https://doi.org/ 10.33472/AFJBS.6.10.2024.4528-4536

AFJBS African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Repair Versus Replacement by Prosthetic valve in ischemic mitral patients

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Article History
Volume 6,Issue 10, 2024
Received:29 Apr 2024
Accepted : 26 May 2024
doi: 10.33472/AFJBS.6.10.2024.4528-4536

Abstract

Background: Chronic secondary mitral regurgitation (MR) has no definitive treatment because MR is only one component of the disease and restoration of mitral valve competence does not cure the condition. This study aimed to review recent advances in understanding of ischemic mitral regurge pathogenesis and to examine the numerous surgical techniques.

Results: This was a retrospective non-randomized study conducted on 254 patients with coronary artery disease who underwent surgical procedures for the management of ischemic mitral regurge from January 2013 to December 2018. There was no statistically significant difference between two groups as regards in hospital mortality and late mortality p= 0.812, 0.760 respectively, there was significant improvement regarding the cardiac function examined by Ejection fraction (EF %) and the grade of mitral regurge p= 0.001 comparing pre-operative with post-operative status in repair group, there was a significant improvement regarding the cardiac function examined by Ejection fraction (EF %) comparing pre-operative with post-operative status and the grade of mitral regurge also showed no regurge p= 0.001 in replacement group.

Conclusion: Both treatment methods significantly improve LV contractility, as shown by improvement in NYHA class in both groups and increase in EF%. MVR offers a better choice in cases with complex MR when repair seems unachievable.

Keywords: Prosthetic valve, ischemic mitral patients, repair, replacement

Background

Uncorrected IMR (Ischemic Mitral Regurge) Mortality is high, with 35% of patients alive at 5y with severe mitral regurge, 44% alive with moderate mitral regurge, and 61% alive without MR [1].

Although treating options and surgical modalities for treating ischemic heart disease are present nowadays with more clear techniques, the resultant mitral disease shows controversial options for treatment [2].

Chronic secondary MR has no definitive treatment because MR is only one component of the disease and restoration of valve competence does not cure the condition. Therefore the debate over the best criteria for defining severe secondary MR remains[3].

When you replace or repair the valve, you stop continuous ventricular overload and thus stop pathological remodeling, which ultimately results in better elliptical geometry [4].

The aim of this study was to review recent advances in understanding of ischemic mitral regurge pathogenesis and to examine the numerous surgical techniques that are currently being used to treat this complex problem in order to determine which patients benefit from repair and which patients benefit from valve replacement and also to quantify the durability of valve repair.

Methods

This was a retrospective non-randomized study conducted on 254 patients with ischaemic heart disease who underwent surgical procedures for the treatment of ischemic mitral regurge from January 2013 to December 2018. Patients were divided into two groups: Group A: 128 patients underwent mitral valve repair and Group B: 126 patients underwent mitral valve replacement.

Our inclusion criteria were cases with moderate or severe ischemic mitral incompetence, The etiology of mitral incompetence was verified to be ischemic in origin by all of the following: The presence of a frank history and coronary angiographic evidence of coronary heart disease, the lack of any history of valvular heart disease preceding the onset of coronary heart disease, the presence of structurally normal mitral valve leaflets and chordae tendinae on preoperative echocardiography; and the lack of features associated with rheumatic, degenerative, or infectious valvular disease.

Our exclusion criteria were cases with papillary muscle rupture as these present acutely and in a severe degree of cardiac decompensation, Patients presenting in cardiogenic shock, Patients with associated left ventricular aneurysm or ischaemic VSD, Patients with valvular heart disease **-** other than ischemic mitral regurgitation- requiring surgical intervention at the time of operation, Patients who had previous CABG or valvular operation and Patients with less than 3+ mitral regurgitation.

