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Predictive Risk Factors for Early Mortality in Operative Treatment for Chronic Ischemic Mitral Insufficiency

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ABSTRACT

Background. The combination of coronary artery bypass grafting and mitral valve surgeries is closely associated with high in-hospital mortality and morbidity. In this study, we sought to analyze the factors that influence early mortality in 68 patients undergoing coronary artery bypass grafting + mitral valve surgery due to ischemic mitral insufficiency.

Methods. Of 1183 patients undergoing coronary bypass surgery between April 2002 and June 2006, 68 patients (42 male and 26 female) 42 to 78 years of age (mean ± SD, 59.3 ± 9.1) underwent mitral valve surgery accompanying coronary bypass surgery (survival, n = 59; mortality, n = 9). The cases were analyzed regarding the demographic, preoperative, and perioperative risk factors that influence mortality.

Results. The early mortality rate was found to be 13.2% (9/68) in patients with ischemic mitral regurgitation undergoing simultaneous coronary bypass and mitral valve surgeries. New York Heart Association class ≥3, left ventricle end-systolic volume, left ventricle end-systolic diameter, cardiopulmonary perfusion time, preoperative unstable angina pectoris, intra-aortic balloon application, and age >65 years were determined to be statistically significant risk factors that influence early in-hospital mortality.

Conclusion. Surgery, despite having a high mortality risk in patients with ischemic mitral insufficiency, is considered to be a treatment measure that generally improves the quality of life and prolongs life.

INTRODUCTION

Ischemic mitral regurgitation (IMR) develops after serious coronary artery disease or myocardial infarction (MI). The presence of IMR is known to have a negative effect on survival after MI, and the 5-year survival rate of patients with mitral regurgitation secondary to coronary artery disease is below 50% [Nicolini 2006]. The survival rate increases to 75% in patients undergoing coronary artery bypass grafting (CABG) + mitral repair/replacement. In this regard, recent reports advocate that correction of mitral insufficiency should be performed along with CABG in patients in whom grade 2+ IMR is present [Szalay 2003; Uchikawa 2004; Ereminiene 2005].

The aim of this study was to analyze the risk factors that influence early mortality in patients undergoing CABG surgery with concomitant correction of IMR via mitral surgery.

MATERIALS AND METHODS

Patient Population

Of 1183 patients that underwent CABG between April 2002 and June 2006, a total of 68 patients with IMR, 59 of whom survived and 9 of whom died within the early postoperative period of 30 days following mitral valve replacement (MVR) or mitral valve repair plus annuloplasty, were analyzed regarding predictive risk factors. In each case, data were collected via a detailed preoperative history of the patient, routine transthoracic echocardiography, and conventional coronary angiography. A diagnosis of IMR was made in patients in whom a rupture of the chorda tendinea and papillary muscles occurred or when grade 2+ regurgitation was present in patients with coronary artery disease accompanied by regional wall movement abnormality and regurgitation through the mitral valve detected by transthoracic echocardiography. The severity of mitral insufficiency was graded (0 = none, 1+ = mild, 2+ = moderate, 3+ = moderate to severe, and 4+ = severe) by calculating the effective regurgitant orifice with the size and geometry of the regurgitant jet.

Surgical Procedure

All operations were carried out with median sternotomy, aorto-bicaval cannulation, and moderate hypothermia. Following sternotomy, the left internal thoracic artery (LITA) was harvested. For myocardial protection, all patients underwent antegrade-retrograde cold blood cardioplegia at the beginning of the operation, followed by retrograde-antegrade cold blood cardioplegia at 20-minute intervals throughout surgery. Preferentially, the LITA, radial artery, and saphenous

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Table 1. Demographic Data

	Total, N = 68	Survivor Group, n = 59	Mortality Group, n = 9
Advanced age (>65), y	20 (29.4%)	15 (25.4%)	5 (55.5%)
Sex			
Female	26 (38.2%)	22 (37.2%)	4 (44.4%)
Male	42 (91.8%)	37 (62.8%)	5 (55.5%)
Diabetes mellitus	18 (26.4%)	14 (23.7%)	4 (44.4%)
Hypertension	38 (55.8%)	35 (59.3%)	3 (33.3%)
Dyslipidemia	12 (17.6%)	9 (15.2%)	3 (33.3%)
Urgent surgery	15 (22%)	11 (18.6%)	4 (44.4%)
New York Heart Association			
Class I	1 (1.4%)	1 (1.7%)	0
Class II	30 (44.1%)	30 (50.8%)	0
Class III	32 (47.0%)	24 (40.6%)	8 (88.8%)
Class IV	5 (7.3%)	4 (6.7%)	1 (11.1%)
Mean ejection fraction	42.9 ± 11.03	43.11 ± 10.63	41.77 ± 14.08
Low ejection fraction (<35%)	14 (20.5%)	10 (16.9%)	4 (44.4%)
Mitral repair + annuloplasty	61 (89.7%)	54 (91.5%)	7 (77.7%)
Mitral valve replacement	7 (10.2%)	5 (8.4%)	2 (22.2%)
Preoperative unstable angina	22 (32.3%)	16 (27.1%)	6 (66.6%)
Preoperative beta blocker use	43 (63.2%)	40 (67.7%)	3 (33.3%)
Preoperative nitrate use	41 (60.2%)	35 (59.3%)	6 (66.6%)
Additional aneurysm repair	10 (14.7%)	8 (13.5%)	2 (22.2%)
Intra-aortic balloon pump use	8 (11.7%)	4 (6.7%)	4 (44.4%)
Smoking	27 (39.7%)	23 (38.9%)	4 (44.4%)
Atrial fibrillation	7 (10.2%)	5 (8.4%)	2 (22.2%)

