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Original Article

Role of the viability study to solve the dilemma of the management of moderate ischemic mitral regurgitation: When to do revascularization alone or revascularization and mitral valve repair?

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Abstract

Back ground

The purpose of this study is to determine the role of the viability study to solve the dilemma of management of moderate ischemic mitral regurgitation (IMR): when to do revascularization alone or revascularization and mitral valve repair?.

Patients and methods

A retrospective study included 120 patients with ischemic heart disease (IHD) who underwent coronary artery bypass surgery (CABG) with IMR aged from 40 to 65 years of both sexes. They were divided into two groups of patients: Group I: 60 patients with IHD and moderate IMR had CABG for revascularization only. Group II: 60 patients with IHD and moderate IMR had CABG for revascularization combined with mitral valve repair. Preoperative viability was done by MRI study for all patients of moderate IMR, to assess the viability of the posteroinferior wall regardless the ejection fraction of the heart.

Results

After 1 week, five patients had severe MR in group I, compared with only one patient in group II. In addition, after 6 months, eight patients had severe MR in group I, whereas in group II, only one patient had severe MR.

Conclusion

Patients with nonviable posteroinferior segment had better results when revascularization was combined with mitral valve repair, than those who only experienced revascularization alone. However, if that territory is viable, the results are similar in both groups.

Keywords: Coronary artery bypass surgery, ischemic mitral regurge, mitral repair, moderate, viability study

Introduction

Ischemic mitral regurgitation (IMR) can be defined as mitral valve insufficiency caused by coronary artery disease and excluding other causes of mitral pathology such as rheumatic, myxomatous, infectious, congenital, or connective tissue diseases [1]. It usually occurs with right or circumflex coronary occlusion that involves the posterior ventricular wall, posterior papillary muscle, and adjacent mitral annulus [2,3].

The management of IMR represents a therapeutic challenge. Although most patients are treated medically, many patients are referred for surgery. Some authors claimed that revascularization alone is sufficient for managing those patients [4], whereas

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others have recommended revascularization combined with mitral valve repair [5,6].

There is a general agreement that patients with mild mitral regurge (1+) are treated with coronary artery bypass surgery (CABG) alone and those with severe (3+ or 4+) IMR should undergo mitral valve surgery at the time of CABG surgery [7].

However, the importance of moderate IMR (2+) is still controversial as some studies showed that uncorrected MR leads to increase postoperative morbidity and mortality after revascularization, whereas others claim that mitral valve surgery may add to the operative risk when combined with revascularization. The optimal strategy for treatment of moderate IMR is not yet known [8].

Aim

The purpose of this study is to determine the role of the viability study to solve the dilemma of management of moderate IMR: when to do revascularization alone or revascularization and mitral valve repair?

It is based on the hypothesis that the mechanism of occurrence of IMR (Carpentier type IIIb) is due to caudal displacement of the posteromedial chordae due to posteroinferior infarction.

Patients and Methods

Study design

A retrospective study included 120 patients with ischemic heart disease (IHD) undergoing CABG with IMR aged from 40 to 65 years of both sexes.

This study was approved by the National Heart Institute Medical Ethical Committee. An informed consent has been taken from all patients.

The patients were divided into two groups:

Group I: 60 patients with IHD and moderate IMR had CABG.

Group II: 60 patients with IHD and moderate IMR had CABG for revascularization combined with mitral valve repair.

Viability study using MRI was done for all patients preoperatively regardless of the ejection fraction (EF), to determine the viability of the posteroinferior wall.

Mitral valve repair with undersizing ring through Left (LT) atriotomy approach was used in group II.

All patients had been evaluated thoroughly preoperative, intraoperatively, and postoperatively. Particular attention was paid to clinical finding of presence of MR, its nature, anesthesia used, preoperative echocardiographic finding of MR and its nature, in addition to the degree of MR intraoperatively. Moreover, postoperative ICU events including the duration of mechanical ventilation, ICU stay, the need of intraaortic balloon pump, and hospital stay were also considered.