All Patients were subjected to the following**;** history taking, physical examination, laboratory investigation, radiological investigation, ECG, and Echocardiography. A complete echocardiography was done for all cases with the following parameters recorded: LAD, LVEDD, LVESD, FS%, EF%, RWMA, and MR: grade and pathology from which the following data was collected to be included in the study: Ejection fraction (EF %) and Grade of mitral regurge.

Intra-operative steps and the anesthetic procedure were the same for all cases. It consisted of fentanyl 5-10µg/kg and endotracheal intubation was done by pancronium 0.02 mg/kg and a supplemented hypnotic dose of propofol 0.5-1 mg /kg. After complete muscle relaxation, the trachea was intubated orally with an endotracheal tube of the appropriate size (single lumen tube was used in all patients). Inhalation isoflurane 0.5-1 % was used to maintain anesthesia in all patients.

The surgical technique for all the patients in the study group were put in the supine position. After hemostasis of the sternum, harvesting of the internal mammary artery (IMA) and/or harvesting of the great saphenous vein (GSV) began. A mattress 3-0prolene suture was placed in the ascending aorta and a needle-bearing catheter was placed in the ascending aorta and connected to the cardioplegia line. Initiation of cardiopulmonary bypass (CPB) followed. Maintaining the heart beating, we dissected the target vessels, identified the planned sites for distal anastomoses, and prepared the Left IMA. Tackling the valve followed. We performed a left atrial incision parallel to the interatrial groove. The chordae were examined to determine their length and potential for rupture. Finally, the papillary muscles were evaluated for elongation or rupture as a result of the infarction. Annuloplasty was achieved by under-sizing of the annulus (usually 2 sizes down), using a Carpentier mitral annuloplasty ring, or by formaldehyde fixed pericardial strip. Additional valve repair techniques included edge-to-edge repair and chordal transfer. The patient was subjected to valve replacement when a competent repair seemed unachievable. We used 2-0 pledgetted (when necessary) ethibond everting sutures passing from the atrial to the ventricular sides of the annulus and then to the sewing ring of the prosthesis. Our strategy was always to preserve as much as possible of mitral leaflets and subvalvular apparatus. The atrium was then closed usually using 3-0 polypropylene sutures. We routinely used 100mg of lidocaine and 2 gm of Mg with aortic unclamping. A side occlusion clamp was placed on the aorta after the heart regained its preoperative rhythm. The fatty tissue overlying the ascending aorta is removed, an arteriotomy is created, and a punch is used to create a circular aortotomy. Gradual weaning from CPB with stepwise diminution of pump flow, monitoring the cardiac function, the pulmonary arterial pressure, systemic blood pressure, and the CVP, in synchronization with the anaesthesiologist and the perfusionist concluded the bypass. Hemostasis and sternal closure with mediastinal and pleural drains placed in the anterior mediastinum and any opened pleura, with closure in anatomical layers, followed by transferral of the patient to the ICU.

Results

There was no difference of statistical significance between two groups as regards age and gender p=0.885, 0.185 respectively. (Table 1)

The same was found between two groups as regards intraoperative findings (Bypass time, XC time) p= 0.384, 0.840 respectively. (Table 2)

There was no statistically significant difference between two groups as regards post-operative complications (Neurological, infective renal, and GI) and multisystem failure p= 0.226, 0.333, 0.130, 0.31, 0.534 respectively. (Table 3)

There was no statistically significant difference between two groups as regards in hospital mortality and late mortality p= 0.812, 0.760 respectively. (Table 4)

There was significant improvement regarding the cardiac function examined by Ejection fraction (EF %) and the grade of mitral regurge p= 0.001 comparing pre-operative with post-operative status in repair group. Comparing the dyspnea status it showed shifting from grades 2 and 3 preoperatively to grades 1 and 2 postoperatively. (Table 5)

There was a significant improvement regarding the cardiac function examined by Ejection fraction (EF %) comparing pre-operative with post-operative status and the grade of mitral regurge also showed no regurge p= 0.001 in replacement group. Dyspnea status showed shifting from grades 2 and 3 preoperatively to grades 1 and 2 with only 3 patients suffering from grade 3 postoperatively. (Table 6)

Table (1): Demographic data of the two studied groups.

