

Variables	Group A (n= 20)	Group B (n= 20)	p value
Age (years)			
Range	46.0-73.0	40.0-69.0	
Mean ± SD	58.53 ± 7.84	56.58 ± 8.15	0.458
Sex			
Male	16 (80.0%)	15 (75.0%)	
Female	4 (20.0%)	5 (25.0%)	1.000

Data are expressed as mean ± SD or number (%). p> 0.05= not significant.

Table (2): Comparison of pre-operative co-morbidities among different study groups.

Variables	Group A (n= 20)	Group B (n= 20)	p value
DM	14 (70.0%)	13 (65.0%)	0.736
HTN	15 (75.0%)	14 (70.0%)	0.723
Recent MI	6 (30.0%)	7 (35.0%)	0.677

Data are expressed as number (%). p> 0.05= not significant.

Table (3): Preoperative NYHA Classes among the different studied groups

Variables	Group A (n= 20)	Group B (n= 20)	P value	Sig
Class II	9 (45%)	8 (40%)		
Class III	11 (55%)	12 (60%)	0.749	NS

NS= p> 0.05= not significant.

Table (4): Preoperative echo-cardio graphic findings among different study groups.

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	Group A (n=20)	Group B (n= 20)	p value
LVED	5.84 ± 0.59	5.42 ± 0.67	0.039
LVES	4.25 ± 0.55	3.77 ± 0.85	0.040
EF	50.25 ± 8.06	52.95 ± 8.46	0.308
Severity of MR			
Grade 2	12 (60.0 %)	15 (75.0 %)	0.311
Grade 3	8 (40.0 %)	5 (25.0 %)	

Data are expressed as mean ± SD or number (%). p> 0.05= not significant.

Operative data:

Table (5): Comparison Of the operative variables among the two studied groups:

Variables	Group A (n= 20)	Group B (n= 20)	p value
Graft number			
Single	1 (5%)	2 (10%)	
Double	1 (5%)	4 (20%)	
Triple	11 (55%)	12 (60%)	0.183
Quadruple	7 (35%)	2 (10%)	
Mean ± SD	3.20 ± 0.77	2.70 ± 0.80	0.051
Cross Clamp Time (minutes)	65.40 ± 30.10	58.00 ±36.62	0.487
Bypass time (minutes)	87.7 ±46.83	82.60 ± 50.08	0.741
Total operation time (minutes)	180.25 ± 30.55	165.15 ± 32.62	0.139

Data are expressed as mean ± SD or number (%). *p> 0.05= not significant.

Postoperative data:

Table (6): Comparison of hospitalization variables among different study groups.

	Group A (n= 20)	Group B (n= 20)	p value
ICU stay (days)	2.35 ± 0.59	3.10 ± 1.17	0.014

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mean ± SD			
Hospital stay (days) mean ± SD	**6.40 ± 0.88**	**8.60 ± 1.98**	**<0.001**
Mechanical ventilation (hrs.) mean ± SD	**12.35 ± 19.82**	**23.50 ± 39.06**	**0.003**

Data are expressed as mean ± SD. p> 0.05= not significant.

 # Mann-Whitney test.

Table (7): Morbidity and mortality in the two studied groups.

	Group A (n= 20)	Group B (n= 20)	p value
Mortality	**1 (5.0%)**	**2 (10.0%)**	**1.000***
Morbidity:			
AF	**4 (20.0%)**	**6 (30.0%)**	**0.465***
Infection	**6 (30.0%)**	**6 (30.0%)**	**1.000***
MI	**0 (0.0%)**	**1 (5.0%)**	**1.000***
Inotropes	**12 (60.0%)**	**15 (75.0%)**	**0.311***
IABP	**1 (5.0%)**	**2 (10.0%)**	**1.000***

Data are expressed as number.

***p> 0.05= not significant**

<u>Follow up Data: Six months duration:</u>

Table (9): Comparison between NYHA Class pre- and post-operative among the two studied groups.