The study was done from November 2019 to December 2020 at the National Heart Institute. The data of the patients were collected on the basis of retrospective data collection.

Patients

The patients with IHDs with moderate ischemic mitral valve regurgitation undergoing on pump CABG surgery were the candidates for the study.

Inclusion criteria

The following were the inclusion criteria:

(1) All patients with IHD and moderate IMR undergoing on pump CABG.
(2) Informed consent was taken for all patients.
(3) Viability study in the form of MRI was done for all patients.

Exclusion criteria

The following were the exclusion criteria:

(1) Patients with mild or severe IMR.
(2) Patients with MR not of ischemic origin.
(3) Patients with other valve disease warranting intervention.
(4) Off-pump patients.
(5) Patients with associated left ventricular aneurysm or ischemic ventricular septal defect (VSD).
(6) Redo patients.

Preoperative parameters

(1) Informed consent, history taking, and clinical examination.
(2) Routine investigations:
    (a) Viability study (MRI) regardless of the EF, to evaluate the viability of the posteroinferior wall of the heart.
    (b) Routine perioperative laboratory investigations, (ECG), radiological examination, echocardiography, preoperative Trans-esophageal-echo (TEE), and coronary angiography.

Steps of surgery

Conventional procedure of CABG was done.

(1) Mitral valve repair was done by using undersizing mitral ring with interrupted ethibond suture via LT atriotomy approach.
(2) Intraoperative transoesophageal echocardiography was done to assess the degree of mitral regurge (jet area) before and after cardiopulmonary bypass and to assess the repair.

Postoperatively

(1) ICU stay, ventilation, inotropic agents when indicated, and postoperative echo were assessed.

Judgment criteria

(1) The main judgment criteria were as follows:
    (a) Vital signs (blood pressure, temperature, pulse, urine output, and oxygen saturation).
    (b) ECG first day, 48 h, and end of the first week.
    (c) Echocardiography.
(2) Patients' evaluation at 1 week:

Patients were evaluated 1 week after the surgery by the following:

    (a) 12-lead ECG.

(b) Echocardiography.
(c) Postoperative complications such as embolic, cerebral, renal, and hepatic complication.

(3) 3- and 6-month evaluation:

Patients were evaluated 3 and 6 months after surgery by the following:

(a) New York Heart Association (NYHA) functional class.
(b) Echocardiography.
(c) Follow-up of complications.

Results

Pre-operative data analysis

Pre-operative data analysis (Tables 1-5).

Postoperative echocardiographic assessment of MR in the two studied groups (Tables 6 and 7):

Follow-up data: 1-week duration

Tables 8–13.

Follow-up data: 3-month duration

This indicates a significant difference between the two groups ($P \leq 0.05$).

Table 1: Demographic data of the two studied groups

	Group I ($n=60$)	Group II ($n=60$)	*P*	Significance
Age (years)	65.0±2.4	66.0±1.6	0.063	NS
Sex (males)	40 (66.66)	35 (58.3)	0.243	NS
Sex (females)	20 (33.33)	25 (41.6)		

Data were expressed as mean±SD and *n* (%). NS, not significant.

Table 2: Risk factors in the two studied groups

	Group I ($n=60$)	Group II ($n=60$)	*P*	Significance
Infarction	50 (85.7)	52 (82.9)	1.00	NS
Diabetes mellitus	14 (46.6)	17 (56.6)	0.605	NS
Hypertension	20 (66.6)	22 (73.3)	0.778	NS
Hyperlipidemia	18 (60)	22 (73.33)	0.411	NS
Smoking	12 (40)	16 (53.33)	0.438	NS
Obesity	8 (26.66)	7 (23.33)	1.000	NS
FH-IHD	11 (36.66)	10 (33.33)	1.000	NS

Data were expressed as *n* (%). IHD, ischemic heart disease; NS, not significant.