vein were chosen as conduits. Except for distal LITA anastomoses, the other distal anastomoses were performed initially. Following the standard left atriotomy procedure, the mitral valve structure was evaluated. Conventional MVR was performed when there was a rupture of the papillary muscles and chorda tendinae. In patients without rupture, MVR was performed when there was a restrictive insufficiency in the valve. In other patients, the classical mitral repair techniques were performed using conventional mitral annuloplasty rings.

Definitions and Statistical Analyses

Hospital mortality included all deaths within 30 days of operation. The statistical analyses, including mean and standard deviation calculations of continuous parameters and univariate (χ^2 test and the Fischer exact test) and multivariate (logistic regression backward LR) analyses of all risk factors, were performed with SPSS 10.0 Statistical Software (SPSS, Chicago, IL, USA). The influence of preoperative and intraoperative variables on hospital mortality was analyzed. $P \leq .05$ was considered statistically significant.

RESULTS

Of the 68 patients, 26 were male and 42 were female. The mean age of the patients was 59.3 ± 9.1, and 20 (29.4%) of the patients were older than 65 years. Mitral repair + annuloplasty was performed in 61 (89.7%) of the patients, while the remaining 8 (10.3%) underwent MVR. The demographic data of the patients are displayed in Table 1. The total in-hospital mortality rate was found to be 13.2%. One patient undergoing alfieri double orifice technique + mitral ring annuloplasty + endoaneurysmorrhaphy died in the operating room because of pump failure and an inability to wean off cardiopulmonary bypass. During the postoperative period, one patient died of cerebral embolism, and the others died of low cardiac output.

Clinical and Operative Data of the Patients

The left ventricle end-systolic volume (LVESV) was found to be 86.5 ± 35.0 mL in the survivors, while it was 100.3 ± 47.5 mL in the mortality group. The mean number of bypass grafts was the same in both groups (2.88 grafts/case). The cardiopulmonary perfusion times were 187.8 ± 82.0 minutes and 142.3 ± 36.8 minutes in the mortality and survivor

Table 2. Clinical and Operative Data*

	Total, N = 68	Survivor Group, n = 59	Mortality Group, n = 9
Age, y	59.3 ± 9.1 (42-78)	58.5 ± 9.0 (42-75)	64.2 ± 8.8 (53-78)
LVEDD, mm	56.1 ± 7.0 (43-71)	55.9 ± 6.8 (45-71)	57.1 ± 8.8 (43-67)
LVEDV, mL	158.3 ± 44.9 (83-264)	157.2 ± 43.7 (92-264)	165.2 ± 54.2 (83-231)
LVESD, mm	42.8 ± 8.3 (26-60)	42.5 ± 8.0 (26-60)	45.2 ± 10.6 (28-55)
LVESV, mL	88.3 ± 37.5 (30-180)	86.5 ± 35 (35-180)	100.3 ± 47.5 (30-147)
NYHA class	2.61 ± 0.62	2.54 ± 0.62	3.11 ± 0.33
Ejection fraction, %	42.9 ± 11.0 (27-66)	43.1 ± 10.6 (27-65)	41.77 ± 14.0 (29-66)
Grafts per patient	2.88 ± 0.88	2.88 ± 0.9	2.88 ± 0.33
Cross-clamp time, min	115.0 ± 27 (60-191)	113.4 ± 28 (60-191)	125.5 ± 25.9 (98-186)
CP perfusion time, min	148.3 ± 47.1 (89-393)	142.3 ± 36.8 (89-257)	187.8 ± 82.0 (127-393)
Degree of MR	2.94 ± 0.64	2.96 ± 0.64	2.77 ± 0.66

*All data are presented as mean ± standard deviation (range). LVEDD indicates left ventricle end-diastolic diameter; LVEDV, left ventricle end-diastolic volume; LVESD, left ventricle end-systolic diameter; LVESV, left ventricle end-systolic volume; NYHA, New York Heart Association; CP, cardiopulmonary; MR, mitral regurgitation.

