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Comparison between the Outcome of Mitral Valve Repair Versus Replacement among Patients with Ischemic Mitral Regurgitation Undergoing Revascularization

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Abstract

Background: Ischemic mitral regurgitation (IMR) frequently occurs as a complication following a myocardial infarction (MI). **Aim and objectives:** To compare the results of mitral valve repair and replacement in cases with ischemic mitral regurgitation who receive revascularization**. Patients and methods:** This analytic comparative cross-sectional research was performed on 88 cases with ischemic mitral regurgitation attending the department of cardiothoracic surgery at Suez Canal University Hospital in Ismailia and at Nasser Institute in Cairo. Cases were separated into 2 groups: **Group I:** 44 cases received mitral valve repair and **Group II:** 44 cases received mitral valve replacement. **Results:** 3 cases in the mitral valve repair group showed early mortality and 8 patients showed late mortality. While 6 patients in the mitral valve replacement group showed early mortality, 12 patients showed late mortality. The mean preoperative EF in the mitral valve repair group was 48.86 ± 13.78, and the median was 49 (0.46–82). While in the MVR group, the mean preoperative EF was 46.04 ± 6.08. The data showed statistically significant variance among both groups regarding early mortality and late mortality and a highly statistically significant difference regarding postoperative ejection fraction (EF). **Conclusion:** In our study, mitral valve repair may be comparable to MVR regarding long-term survival and early mortality. Nevertheless, one year after the mitral valve repair operation, there was a higher risk of persistent or recurrent mitral regurgitation.

Key words: IMR, Mitral valve repair, Myocardial infarction, Mitral valve replacement.

Introduction

IMRi is a complication that occurs frequently following myocardial infarction (MI). Around fifty percent of cases acquire ischemic mitral regurgitation following MI, and further than ten percent of them suffer moderate or severe IMR. A poor prognosis is predicted by the presence of IMR. Prior studies have demonstrated that a higher severity of ischemic mitral regurgitation is correlated with reduced long-term survival. The mortality rate of cases with even moderate IMR is seventeen percent greater than that of those without it [(1)].

The optimal surgical therapy for moderate ischemic mitral regurgitation with concomitant coronary artery illness is also an issue of controversy. In a retrospective investigation, we investigated the real-world surgical results of cases with coronary artery illness & ischemic mitral regurgitation who underwent concomitant coronary artery bypass grafting and mitral valve surgeries [(2, 3)].

Presently, the most performed surgical technique for the management of cases with severe ischemic MR is restrictive mitral valve annuloplasty. Nevertheless, this procedure has been related with a ten percent to twenty percent incidence of persistent MR in the first period following surgery and a fifty percent to seventy percent incidence of recurrent MR at five years. Additionally, the presence of recurrent or persistent MR is related to a greater frequency of cardiac events and a lower survival rate [(4,5)].

Mild systemic hypothermia (32 oC), cardiopulmonary bypass (CPB), as well as antegrade crystalloid cardioplegia, have been utilized during all surgeries, which were conducted during midline sternotomy. The decision to conduct repairs or replacements was left to the discretion of the personal surgeon. A concomitant coronary bypass procedure was implemented on primary coronary branches or vessels that exhibited luminal stenosis of over seventy percent on a preoperative coronary angiogram [(6)].

An elevated operative death rate and poor long-term survival are correlated with the surgical management of ischemic mitral regurgitation. The selection of the most suitable surgical therapy to optimize survival is complicated by the absence of randomized studies of valve repair versus valve replacement, a lack of long-term information to compare alternatives, & inconsistent categorization schemes for the entity [(6)].

The purpose of the work was to compare the outcomes of mitral valve repair against replacement among cases with ischemic mitral regurgitation undergoing revascularization.

Patients and methods

This analytic comparative cross-sectional research was performed on 88 cases with ischemic mitral regurgitation attending the department of cardiothoracic surgery at Suez Canal University Hospital in Ismailia and at Nasser Institute in Cairo. Cases were separated into two groups: **Group I:** 44 cases received mitral valve repair and **Group II:** 44 cases received mitral valve replacement. **Inclusion criteria:** cases among the ages of 40 & 70, ischemic mitral regurgitation cases who will undergo CABG and patients with a history of diabetes or hypertension.

Exclusion criteria: cases who had had previous mitral valve operation or previous mitral valve balloon valvoplasty (MVBV), cases with non-ischemic nature of their mitral valve disease (degenerative, rheumatic, etc.), cases with valvular heart illness other than ischemic mitral regurgitation requiring surgical intervention at the time of operation and cases with less than grade 2 mitral regurgitations.