	Repair (n= 128)	**Replacement (n= 126)**	**P value**
Age (yrs.)	56.88 ± 6.89	56.75 ± 7.59	0.885 (NS)
Gender			
Female	21 (16.4%)	29 (23.0%)	0.185(NS)
Male	107 (83.6%)	97 (77.0%)	

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

Table (2): Intraoperative findings in the two studied groups.

	Repair(n= 128)	**Replacement (n= 126)**	**P value**
Bypass time	160.01 ± 58.42	153.27 ± 64.52	0.384(NS)
XC time	110.04 ± 32.41	108.97 ± 50.04	0.840(NS)
Failed to come off bypass	1 (0.8%)	1 (0.8%)	1(NS)
High intropic support	16 (12.5%)	8 (6.3%)	0.205(NS)
IABP	12 (9.4%)	9 (7.1%)	0.90(NS)
Minimal support	80 (62.5%)	91 (72.2%)	0.41(NS)
No support	19 (14.8%)	17 (13.5%)	0.35(NS)

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

Table (3): Post-operative complications in the two studied groups.

	Repair (n= 128)	**Replacement (n= 126)**	**P value**
Neurological complications (delayed recovery)	4 (3.1%)	8 (6.3%)	0.226 (NS)
Infective complications			
Deep wound infection	4 (3.1%)	5 (4.0%)	0.333 (NS)
Superficial chest-wound infection	0 (0.0%)	2 (1.6%)	
Renal complications (severe renal impairment requiring dialysis or UF)	8 (6.2%)	3 (2.4%)	0.130 (NS)
GI complications	0 (0.0%)	1 (0.8%)	0.313(NS)
Multisystem failure	14 (10.9%)	17 (13.5%)	0.534(NS)

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

Table (4): Mortality in the two studied groups.

	Repair (n= 128)	**Replacement (n= 126)**	**P value**
In hospital mortality	15 (11.7%)	16 (12.7%)	0.812(NS)
Mortality			
Died in hospital	15 (11.7%)	16 (12.7%)	0.760(NS)
Died late	27 (21.1%)	22 (17.5%)	

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

Table (5): Comparison between pre- and post-operative findings in repair group.

	Pre-operative	**Post-operative**	**P value**
EF (%) (n=86)	47.67 ± 13.00	57.28 ± 13.34	0.001*(S)
Mitral regurge grade (n= 86)	3.48 ± 0.50	1.62 ± 0.86	0.001*(S)
Dyspnea NYHA(n=128)			
NA#	0 (0.0%)	42 (32.8%)	----
NYHA 1	0 (0.0%)	36 (28.1%)	
NYHA 2	61 (47.7%)	50 (39.0%)	
NYHA 3	67 (52.3%)	0 (0.0%)	

Data are expressed as mean ± SD or number (%). *p≤ 0.05= significant. #NA= not applicable (i.e. mortality patients)

Table (6): Comparison between pre- and post-operative findings in replacement group.

	Pre-operative	**Post-operative**	**P value**
EF (%) (n= 88)	47.28 ± 12.01	56.50 ± 12.27	0.001*(S)
Mitral regurge grade (n= 88)	3.45 ± 0.50	0.00 ± 0.00	0.001*(S)
Dyspnea NYHA (n= 126)			
NA#	0 (0.0%)	38 (30.1%)	----
NYHA 1	0 (0.0%)	53 (42.0%)	
NYHA 2	47 (37.3%)	32 (25.3%)	
NYHA 3	79 (62.7%)	3 (2.4%)	

Data are expressed as mean ± SD or number (%). *p≤ 0.05= significant. #NA= not applicable (i.e. mortality patients)

Discussion

The mean age at surgery in our study was 56.88±6.89 in group I and 56.75±7.59 in group II, with no significant differences, and 204 males (80%) in the entire cohort.