Table 3. The Results of Univariate and Multivariate Analyses*

	Univariate Analyses	Multivariate Analyses
New York Heart Association ≥3	.002	—
Left ventricle end-systolic volume	.042	.030
Left ventricle end-systolic diameter	.035	.010
Cross-clamp time	—	.030
Cardiopulmonary perfusion time	.006	.009
Preoperative unstable angina	.018	—
Intra-aortic balloon pump use	.001	.0067
Advanced age (>65), y	.046	—
Low ejection fraction (<35%)	—	.040
Additional left ventricle aneurysm repair	—	.035

*Data presented are statistically significant *P* values.

groups, respectively. The clinical and operative data of the groups are displayed in Table 2.

Univariate and Multivariate Analyses

The results of the univariate and multivariate analyses of predictive risk factors are displayed in Table 3. The univariate analyses revealed a significantly higher risk in patients with NYHA classes 3 and 4, increased LVESV and left ventricle end-systolic diameter (LVESD), prolonged duration of perfusion, preoperative unstable angina, advanced age, and intra-aortic balloon pump (IABP) requirement. The multivariate analyses revealed a statistically higher risk with increased LVESD and LVESV, prolonged cross-clamp and cardiopulmonary perfusion times, ejection fraction (EF) <35%, concomitant aneurysm repair as an additional operation, and IABP application.

DISCUSSION

IMR develops as a complication of coronary artery disease in the absence of an intrinsic valve disease such as rheumatic heart disease. A remodeling process that develops after ischemia or MI causes abnormalities of the left ventricular volume, function, and shape. Several authors have proposed that higher survival rates and better postoperative prognosis are obtained in patients with grade II or III IMR and improved left ventricle geometry, in whom mitral regurgitation is corrected along with CABG [Szalay 2003; Jouan 2004; Uchikawa 2004; Geidel 2005; Nicolini 2006]. In contrast, others have suggested that mitral regurgitation is corrected spontaneously in patients in whom CABG is performed without operating on the mitral valve, or that the survival rates are similar to those in whom concomitant mitral surgery is performed [Prifti 2001; Harris 2002].

Seipelt et al [2001] analyzed 262 cases with ischemic and nonischemic mitral valve disease in which patients underwent CABG and mitral valve surgery concomitantly, and found a mortality rate of 19.5% in patients who had undergone surgery due to ischemic valve disease, whereas the mortality rate in the group with nonischemic valve disease was only 6.7%. While the only independent predictor of in-hospital mortality was moderate-to-severe disruption of the left ventricle function in the group with ischemic valve disease, advanced age and preoperative IABP use were also found to be significant factors. The severity of mitral insufficiency was reported as not affecting early outcome [Seipelt 2001].

In the study reported by Grigioni et al [2001], 303 cases with Q-wave MI were analyzed, and the 5-year mortality rates of cases with and without ischemic mitral insufficiency were 62% and 39%, respectively, and the authors concluded that the degree of ischemic mitral insufficiency was a risk factor for mortality. In our series, concomitant mitral valve surgery was performed in 5.74% of our total cases of CABG. While the early mortality was 3.0% in our patients undergoing CABG without valve surgery, this had risen to 13.2% in the patients undergoing concomitant mitral valve surgery and CABG.

In several studies, reduced left ventricle function, advanced age, and preoperative advanced NYHA class have been shown to predict in-hospital mortality [Czer 1984; Andrade 1987; Seipelt 2001]. Likewise, decreased left ventricle systolic function, NYHA class ≥3, advanced age, and preoperative angina pectoris were found to predict risk in our series. The mortality rates were also significantly higher in cases with prolonged duration of perfusion and IABP requirement.

It has been demonstrated that the surgical mortality is higher in patients with ischemic cardiomyopathy who have low EF, advanced age, and advanced mitral regurgitation, but these patients have better survival after this procedure than with other treatment options [Uchikawa 2004]. Jouan et al [2004] have indicated that the requirement of inotropic support, emergency surgery, IABP application, the grade of mitral regurgitation, the area of effective regurgitant orifice, the location of MI, and the severity of coronary lesions are all significant risk factors for early mortality. One difference from our series was that they found the left ventricle end-diastolic volume to be a risk factor. Seipelt et al [2001] have found significant effects of advanced age, IABP application, and low EF on early mortality in mitral surgery, which is compatible with the findings of our series.

CONCLUSION

Combined mitral valve and coronary artery surgery has more risk of early mortality than both isolated valve surgery and isolated coronary surgery. Evaluation of the factors predictive of mortality might be helpful in estimating the surgical outcome and identifying patients with higher operative risk.

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