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The Progress of Mitral Regurgitation after Isolated Coronary Artery Bypass in Cases of Ischemic Mitral Regurgitation

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ABSTRACT

Background. Mitral valve intervention combined with coronary artery bypass surgery is inevitable in the case of severe mitral regurgitation in patients with coronary artery disease because the prognosis is poor without mitral correction. The best treatment protocol for patients with a moderate degree of mitral regurgitation is under debate. To clarify the optimal management for these patients, we evaluated the progress of mitral regurgitation after isolated coronary artery bypass surgery in cases of ischemic mitral regurgitation.

Methods. The study was conducted between March 2001 and April 2003. Forty-seven patients (70% men, with a mean age of 61 years, a mean ejection fraction of 43.7%, and a mean New York Heart Association class of 2.53) with preoperative diagnoses of moderate degree ischemic mitral regurgitation (Grade 3 mitral regurgitation on a scale of 0 to 4) and coronary artery disease, without leaflet pathology, underwent isolated coronary artery bypass surgery. Patients were followed-up at a mean of 22 months and an echocardiographic evaluation was done to determine the progress of the mitral disease.

Results. The 30-day operative mortality rate was 2.1%. In the postoperative period, the mean ejection fraction was 46.9% and the mean functional capacity of the patients was 1.31. Mitral regurgitation regressed to a mild degree in 56.9% of the patients. The 2-year survival rate was 93.7%.

Conclusions. Patients with moderate ischemic mitral regurgitation and coronary artery disease who underwent coronary artery bypass surgery alone had acceptable results. We are of the opinion that isolated coronary artery bypass surgery might be a good treatment choice for moderate degree ischemic mitral regurgitation.

INTRODUCTION

Most surgeons agree that the treatment of choice for severe mitral valve regurgitation with coronary artery disease is coronary artery bypass surgery (CABG) with mitral valve replacement (MVR) or repair [Duarte 1999; Aklog 2001]. CABG alone is suggested for mild mitral regurgitation [Pinson 1984; Connolly 1986; Duarte 1999; Aklog 2001]. There is not an agreement on the best treatment for coronary artery disease with moderate mitral regurgitation. Some authors suggest mitral intervention [Hickey 1988; Rankin 1989; Yun 1991; Akins 1994; Bolling 1996; Aklog 2001], whereas others say that CABG alone is enough [Pinson 1984; Connolly 1986; Duarte 1999].

Authors suggesting isolated CABG reported that mitral regurgitation would regress after revascularization because of the improvement of wall motion [Balu 1982; Christenson 1995; Aklog 2001]. If residual mitral regurgitation occurred, it would be well tolerated and would not affect the long-term prognosis [Connolly 1986; Arcidi 1988; Duarte 1999]. Mitral intervention combined with CABG had a higher mortality rate than isolated CABG (>10%) [Rankin 1989; Cohn 1995; Dion 1995; Ruvolo 1995; Chen 1998; Duarte 1999; Hausmann 1999; Von Oppell 2000; Aklog 2001]. Intervention of the mitral valve might be harder because of the smaller left atrium in ischemic mitral regurgitation. Complications due to anticoagulation might occur in the case of MVR and reoperation may be necessary in the case of bioprosthesis degeneration [Aklog 2001].

Authors preferring combined mitral intervention suggest that mitral regurgitation would not improve in the patients who had myocardial scarring and ventricular and annular dilatation [Balu 1982; Christenson 1995; Aklog 2001]. Severe residual mitral regurgitation would make the patient symptomatic and would decrease the prognosis [Adler 1986; Hickey 1988]. Mitral repair could be possible in nearly all patients [Arcidi 1988; Aklog 2001]. Mitral intervention combined with CABG does not have a higher mortality rate than isolated CABG (3-4%) [Bolling 1996, Gangemi 2000]. The operative mortality rate would be higher in cases undergoing reoperation for residual mitral regurgitation [Izhar 1999].

To clarify the optimal management for such patients, we evaluated the progress of mitral regurgitation after isolated CABG in cases of ischemic mitral regurgitation.

METHODS

The study was conducted between March 2001 and April 2003. The progress of ischemic mitral regurgitation was evaluated in 47 patients with moderate mitral regurgitation and coronary artery disease, all of whom received isolated CABG.