Table 3: New York Heart Association classification of the two studied groups

NYHA	Group I	Group II	Total
II	26	24	50
III	34	36	70
Total	60	60	120
P	1.000		

Data were expressed as *n* (%). NS, not significant; NYHA, New York Heart Association.

This indicates a nonsignificant difference between the two groups ($P \geq 0.05$).

Follow-up data: 6-month duration

This indicates a significant difference between the two groups ($P \leq 0.05$).

This indicates a nonsignificant difference between the two groups ($P \geq 0.05$).

Discussion

There is general agreement that patients with severe (3+ or 4+) IMR should undergo mitral valve surgery at the time of CABG. However, the importance of moderate (2+) IMR in such patients is controversial. Clinical studies have conflicting data regarding the correction of MR after CABG surgery [9,10].

Therefore, we traced the course of moderate IMR after CABG surgery alone and after doing both CABG surgery and mitral valve repair on the immediate and early outcome of IHD

Table 4: Preoperative echocardiographic data in the two studied groups

	Group I ($n=60$)	Group II ($n=60$)	*P*	Significance
LVED	5.9±0.2	6.0±0.22	0.071	NS
LVES	4.4±0.12	4.45±0.12	0.112	NS
LA	4.0±0.08	4.2±0.12	0.061	NS
EF%	51±2.0	49.0±2.0	0.059	NS
Jet area	5.1±0.24	5.7±0.3	0.057	NS

Data were expressed as mean±SD. EF, ejection fraction; LA, left atrial; LVED, left ventricular end diastolic; LVES, left ventricular end systolic; NS, not significant

Table 5: Preoperative viability study of the posteroinferior wall of the heart

	Group I ($n=60$)	Group II ($n=60$)	*P*	Significance
Viable posteroinferior wall	40	35	0.24	NS
Nonviable posteroinferior wall	20	25	0.112	NS

Data were expressed as number. NS, not significant.

Table 6: Operative data in the two studied groups

	Group I ($n=60$)	Group II ($n=60$)	*P*	Significance
Total bypass time	83.0±19.0	91.1±19.3	0.110	NS
Cross-clamp time	55.45±14.76	64.77±13.6	0.055	NS
Operation time	199.34±11.00	205±12.1	0.06	NS
Use of inotropes	12 (40.0)	14 (46.66)	0.794	NS
Electric cardioversion	7 (23.33)	9 (30.0)	0.770	NS
IABP	2 (6.66)	1 (3.33)	1.00	NS
SVG to RCA	50 (83.33)	46 (76.66)	0.612	NS

Data were expressed as mean±SD or *n* (%). IABP, intraaortic balloon pump; SVG, saphenous vein graft; RCA, Right coronary artery; NS, not significant.

Table 7: Postoperative data in the two studied groups

	Group I (*n*=60)	Group II (*n*=60)	*P*	Significance
Mechanical ventilation (h)	13.0±4.8	15.3±4.6	0.105	NS
Inotropic support (h)	20.72±13.05	24.9±12.71	0.783	NS
Total ICU stay (h)	41.0±7.2	44.0±7.6	0.122	NS
Reexploration for bleeding	3	5	0.704	NS
Chest infection	2	3	1.00	NS
Renal failure	0	1	1.00	NS
Mediastinitis	1	2	1.00	NS

Data were expressed as mean±SD. NS, not significant.

Table 8: Results of degree of mitral regurgitation in patients with nonviable posteroinferior wall of the heart after 1 week in both groups

Degree of mitral regurgitation	Group I (*n*=20)	Group II (*n*=25)	*P*	Significance
MR=0-1+	5 (25)	20 (80)	<0.05	Significant
MR=2+	10 (50)	4 (16)	<0.05	Significant
MR=3-4+	5 (25)	1 (5)	<0.05	Significant

Data were expressed as *n* (%).