Maltais and colleagues looked into the surgical management of mitral incompetence in cases who had both ischemic cardiomyopathy and ischemic mitral regurgitation at the same time. The mean age of their patient cohort was 70.1±9.1 years (range 43–91 years), and 261 patients were male (67 %). All cases underwent CABG surgery. In 302 patients (78 %), MV repair was performed; in 85 patients, MV replacement was performed (22 %) [5].

Both groups had most of the cases in the NYHA class II-III (NYHA class III is 52.3 % in group I and 79 % in group II). This is consistent with the findings of other authors; Lam et al. reported that nearly 60% of their patients were in NYHA class III. However, it was slightly higher in other studies, such as Lam and colleagues', who classified approximately 73% of patients as NYHA class II-III, and Tolis et al., who classified approximately 75% of patients as NYHA class II-III [6-7].

The mean EF was 47.4 % in group I and 47.13 % in group II, which was nearly identical to Chan et al. but slightly higher (40.5 % for repair and 42.4 % for replacement group)[8]. However, higher than Lorusso et al (35.8%.'S for repair and 36.6% for replacement) [9].

All cases underwent conventional coronary bypass grafting through a classic midline sternotomy under normothermic CPB with intermittent antegrade cold-blood cardioplegia. For every patient, the bypass grafts used were the internal mammary artery and the long saphenous vein. All distal anastomoses were performed during a single aortic crossclamping. The proximal graft anastomoses were performed during side clamping.” [10].

128 patients in our study had MVRp. The technique most frequently used was annuloplasty. Mostly received complete annuloplasty (using Carpentier- Edwards rings), always downsizing by 2 measurements. In their study reviewing the data of 482 patients, Gillinov and his group from the Cleveland Clinic Foundation (CCF), reported: “The most common repair technique was mitral annuloplasty (98%)” [11].

The mean size of the annuloplasty rings used for the 128 patients who received complete annuloplasty was 28.23 ± 1.8 mm (range from 26 – 32 mm).

Bolling et al. pioneered performing an undersized annuloplasty to treat ischemic MR in 1995 by placing rings that were one or two sizes less than the measured interregional length. According to Bolling and colleagues, “an undersized annuloplasty may result in reversal of ventricular remodeling over time.” [12].

126 Patients in our study had mitral valve replacement, all with mechanical valves. The mean size of the mitral prosthesis used was 28.1 ± 1.67 (range 27-31).

Milano and colleagues stated that while valve replacement procedures have decreased significantly over the last few years, a small but consistent subgroup of patients has continued to receive replacement. This cohort could have had unique mitral characteristics that prompted the surgeon to forego repair and opt for replacement. Because extensive tethering of the posterior leaflet may not be easily overcome with full annuloplasty rings, surgeons may have chosen the replacement strategy in these instances. The observation of more severe MR in the replacement group is in line with this possibility [13].

In most patients with annular dilation, a repair was performed, while prosthetic replacement was predominant in patients with altered leaflet motion [14].

Although our basic technique involves posterior leaflet preservation, some patients had their both leaflets removed in order to allow for bigger valve to be implanted.

The mean cross clamp and total CPB times were 110.04 ± 32.41 min & 160.01 ± 58.42 min in the repair group, compared to 108.97 ± 50.04 & 153.27 ± 64.52 for the replacement group. With no significant changes between both.

Magne et al reported ischemic time and CPB time were 100 ± 29 & 134 ± 42 for MVRp compared to 99 ± 32 and 137 ± 42 & for MVR. Aortic cross-clamp time was 105 ± 42 minutes in the repair group and 98 ± 39 minutes in the replacement group (P = 0.158) [15].

CPB time was 136 ± 50 & 129 ± 41 for the repair and replacement groups, respectively [16].