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Table 1. Coronary Artery Lesions, Cardiac Status, and Coexisting Pathologies

	No. of Patients (%)
Extent of coronary artery disease	
2-Vessel disease	13 (27.7)
3-Vessel disease	34 (72.3)
Cardiac presentation	
Stable angina	30 (63.8)
Unstable angina	17 (36.2)
Prior myocardial infarction	37 (78.7)
Coexisting pathologies	
Hypertension	19 (40.4)
Diabetes mellitus	13 (27.7)
Peripheral vascular disease	3 (6.4)
Chronic obstructive pulmonary disease	12 (25.5)
Cerebrovascular disease	2 (4.2)
Renal insufficiency	5 (10.6)

The mean age of the patients was 61 years (range, 34-81 years). Thirty-three patients were men (70%) and 14 patients were women (30%). The diagnosis of coexistent mitral regurgitation depended on ventriculographic and echocardiographic data. Mitral regurgitation was defined as moderate when regurgitation was 3 on a scale of 0 to 4. Patients who had undergone previous mitral valve operations, who required aortic valve operations, coronary artery reoperations, and emergent operations were excluded from the study. All patients underwent an operation at least 6 weeks after the myocardial infarction.

The diagnosis of ischemic or rheumatologic mitral regurgitation was based on history, physical examination, echocardiography, and catheterization. Acute rheumatoid fever history, long-term presence of a murmur, absence of wall motion abnormalities, and structural mitral valvular pathologies on echocardiography were classified as symptomatic of rheumatologic mitral regurgitation. Significant symptomatic multivessel coronary artery disease with or without documented prior myocardial infarction, presence of wall motion abnormalities on echocardiography or catheterization, absence of mitral stenosis, type 1 or 3b Carpentier functional classification (annular dilatation with normal leaflet motion [type I], no leaflet prolapse [type 2], restricted leaflet motion during systole [type 3b], or other leaflet pathology), and absence of acute rheumatoid fever history were classified as symptomatic of ischemic mitral regurgitation. Patients with acute myocardial infarction or with a ruptured papillary muscle were excluded from the study. Patient data for coexisting pathologies, coronary artery lesions, and cardiac status are presented in Table 1. The preoperative data of the 47 patients are presented in Table 2.

Table 2. Preoperative Data*

	Preoperative
No. of patients	47
Moderate degree mitral regurgitation	47
Mean EF, %	43.7
NYHA functional class, mean	2.53
Rhythm	
Normal sinus rhythm (%)	40 (85.1)
Atrial fibrillation (%)	7 (14.9)
LVEDD, mm	40.5
LVESD, mm	54.0
LAD, mm	41.1

*EF indicates ejection fraction; NYHA, New York Heart Association; LVEDD, left ventricular end diastolic diameter; LVESD, left ventricular end systolic diameter; LAD, left atrial diameter.

Table 3. Operative Data*

	No. of patients (%)
Operation	
OPCAB	11 (23.4)
CABG	36 (76.6)
1-Vessel CABG	2 (4.3)
2-Vessel CABG	18 (38.3)
3-Vessel CABG	24 (51.0)
4-Vessel CABG	3 (6.4)
LIMA graft usage	41 (87.2)
Bleeding	
Blood transfusion, unit	0.93
Mean drainage, mL	462.5
Reoperation for bleeding	3 (6.4)
Median recovery times	
Mean intensive care unit stay, d	2.2
Mean postoperative hospital stay, d	6.5
Mean ventilator support time, h	6.2

*OPCAB indicates off-pump coronary artery bypass; CABG, coronary artery bypass grafting; LIMA, left internal mammarian artery.

Operative Techniques

Under general anesthesia, 36 patients (77%) underwent conventional CABG through a full midline sternotomy on moderate hypothermic cardiopulmonary bypass and 11 patients (23%) had off-pump coronary artery bypass surgery. No intervention was performed on the mitral valve. Full revascularization was performed for all patients. Operative data are presented in Table 3.

Table 4. Predictors of Mortality*

	Postoperative		
	Alive (%)	Deceased (%)	*P*
HT	17 (38.6)	2 (66.7)	.557
DM	11 (25)	2 (66.7)	.181
COPD	12 (27.3)	0	.560
CRF	1 (2.3)	2 (66.7)	.008
MI	34 (77.3)	3 (100)	.840

*P values obtained using a χ^2 test. HT indicates hypertension; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; CRF, chronic renal failure; MI, myocardial infarction.

Table 5. Predictors of Mortality

	Postoperative		
Rhythm	Alive (%)	Deceased (%)	*P*
Sinus rhythm	38 (86.4)	2 (66.7)	.391
AF	6 (13.6)	1 (33.3)	

*P values obtained using a χ^2 test. AF indicates atrial fibrillation.