Table 9: Results of degree of mitral regurgitation in patients with viable posteroinferior wall of the heart after 1 week in both groups

Degree of mitral regurgitation	Group I (*n*=40)	Group II (*n*=35)	*P*	Significance
MR=0-1+	35 (87.5)	31 (88.5)	0.642	NS
MR=2+	4 (10)	3 (8)	0.753	NS
MR=3-4+	1 (2.5)	1 (2.8)	<0.421	NS

Data were expressed as *n* (%). NS, not significant.

Table 10: Results of degree of mitral regurgitation in patients with nonviable posteroinferior wall of the heart after 3 months in both groups

Degree of mitral regurgitation	Group I (*n*=20)	Group II (*n*=25)	*P*	Significance
MR=0-1+	4 (20)	19 (76)	<0.05	Significant
MR=2+	10 (50)	5 (20)	<0.05	Significant
MR=3-4+	6 (30)	1 (5)	<0.05	Significant

Data were expressed as *n* (%).

Table 11: Results of degree of mitral regurgitation in patients with viable posteroinferior wall of the heart after 3 months in both groups

Degree of mitral regurgitation	Group I (*n*=40)	Group II (*n*=35)	*P*	Significance
MR=0-1+	34 (85)	30 (85.7)	0.642	NS
MR=2+	5 (12.5)	4 (11.4)	0.753	NS
MR=3-4+	1 (2.5)	1 (2.8)	<0.421	NS

Data were expressed as *n* (%). NS, Not significant.

Table 12: Results of degree of mitral regurgitation in patients with nonviable posteroinferior wall of the heart after 6 months in both groups

Degree of mitral regurgitation	Group I (*n*=20)	Group II (*n*=25)	*P*	Significance
MR=0-1+	3 (15)	18 (72)	<0.05	Significant
MR=2+	9 (45)	6 (24)	<0.05	Significant
MR=3-4+	8 (40)	1 (5)	<0.05	Significant

Data were expressed as *n* (%).

patients undergoing CABG and identified factors which could predict the regression of moderate IMR.

We considered the hypothesis that the mechanism of occurrence of IMR (Carpentier type IIIb) is due to caudal displacement of the posteromedial chordae owing to posteroinferior infarction.

First, the majority of the patients in both groups were in a NYHA classes II–III (NYHA class III in 56.7% in group I and 69% in group II). This is similar to the results stated by other authors, such as Lam *et al.* [11] who had nearly 60% of their patients in NYHA class III. However, it was a little bit higher in other studies, such as Lam and colleagues who had the patients with a NYHA classes II–III around 73% and Tolis *et al.* [12], who also had around 75% of the patients classified as NYHA classes II–III. Although these studies were conducted on patients with mild–moderate IMR, several points can be used to differentiate. In the study by Lam *et al*. [11], all the patients in their study group had a previous myocardial infarction to be accepted as having IMR as opposed to 83.3% in group I and 86.7% in group II in our study [11,13]. Moreover, 53% of their patients had moderate to severe LV dysfunction (EF <40%) as compared with none in our study. Additionally, 6% of their patients had preoperative atrial fibrillation as opposed to none in our study. The series by Tolis and colleagues was essentially conducted on patients with ischemic cardiomyopathy (mean EF=22%) and also included patients with 3+ IMR [12,14].

The series by Lam *et al*. [11] gave no data on the use of preoperative viability study to assess the posteroinferior wall regardless of the EF of the heart.

Second, it was found in both groups that 83.3% of the patients in group I had a previous posteroinferior infarction and 86.7% of the patients in group II had a previous posteroinferior infarction. This validates data by other authors, who stated that, although anterior infarctions are common to occur in IHD patients, the occurrence of IMR is more common after a posteroinferior myocardial infarction [15].