Variables	Group A	Group B	P value	Sig
	No-%	***No-%***		
Preoperative				
Class II	**9 (45%)**	**8 (40%)**	**0.749**	**NS**
Class III	**11(55%)**	**12 (60%)**		
Postoperative				
Class I	**13 (65%)**	**8 (40%)**	**0.025**	**S**
Class II	**6 (35%)**	**10 (60%)**		

NS= p> 0.05= not significant. S= p< 0.05= significant.

Table (10): Comparison between pre- and follow up (6 months) echocardiographic findings findings in group A.

	Preoperative	Postoperative	p value
LVED	5.84 ± 0.59	5.07 ± 0.57	< 0.001*
LVES	4.25 ± 0.55	3.94 ± 0.50	< 0.001*
EF	50.25 ± 8.06	53.42 ± 7.24	< 0.001*

Data are expressed as mean ± SD.
***p< 0.05= significant.**

Table (11): Comparison between pre- and follow up (6 months) echocardiographic findings in group B.

	Preoperative	Postoperative	p value
LVED	5.42 ± 0.67	5.46 ± 0.64	0.307
LVES	3.77 ± 0.85	3.79 ± 0.84	0.416
EF	52.95 ± 8.46	50.83 ± 8.64	0.146

Data are expressed as mean ± SD.
***p< 0.05= significant.**

Our results demonstrated that the LVED changed from 5.84±0.59 to 5.07±0.57, the LVES changed from 4.25±0.55 to 3.94±0.50 in the combined procedure group compared to LVED change from 5.42±0.67 to 5.46±0.64 and the LVES changed from 3.77±0.85 to 3.79±0.84 in the CABG alone group.

This finding is the basis of a greater postoperative ejection fraction in the combined procedure group. The EF increased significantly in the combined procedure group from 50.25% to 53.42% (P value< 0.001); while there was an insignificant decrease from 52.95% to 50.83% in the CABG alone group (P value = 0.146). The final EF (53.42% ±7.24% in the combined procedure group versus 50.83%±8.64% in the CABG alone group) was greater in the combined procedure group. (P=0.329)

Discussion:

In our study we tracked the course of moderate IMR After repairing it by posterior annuloplasty using flexible band versus observing it and performing CABG alone on the immediate and early outcomes of IHD patients undergoing CABG. We divided our patients into 2 equal groups.

The results of our study agree with the results of other studies; however, our sample size was smaller.

In our study, the preoperative systloic and diastolic dimensions were mildly higher in the CABG and mitral annuloplasty group. However, a significant reduction in dimensions occurred in that group. While in the CABG alone group dimensions were insignificantly higher than they were preoperatively.

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annulus and increase coaptation length with placement in the posterior annulus, sparing the anterior annulus and commissures. Two mitral leaflets can yield competent coaptation with reduction of the septo-lateral annular dimensions without reduction of the transverse annular dimensions, particularly in patients with functional MR. (Kim et al, 2015)

Although transverse reduction of the mitral annular dimensions is developed in the usual mitral annuloplasty, a transverse annular reduction is not likely to be a prerequisite for two leaflet coaptation. In their study, preoperative echocardiographic data showed that 45.9% of patients had grade +3 MR and 54.1% had +4 MR. Postoperatively, grade of MR significantly decreased to 0 in 81.4% of patients, +1 in 9.7% of patients, +2 in 4.2% and +3 in 1.4% of patients (P value < 0.001). (Kim et al, 2015)

The study concluded that PMA using a novel strip for placement in the posterior annulus showed a sufficient coaptation height secondary to reduction of the septo-lateral annular dimension and dynamic change of the dimensions. It can be considered as an alternative mitral annuloplasty technique with satisfactory results. (Kim et al, 2015)

Finally, and in consideration of our data, we believe that any differences between our study and other previous studies may in part reflect differences in the end points assessed , the duration of mitral regurgitation from initial diagnosis to trial enrollment, as well as methods used to assess the severity of mitral regiurgitation.