Table 6. Predictors of Mortality*

	Postoperative		
NHYA Class	Alive (%)	Deceased (%)	*P*
II	22 (50)	0	.237
III	22 (50)	3 (100)	

*P values obtained using a χ^2 test.

Statistical Analysis

The numerical data were expressed as mean ± standard deviation. The predictors of mortality are studied with the Mann-Whitney U nonparametric test and the χ^2 test. P values <.05 were considered to be statistically significant.

RESULTS

Patients were followed-up to determine all causes of complications or death. There was only 1 early mortality due to multiorgan failure. Two patients who had preoperative chronic renal failure (CRF) died in the late postoperative period. Preoperative CRF was found to be statistically significant as a mortality predictor (P <.05). Age, preoperative atrial fibrillation (AF), preoperative functional capacity, preoperative ejection fraction (EF), left ventricular end systolic diameter (LVESD), left ventricular end diastolic diameter (LVEDD), pulmonary artery pressure (PAP), left atrial diameter (LAD), and history or hypertension (HT), chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), or myocardial infarction (MI) were not statistically significant as mortality predictors (P >.05; Table 4-7). The incidence of perioperative complications and early and late mortality is presented in Table 8.

Follow-up occurred at a mean of 22 months, and echocardiographic evaluation was done to determine the progress of the mitral disease. We found that mitral regurgitation decreased with the increase in EF. LVESD, LVEDD, and LAD decreased after the operations, too. The mitral regurgitation regressed to a mild degree in 54.6% of the patients, and no mitral regurgitation was seen in only 1 patient in the postoperative period. The improvement in the EF and functional capacity, the regression of mitral regurgitation, and the decrease in the LVESD, LVEDD, and LAD were statistically significant when compared with the preoperative values. The functional capacity class (New York Heart Association) of patients who had persistent mitral regurgitation in the postoperative period improved from 2.42 ± 0.50 to 1.42 ± 0.50 (P = .022). There was no difference between off-pump and on-pump groups in terms of postoperative ischemic mitral regurgitation degree. None of the patients needed intra-aortic balloon counterpulsation. The preoperative and postoperative data are presented in Table 9.

DISCUSSION

Mitral valve intervention combined with CABG is inevitable in the case of severe mitral regurgitation in patients with coronary artery disease. The prognosis is poor without mitral correction. The best treatment protocol for patients with moderate degree ischemic mitral regurgitation and coronary artery disease is under debate. As techniques of valvular repair continue to be refined, many surgeons have advocated simultaneous mitral valve repair and CABG for these patients. Others have continued to treat these patients with CABG alone [Duarte 1999]. Ischemic mitral regurgitation after myocardial infarction may be severe in the early period. After myocardial remodeling, the ischemic mitral regurgitation may regress. It is not clear when the myocardial remodeling occurs [Grigioni 2001]. In this study, if emergent surgical intervention was not necessary we delayed surgery for 6 weeks after myocardial infarction.

Cases requiring combined CABG and mitral valve intervention procedures represent some of the most challenging clinical cases with high associated risks [Hickey 1988; Flameng 1994; Cohn 1995]. For these critically ill patients with diminished reserves, extensive surgical intervention has a high operative mortality rate [Hickey 1988; Flameng 1994; Duarte 1999]. Mitral valve surgery significantly adds to the operative risk of CABG, with most series reporting operative mortality rates >10% [Cohn 1995; Ruvolo 1995; Aklog 2001]. Cohn et al found a 9.5% operative mortality rate for combined surgery [Cohn 1995]. We found a 2.1% early (0-30 days) mortality rate and a 4.2% late mortality rate in the 47 patients with moderate degree ischemic mitral regurgitation.

Revascularization of the ischemic myocardium can improve the ventricular wall and papillary muscle motion so that mitral regurgitation will regress [Balu 1982; Christenson 1995; Aklog 2001]. Reduction of mitral regurgitation after coronary revascularization in patients with ischemic mitral regurgitation probably occurs as a result of the restoration of blood flow to an area of hibernating myocardium; that is, ischemic but viable myocardium that does not function properly at rest but does function with adequate blood flow [Kim 2005]. Full revascularization is very important for recovery from ischemic mitral regurgitation. We found that mitral regurgitation of the patients decreased as the EF increased. The mitral regurgitation regressed to a mild degree or disappeared in 56.9% of the patients.

The degree, but not the existence, of mitral regurgitation was reported to affect the survival rate [Pinson 1984; Connolly 1986; Hickey 1988]. Additionally, this nonintervention for mitral regurgitation was reported not to affect the functional capacity of the patient and prognosis [Connolly 1986; Arcidi 1988; Duarte 1999]. We found improvement in the functional capacities of the patients after the operation.