Sample size:

The sample size will be estimated based on the following equation:

[(7)]

$$n = \left[\frac{Z_{\alpha/2} + Z_{\beta}}{P_1 - P_2}\right]^2 (p_1 q_1 + p_2 q_2)$$

Where
n= sample size
$Z_{\alpha/2}$ = 1.96
Z_{β} = 0.84
p_1 = 50.6% Prevalence of patients with IHD and severe IMR, who had GABD for revascularization and mitral valve repair and had complete resolution of IMR in the experimental group [(8)].
p_2 = 51.3% Prevalence of patients with IHD and severe IMR, who had GABD for revascularization and mitral valve replacement and had complete resolution of IMR in the control group [(8)].
q = 1-P
According to the previous calculations, and after adding 10% drop-out rate, a total of 44 patients per group was required.

Ethical considerations:

The investigation ethics committee of the faculty of medicine at Suez Canal University & the cardiac surgery department at Nasser Institute authorized the research protocol. The operation was conducted with the informed consent of the cases participating in the current investigation.

Methods:

All the patients were evaluated by the following parameters: medical history & clinical examination**, i**nvestigations**,** chest radiography (CXR) lateral and postero-anterior view**,** electrocardiogram (ECG), echocardiography**, c**ardiac catheterization, and carotid duplex.

Operative management: All patients were done under general anesthesia.

Surgical technique:

All the cases in the study group were in the supine position. Median sternotomy is the incision of choice in all cases. After hemostasis of the sternum, harvesting of the internal mammary artery (LIMA) and/or harvesting of the great saphenous vein (GSV) began. The distal ascending aorta is consistently selected as the site of arterial cannulation, with bicaval cannulation performed on the venous side. A needle-bearing catheter is inserted into the ascending aorta & connected to the cardioplegia line, and a 2-0 braided polyester suture is inserted into the aorta. Initiation of cardio-pulmonary bypass (CPB) followed. Maintaining the heartbeat, we dissected over the target vessels, identified the planned sites for distal anastomoses and prepared the LIMA. The aorta is cross clamped, with an infusion of antegrade cold blood cardioplegia, starting at an initial dose of 15 ml/kg, together with systemic mild hypothermia between 28 and 32 °C, with or without the application of topical ice slush for myocardial protection. We started by performing the distal anastomoses first, then the valve procedure, whether replacement or repair and finally the proximal anastomoses. We performed a left atrial incision parallel to the interatrial groove. Dilatation and deformity of the mitral annulus are assessed in a systematic manner. Leaflets and leaflet motions are investigated. Leaflet pliability and leaflet prolapse, or restriction, have been evaluated using hooks. The chordae have been inspected to assess their length or rupture. Lastly, the papillary muscles have been evaluated for elongation or rupture because of infarction. Annuloplasty was achieved by under-sizing the annulus, using a Carpentier-Edwards mitral annuloplasty ring, or by using a using a formaldehyde-fixed pericardial string, Dacron patch, or gortex patch. Additional mitral valve repair includes edge-to-edge repair & chordal transfer. The patient was subjected to mitral valve replacement when a competent repair seemed unachievable or in acute situations. We used 2-0 pledgetted (when necessary) ethibond everting sutures passing from the atrial to the ventricular sides of the annulus, then to the sewing ring of the prosthesis. Our strategy was to preserve as much as possible of valve leaflets and subvalvular apparatus. In the replacement group, the anterior leaflet is excised with preservation of the posterior leaflet. Then the mitral valve sizer is applied to know the measurement of the valve, & the mitral valve is inserted, whether mechanical or tissue valve, using interrupted ethibond everting sutures passing from the atrial to the ventricular sides of the annulus, then to the sewing ring of the valve. The atrium was then closed using 3-0 polypropylene sutures. Gradual weaning from the CPB with stepwise diminution of pump flow, monitoring the appearance of the heart, the pulmonary artery pressure, systemic blood pressure, and the CVP in synchronization with the anesthesiologist and the perfusionist, concludes the bypass. An evaluation of the competence of mitral repair using TEE will be done. We accept the presence of a mild degree of regurgitation. Inotropic support is started whenever needed by that time. Hemostasis and closure of the sternum with mediastinal and pleural drains placed in the anterior mediastinum and any opened pleura, with closure in anatomical layers, followed by transfer of the patient to the ICU.

Postoperative assessment:

Patients were followed for the period of their hospital stay and at regular intervals thereafter. The follow-up period was divided into two phases: In-hospital follow-up corresponds to the period of hospital stay postoperatively (in the ICU and the ward). Late follow-up corresponds to the rest of the follow-up duration. The following data is recorded.