In addition to that our study was established on a relatively short period of 6 months. May be if Follow up continued for a longer period of time,

Smith and colleagues reported in their study a reduction in systolic and diastolic dimensions in both groups but only in the CABG and mitral annuloplasty group were the variations statistically significant (P=0.022 for diastolic and P=0.029 for systolic). This finding is the basis of better EF in the CABG with mitral annuloplasty group. Although the EF increased in both groups, (from 41.2% to 43.9% in the CABG alone group, Pvalue<.0001; and from 39.3%to 45.1%in the combined procedure group, P=0.006), the final EF was better in the combined procedure group. (P=0.041) (Smith et al, 2014)

Goland and colleagues reported that the LV function was improved in both groups postoperatively. However, the change in LV ejection fraction from the preoperative to the follow up period was insignificantly higher in the CABG only group; 3.4% relative (not absolute) increase versus 2.7% in the combined procedure group. (P=0.9) (Goland et al, 2009)

Fattouch and colleagues reported during the follow up period that in the CABG and mitral annuloplasty group LVEDD decreased from 59±8 mm preoperatively to 52±7 mm at 1-2 years after the operation (P value < 0.001). LVESD decreased from 45±8 mm to 37±5 mm at follow up (p value < 0.001). Mean LVEF was 42% ±10% preoperatively which decreased to 48%±8% at 1-2 years after operation (p value<0.001). (Fattouch et al, 2009)

Regarding the efficiency of flexible band posterior mitral annuloplasty technique, Kim and colleagues conducted a retrospective study on 74 patients who underwent posterior mitral annuloplasty over 4 years. They stated that the PMA strip was designed to lift the middle portion of the posterior

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Because of the retrospective nature of the study, patient consent was waived.

Competing interests

The authors declare that they have no competing interests.

References:

1. Smith PK, Puskas JD, Ascheim DD, Voisine P, Gelijns AC, Moskowitz AJ, Hung JW, Parides MK, Ailawadi G, Perrault LP, Acker MA, Argenziano M, Thourani V, Gammie JS, Miller MA, Pagé P, Overbey JR, Bagiella E, Dagenais F, Blackstone EH, Kron IL, Goldstein DJ, Rose EA, Moquete EG, Jeffries N, Gardner TJ, O'Gara PT, Alexander JH, Michler RE; Cardiothoracic Surgical Trials Network Investigators. Surgical treatment of moderate ischemic mitral regurgitation. N Engl J Med. 2014 Dec 4;371(23):2178-88. doi: 10.1056/NEJMoa1410490. Epub 2014 Nov 18. PMID: 25405390; PMCID: PMC4303577.
2. Penicka M, Linkova H, Lang O, et al. 2009. Predictors of improvement of unrepaired moderate ischemic mitral regurgitation in patients undergoing elective isolated coronary artery bypass graft surgery. Circulation 120:1474-1481.
3. Fattouch K, Guccione F, Sampognaro R, Panzarella G, Corrado E, Navarra E, Calvaruso D, Ruvolo G. 2009. POINT: Efficacy of adding mitral valve restrictive annuloplasty to coronary artery bypass grafting in patients with moderate ischemic mitral valve regurgitation: a randomized trial. J ThoracCardiovascSurg 138:278–285.
4. Gulack BC, Englum BR, Castleberry AW, Daneshmand MA, Smith PK, Perrault LP. Repair or observe moderate ischemic mitral regurgitation during coronary artery bypass grafting? Prospective randomized multicenter data. Ann CardiothoracSurg 2015;4(3):266-272. doi: 10.3978/j.issn.2225-319X.2015.04.02.

during which time differences in the durability of improvement in mitral regurgitation and any associated effects on clinical outcome may be apparent.

Conclusion

Adding mitral annuloplasty with flexible band to CABG improves mitral valve leaflet mobility and reduces mitral regurgitation recurrence in patients with moderate ischemic mitral regurgitation and is evidenced clinically by improvement in NYHA class.

Abbreviations

CABG Coronary Artery Bypass Grafting
COP: Cardiac output;
CPB: Cardiopulmonary bypass ;
EF: Ejection fraction
IABP: Intra-aortic balloon counter-pulsation;
IMR: Ischeamic mitral regurge
LV: Left ventricle;
MI: Myocardial infarction
MR: Mitral regurgitation;
MVR: Mitral valve repair
NYHA: New York Heart Association
RWMA: Regional wall motion abnormalities
TTE: Transthoracic echocardiography

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Authors' contributions

All authors participated in data collection and analysis. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the institutional ethical board.