The mean cardiopulmonary bypass time was 124.4 ± 47.5 minutes (range, 30–340), and the mean aortic cross-clamp time was 82.2 ± 31.6 minutes (range, 16.5–46.4) [5].

Our post-operative complications as regards IABP need, acute renal failure, arrhythmias, neurological complications, reoperations, and multisystem failure; show no significant differences; although ICU stay was significantly less in the replacement group; which compares favorably with results obtained by Calafiore and his colleagues [17].

We had 31 cases of hospital mortality in the series, 15 in the mitral repair group, and 16 in the other group, making perioperative mortality 11.7% for the repair group and 12.7% for the replacement group. The perioperative for the group as a whole is 12.2%. We understand that because of the relatively small number of cases in our study, these values may not be very reflective, yet operative mortality in our study was comparable with that in most reported series and compares favorably with the results published by Magne et [15].

"Overall operative mortality was 13.5% (n=50) in the whole cohort. Operative mortality was significantly lower in patients who underwent MVRp (9.7%) than in those with MVR (17.4%)." [15].

"Fifty-four patients (11%, confidence interval 9%-13%) died during their hospital stay. Operative mortality rate (including those dying within 30 days) was 13% (confidence interval 11%-14%)" [11].

Our results though, compares unfavorably with Qui et al "Early mortality was 3.2% (7 of 218 patients). Three of them had undergone MV repair (2.7%) and four had undergone MV replacement (3.8%; P = 0.647) [16].

Chan et al "Thirty-day mortality across both groups of patients in the study was 4% (5 of 130 patients; 2 [3%] in the repair group & 3 [5%] in the replacement group), and was not significantly different in the two groups" [4].

100% of the patients in the replacement group in our study received mechanical valves. Some would argue that biological valves would offer an intermediate solution between repair and mechanical valves, with lower risk of valve related events (thrombo-embolism, PVE, etc.), and better freedom from recurrent/ residual MR, particularly in a category of patients where long term survival rates is not so high. Yet with patients presenting at younger ages, better follow-up and adjustment of postoperative medical treatment, we expect survival rates would improve, and feel that the placement of mechanical valves in some cases would be completely justified.

"It has been suggested that only a bioprosthesis should be implanted for chronic IMR, due to the patients' short life expectancy. However, the present authors feel justified in choosing a mechanical prosthesis for younger patients based upon the long-term survival observed herein for prostheses (73.4% at five years)." [14].

The main finding of the our study was that long-term survival is dependent upon preoperative left ventricle condition not the type of procedure used, and that the LVEF and PAP are independent risk factors. A low LVEF has already been described as major risk factor, but a high PAP is a relatively new finding. Some reports have focused on NYHA class III [14].

Conclusions

Both methods of treatment result in a significant improvement of left ventricular contractility as shown by improvement in NYHA class in both groups and increase in EF%, but no significant differences were found between the two ways of surgical tackling of ischemic mitral regurge along short or long terms; although MVR offers a better choice in cases with complex MR, when repair seems unachievable.

List of Abbreviations

- Ischemic Mitral regurgitation (IMR)
- Ejection fraction (EF)
- Ventricular septal defect (VSD)
- Coronary artery bypass grafting (CABG)
- Left anterior descending artery (LAD)
- Left ventricular end-diastolic diameter (LVEDD)
- Left ventricular end-systolic diameter (LVESD)
- Fractional Shortening (FS)
- Resistance Welding Manufacturing Alliance (RWMA)
- Internal mammary artery (IMA)
- Great saphenous vein (GSV)
- Cardiopulmonary bypass (CPB)
- Central venous pressure (CVP)
- Intensive care unit (ICU)
- Gastrointestinal (GI)
- Mitral valve (MV)
- Cleveland Clinic Foundation (CCF)
- Mitral valve repair (MVRp)
- New York Heart Association (NYHA)

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