Statistical analysis

SPSS 26.0 for Windows (SPSS Inc., Chicago, IL, USA) was utilized to acquire, tabulate, and conduct statistical analyses of all data. Numbers and percentages have been utilized to describe qualitative data. Range (maximum & minimum), standard deviation, mean, and median were employed to describe quantitative data. All statistical comparisons have been two-tailed and statistically significant. A P-value of 0.05 or lower indicates a significant distinction; a P-value of 0.001 or lower indicates a highly significant distinction; and a P-value of 0.05 or higher indicates a non-significant distinction. The tests that were implemented included: The Chi-square (X^2) test of significance was utilized to compare the proportions of qualitative parameters, while the independent T-test was utilized to compare parametric quantitative data among two separate groups.

Results

A statistically insignificant distinction was observed among both groups regarding age and gender **(Table 1)**.

A highly statistically significant distinction was observed among both groups regarding the mean CPB time (min), the statistically significant difference regarding the to the mean AXC time (min) and the statistically insignificant variance regarding the number of grafts **(Table 2)**.

A statistically significant distinction was observed among groups regarding reopening for bleeding and new-onset AF **(Table 3)**.

There was a was a highly statistically significant distinction observed among both groups regarding post-operative ventilator (hrs), LOIS (days), and LOHS (days) **(Table 4)**.

A statistically insignificant distinction was observed among both groups regarding postoperative hemoglobin and creatinine **(Table 5)**.

There was a statistically significant variance observed among both groups regarding early mortality and late mortality and a highly statistically significant difference regarding postoperative ejection fraction (EF) **(Table 6)**.

Table (1): Comparison among both groups as regard general characteristics

	Group I (number = forty-four)	**Group II (number = forty-four)**	P-value
Age, years			0.24
Mean ± standard deviation	55.7 ± 8.51	53.89 ± 9.54	
Median (Minimum - Maximum)	55 (36-71)	54 (30-71)	

Gender			0.22
Male	35 (79.5%)	37 (84%)	
Female	9 (20.4%)	7 (16%)	

T: Two-Sample Independent t Test or Chi square, p value >0.05: non-significant, p value <0.05 significant, Data are presented as frequency (%) unless otherwise mentioned, Median (Minimum - Maximum)

Table (2): Comparison among both groups regarding to Operative details.

	Group I (number = forty-four)	Group II(number = forty-four)	P-value
Mean CPB time (min)			<0.001
Mean ± SD	143.48 ± 32.63	159.49 ± 58.25	
Median (Minimum - Maximum)	130 (100-230)	160 (90-390)	
Mean AXC time (min)			0.04
Mean ± SD	94.55 ± 25.22	98.73 ± 27.35	
Median (Minimum - Maximum)	90 (70-180)	95 (58-173)	
Number of grafts			0.22
Mean ± SD	2.84 ± 0.81	2.62 ± 0.91	
Median (Minimum - Maximum)	3 (1-5)	3 (1-4)	

Table (3): Comparison among both groups regarding to post-operative details.

	Group I (number = forty-four)	Group II(number = forty-four)	P-value
Postoperative IABP	11 (25%)	17 (38.63%)	0.4
Reopen for bleeding	6 (13.6%)	15 (34%)	<0.001
New-onset AF	12 (27.27%)	18 (41%)	0.04
ARF requiring haemodialysis	0	0	-
TND (ICU syndrome)	1 (2.2%)	0	0.88
PND (new CVA, hypoxia)	0	1 (2.2%)	0.2

Table (4): Comparison among both groups regarding to post-operative ventilator, LOIS and LOHS details.

	Group I (number = forty-four)	Group II(number = forty-four)	P-value
Post-operative ventilator (hrs)			<0.001
Mean ± SD	22.14 ± 19.44	22.33 ± 10.88	
Median (Minimum - Maximum)	17 (6-120)	20 (6-48)	
LOIS (days)			<0.001
Mean ± SD	2.41 ± 1.32	3 ± 2.11	
Median (Minimum - Maximum)	2 (1-7)	2 (1-10)	
LOHS (days)			<0.001
Mean ± SD	8.52 ± 6.27	10.58 ± 13.6	
Median (Minimum - Maximum)	7 (2-42)	8 (1-83)	

Table (5): Comparison among both groups regarding post-operative laboratory investigation.

	Group I (number = forty-four)	Group II (number = forty-four)	P-value
Postoperative haemoglobin			0.44
Mean ± SD	1.01 ± 0.14	1.04 ± 0.17	
Median (Minimum - Maximum)	1 (0.8-1.3)	1 (0.7-1.4)	
Postoperative Creatinine			0.25
Mean ± SD	10.68 ± 1.25	10.29 ± 0.92	

Median (Minimum - Maximum)	11 (9-14)	10 (9-12)	

Table (6): Comparison among both groups regarding to early and late mortality.