Duarte et al found similar 5-year survival rates (81%) between patients who had moderate degree mitral regurgitation and isolated CABG and patients who did not have mitral regurgitation and had CABG [Duarte 1999]. Pinson et al reported a 5-year survival rate of 72% for patients receiving isolated CABG [Pinson 1984]. Cohn and coworkers reported

Table 7. Predictors of Mortality*

	Postoperative						
	Alive			Deceased			
	Min-Max	Median	Mean ± SD	Min-Max	Median	Mean ± SD	*P*
Age, y	34-82	62.5	60.84 ± 9.85	63-74	71.0	69.33 ± 5.69	.098
PAP, mmHg	7-66	18	20.88 ± 11.37	16-34	26	25.33 ± 9.02	.316
LVEDD, mm	24-56	41	40.32 ± 8.56	39-50	42	43.67 ± 5.69	.601
LVESD, mm	35-69	54	53.97 ± 7.42	51-62	51	54.67 ± 6,35	.861
LAD, mm	35-54	41	41.16 ± 4.22	36-48	37	40.33 ± 6.66	.600
EF, %	25-71	40	44.09 ± 12.47	30-47	37	38 ± 8.54	.394

*P values obtained using a Mann-Whitney U test. SD indicates standard deviation; PAP, pulmonary artery pressure; LVEDD, left ventricular end diastolic diameter; LVESD, left ventricular end systolic diameter; LAD, left atrial diameter; EF, ejection fraction.

Table 8. Perioperative Complications

	No. of Patients (%)
Operative mortality, 0-30 days	1 (2.1)
Mortality in the follow-up period	2 (4.2)
Perioperative myocardial infarction	1 (2.1)
New atrial fibrillation	7 (14.9)
Postoperative cerebrovascular accident	1 (2.1)
Postoperative renal failure	3 (6.4)

Table 9. Preoperative and Postoperative Data*

	No. of Patients (%)		
	Preoperative	Postoperative	*P*
No. of patients	44 patients	44 patients	
Mitral regurgitation			
No regurgitation		1 (2.3)	1.000
Mild		24 (54.6)	<.001
Moderate	44 (100)	19 (43.1)	<.001
Left ventricular function			
Normal, EF >50%	10 (22.7)	12 (27.3)	.622
Mild dysfunction, EF 40-49%	13 (29.6)	15 (31.2)	.647
Moderate dysfunction, EF 30-39%	15 (34.0)	13 (29.5)	.647
Severe dysfunction, EF <30%	6 (13.6)	4 (9.1)	.739
Mean EF, %	38.55	50.45	<.001
NYHA functional class			
I	10 (22.7)	31 (70.5)	<.001
II	20 (45.4)	13 (29.5)	.186
III	14 (31.9)	—	<.001
IV	—	—	
Mean	2.5	1.31	<.001
Rhythm			
Normal sinus rhythm	38 (86.3)	34 (77.3)	.269
Atrial fibrillation	6 (13.7)	10(22.7)	.407
Pacemaker	—	—	
LVEDD, mm	40.23	38.59	<.001
LVESD, mm	53.97	52.34	.001
LAD, mm	41.15	38.90	<.001

*EF indicates ejection fraction; NYHA, New York Heart Association; LVEDD, left ventricular end diastolic diameter; LVESD, left ventricular end systolic diameter; LAD, left atrial diameter.

a 5-year survival rate of 56% in combined mitral and coronary intervention [Cohn 1995]. The 2-year survival was 93.7% in our study.

One must be sure that the valvular regurgitation is caused by ischemia to make a decision for mitral intervention for moderate degree mitral regurgitation in patients with coronary artery disease and mitral regurgitation. Mitral regurgitation will not regress after CABG if it is caused by primary valvular pathology.

CONCLUSION

We studied the early and midterm outcomes of mitral regurgitation after isolated CABG in the patients with coronary artery disease and ischemic moderate degree mitral regurgitation. Moderate degree mitral regurgitation regressed in 56.9% of the patients after isolated CABG. This change can be explained by the disappearance of ischemia, which caused left ventricular wall dysfunction and improvement of left ventricular and papillary muscle function.

Additional risks of mitral intervention were avoided by isolated CABG. The mortality and morbidity rates were in an acceptable range. The functional capacities of the patients were good in the midterm run. We are of the opinion that isolated CABG is a convenient protocol for the treatment of mild and moderate degree ischemic mitral regurgitation.

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