Finally, in our study, it was found that there was a significant correlation between the preoperative viability of posteroinferior wall and the prognosis of IMR ($P \geq 0.05$).

The operative and postoperative results of our two studied groups were similar. There were no statistically significant differences regarding the weaning off bypass, total bypass, and ischemic times. Additionally, the dosage and the length of time that patients were on inotropic support were also

Table 13: Results of degree of mitral regurgitation in patients with viable posteroinferior wall of the heart after 6 months in both groups

Degree of mitral regurgitation	Group I ($n=40$)	Group II ($n=35$)	*P*	Significance
MR=0-1+	33 (82.5)	29 (82.8)	0.642	NS
MR=2+	6 (15)	5 (14.2)	0.753	NS
MR=3-4+	1 (2.5)	1 (2.8)	<0.421	NS

Data were expressed as *n* (%). NS:not significant.

nonsignificant. Moreover, the need of intraaortic balloon pump counterpulsation, the period of mechanical ventilation, the total blood loss, the perioperative morbidity or mortality, and the total period of ICU or hospital stay were also nonsignificant.

As known, the main mechanism behind the development of IMR is the apical displacement of the papillary muscles with the associated tethering of the leaflets as a result of the underlying LV remodeling [16]. All the aforementioned factors lead to worsening of LV remodeling [17]. Failure to graft the right coronary artery or its posterior descending branch might influence the grade of IMR postoperatively by the fact that the failure to vascularize hibernating myocardium in this territory may impair the improvement of left ventricular contractility postoperatively, thus preventing regression of MR [18]. Furthermore, the development of new regional wall motion abnormalities in the inferior–posterior LV wall territory owing to the development of new ischemia without infarction additionally leads to progression of IMR after CABG owing to change in regional LV geometry [10,19].

Our results agree with other authors in that sense. Milano *et al*. [4] found failure to graft the Posterior descending artery (PDA) territory as an independent predictor of postoperative IMR progression. Watanabe *et al*. [19] also identified inferior LV dysfunction as a predictor of worsening IMR grade postoperatively.

The study of Khallaf *et al*. [20] revealed many advantages of adding mitral repair to surgical revascularization in patients with moderate IMR, with regression in the degree of MR and NYHA functional class. On the contrary, there were no significant differences between the groups regarding the postoperative course and incidence of mortality.

Michler *et al*. [16] claimed that in patients with moderate IMR undergoing CABG, the addition of mitral-valve repair did not lead to significant differences in left ventricular reverse remodeling at 2 years. Mitral-valve repair provided a more durable correction of MR but did not significantly improve survival or reduce overall adverse events or readmissions and was associated with an early hazard of increased neurologic events and supraventricular arrhythmias [16].

Conclusion

After assessing all our results, we can conclude the following from this study:

(1) Patients with nonviable posteroinferior segment had better outcome when revascularization combined with mitral valve surgery done, than those who only experienced revascularization alone.
(2) On the contrary, in patients with viable posteroinferior wall, there were no significant difference between both groups in the management, whether revascularization combined with mitral valve surgery or revascularization alone.

Recommendation

(1) Preoperative viability study should be done for all patients with moderate IMR, to assess the viability of the posteroinferior wall regardless of the EF of the heart.
(2) So, if posteroinferior wall is not viable, both revascularization and mitral valve surgery should be done. However, if posteroinferior wall is viable, revascularization alone would be sufficient.
(3) Preoperative left ventricular profile and function should be considered while making the decision of doing mitral repair or not in order to not jeopardize the heart owing to long ischemic time.
(4) Parameters including higher number of preoperative infarctions, a larger LV size, lower EF, and failure to graft the right coronary artery territory can all lead to the persistence or progression of moderate IMR postoperatively.
(5) The use of intraoperative transesophageal echocardiography can frequently lead to downgrading of IMR, and therefore, caution should be taken in interpreting its results when making operative decisions.

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Conflicts of interest

None declared.

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