	Group I (number = forty-four)	Group II (number = forty-four)	P-value
Early mortality	3	6	0.01
Late mortality	8	12	0.02
Postoperative EF			<0.001
Mean ± SD	48.86 ± 13.78	46.04 ± 6.08	
Median (Minimum - Maximum)	49 (0.46-82)	47 (29-68)	

Discussion

A statistically significant distinction was observed among both categories in terms of age and sex. a statistically significant variance in age and gender between the two groups.

Lee et al. [(6)] looked at eight years of operating therapy data in people with IMR to see how well mitral valve repair worked compared to replacement along with coronary artery bypass grafting (CABG). The study included a total of twenty-two cases, comprising twenty-one men and one woman**.** The average age was 62.1±11.4 years. The cases were categorized into two groups, one undergoing mitral valve repair & the other undertaking valve replacement, to investigate the potential impact of these two surgical methods on long-term survival & early mortality. The baseline features of both groups were statistically similar, except for sex. both groups illustrated a highly statistically significant difference in mean CPB time (min), post-operative ventilator (hrs), LOIS (days), and LOHS (days). Additionally, there was a statistically significant difference in mean AXC time (min), reopening for bleeding, and new-onset AF. Nevertheless, there a statistically significant variation was observed in the number of grafts.

Lee et al. [(6)] exhibited that a statistically insignificant distinction was observed among groups regarding post-operative ventilators, LOIS, and LOHS.

Our research demonstrated that a statistically insignificant distinction was observed among two groups regarding postoperative haemoglobin and creatinine. Three patients in the mitral valve repair group showed early mortality, while eight patients showed late mortality. While six patients in the MVR group showed early mortality, 12 patients showed late mortality. The mean preoperative EF in the mitral valve repair group was 48.86 ± 13.78, and the median was 49 (0.46–82). In the MVR group, the mean preoperative EF was 46.04 ± 6.08. The data showed a significant difference between groups.

De Bonis et al. [(9)] reported that the repair group had significantly greater survival rates than the replacement group. However, recurrent or persistent moderate (2+/4+) MR was documented in fourteen percent of cases, and severe MR was observed in seven percent of the cases at the two-year monitoring.

Kopjar et al. [(10)], in a meta-analysis involving five observational investigations and four RCTs, also determined that concomitant CABG and mitral valve repair didn't result in a rise in operative mortality or a survival benefit over coronary artery bypass grafting only for moderate ischemic mitral regurgitation.

At twelve months, **Acker et al.** [(11)] did not observe a significant distinction in cumulative mortality among the repair group & the replacement group (hazard ratio, 0.79; ninety-five percent confidence interval, 0.42 to 1.47). The repair group had a thirty-day mortality rate of 1.6 percent (two deaths) and the replacement group had a mortality rate of four percent (five deaths). Thirty-three additional deaths occurred between the thirty-day and one-year periods, and they were evenly distributed among both research groups. Heart failure (12.5 percent), renal failure (ten percent), and multisystem organ failure (37.5 percent) were the most prevalent primary causes of mortality. According to the log-rank test, there is a significant among-group variance in the composite end point of major adverse cerebrovascular or cardiac events (HR, 0.91; ninety-five percent confidence interval, 0.58 to 1.42; P = 0.68) or any of its individual components at twelve months. Particularly, the relative long-term risk of mortality was thirty-five percent more in the replacement group than in the repair group, as demonstrated by a meta-analysis conducted by **Vassileva et al.** [(12)]. Adjusting for baseline variations has been essential in nonrandomized research, as cases who undergo mitral-valve replacement are typically older and have a greater number of coexisting conditions than those who undergo repair. However, these methods are unable to adjust for variations when specific risk factors are unmeasured or unknown. This may be the reason why some investigations haven't demonstrated any variations in long-term or short-term survival rates among replacement & repair groups, while most investigations have favored repair. In comparison to previous research, the improved results we observed may be attributed to the evolution of valve replacement with chordal sparing. This is because the left ventricle internal architectural support may be preserved, which could decrease left ventricular dysfunction and dilatation & preserve contractile efficiency [(13)].

Conclusion

In our series, mitral valve repair appears to be like MVR regarding to both long-term survival & early death. Nevertheless, mitral valve repair was associated with a greater risk of persistent or recurring mitral regurgitation within one year following the surgery. The most effective surgery approach is controversial because there is a lack of clinical data. Based on the existing evidence, there appears to be a valid justification for the use of MVR in patients who have severe IMR. For individuals with moderate IMR, doing only coronary artery bypass grafting may yield comparable clinical results to a combination of coronary artery bypass and mitral valve repair operation.

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