Consent for publication

revascularization alone or with mitral valve repair: outcomes in patients with moderate ischemic mitral regurgitation. Tex Heart Inst J. 2009;36(5):416-24. PMID: 19876417; PMCID: PMC2763474.

10. Salik I, Lee L, Widrich J. Mitral Valve Repair. [Updated 2020 Jul 31]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. [Figure, Mitral valve anatomy. Image courtesy S Bhimji MD].
11. Campwala ZC, Bansal RC, Wang N, Razzouk A, Pai RG, et al. 2006. Mitral regurgitation progression following isolated coronary artery bypass surgery: frequency, risk factors, and potential prevention strategies. Eur J CardiothoracSurg 29:348-354.
12. Magne J., Sénéchal M., Dumesnil J.G., PibarotP.,Ischemic mitral regurgitation: a complex multifaceted disease. Cardiology 2008; 112:244-259.
13. Moten S.C., Das D., Mitral valve repair with a 3-dimensional rigid annuloplasty ring: initial experience using the St. Jude saddle annuloplasty ring. Heart Lung Circ 2009; 18:81. 10.1016/j.hlc.2008.11.043.
14. Kim JH, Kim KH, Choi JB, Kuh JH. Posterior mitral annuloplasty for enhancing mitral leaflet coaptation: using a strip designed for placement in the posterior annulus. J Cardiothorac Surg. 2015 Nov 13; 10:164. doi: 10.1186/s13019-015-0350-6. PMID: 26563309; PMCID: PMC4643521.

5. Zoghbi WA, Adams D, Bonow RO, Enriquez-Sarano M, Foster E, Grayburn PA, Hahn RT, Han Y, Hung J, Lang RM, Little SH, Shah DJ, Shernan S, Thavendiranathan P, Thomas JD, Weissman NJ. Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation: A Report from the American Society of Echocardiography Developed in Collaboration with the Society for Cardiovascular Magnetic Resonance. J Am SocEchocardiogr. 2017 Apr;30(4):303-371. doi: 10.1016/j.echo.2017.01.007. Epub 2017 Mar 14. PMID: 28314623.
6. Michler RE, Smith PK, Parides MK, Ailawadi G, Thourani V, Moskowitz AJ, Acker MA, Hung JW, Chang HL, Perrault LP, Gillinov AM, Argenziano M, Bagiella E, Overbey JR, Moquete EG, Gupta LN, Miller MA, Taddei-Peters WC, Jeffries N, Weisel RD, Rose EA, Gammie JS, DeRose JJ Jr, Puskas JD, Dagenais F, Burks SG, El-Hamamsy I, Milano CA, Atluri P, Voisine P, O'Gara PT, Gelijns AC; CTSN. Two-Year Outcomes of Surgical Treatment of Moderate Ischemic Mitral Regurgitation. N Engl J Med. 2016 May 19;374(20):1932-41. doi: 10.1056/NEJMoa1602003. Epub 2016 Apr 3. PMID: 27040451; PMCID: PMC4908820.
7. Chan KM, Punjabi PP, Flather M, et al. Coronary artery bypass surgery with or without mitral valve annuloplasty in moderate functional ischemic mitral regurgitation: final results of the Randomized Ischemic Mitral Evaluation (RIME) trial. Circulation 2012; 126:2502-10.
8. Kang DH, Kim MJ, Kang SJ, Song JM, Song H, Hong MK, Choi KJ, Song JK, Lee JW. Mitral valve repair versus revascularization alone in the treatment of ischemic mitral regurgitation. Circulation. 2006 Jul 4;114(1 Suppl):I499-503.
9. Goland S, Czer LS, Siegel RJ, DeRobertis MA, Mirocha J, Zivari K, Kass RM, Raissi S, Fontana G, Cheng W, Trento A. Coronary