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Mitral valve repair for ischemic mitral insufficiency: an increased early postoperative risk for the elderly

İskemik mitral yetmezlikte mitral kapak tamiri: yaşlı hastalarda artmış erken ameliyat sonrası risk

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ABSTRACT

Background: This study aims to evaluate our early results (first postoperative 30 days) of coronary artery bypass grafting (CABG) and complete or partial ring mitral annuloplasty procedures and to define the mortality rate in the patients with ischemic heart disease and ischemic mitral insufficiency.

Methods: Between May 2000 and May 2012, 180 consecutive patients underwent simultaneous CABG and complete or partial mitral ring annuloplasty for ischemic heart disease and moderate to severe ischemic mitral insufficiency. Prospectively collected data were analyzed retrospectively in terms of early outcomes.

Results: Thirty days mortality rate was 6.1% compared to a mean logistic EuroSCORE value of 9.2% (range 1.5 to 62.2). The mean intensive care unit and hospital stays were 49 (range 4 to 576) hours and 10 (range 0 to 105) days, respectively. The only independent risk factor for mortality was increased age (7.4 times higher mortality rate in patients aged more than 70 years compared to the younger patients, p=0.006).

Conclusion: Moderate to severe functional mitral regurgitation in ischemic heart disease may be treated with mitral valve repair combined with CABG with acceptable operative risk. However, advanced age (>70 years old) is an independent risk factor for 30-day mortality. This should be considered for operative planning.

Keywords: Coronary artery bypass grafting; ischemic mitral insufficiency; mitral valve repair.

ÖZ

Amaç: Bu çalışmada, iskemik kalp hastalığı ve iskemik mitral yetersizliği bulunan hastalarda koroner arter baypas greftleme (KABG) ve tam veya kısmi mitral halka annüloplasti ameliyatının erken dönem sonuçları (ameliyattan sonra ilk 30 gün) değerlendirildi ve mortalite için risk faktörleri belirlendi.

Çalışma planı: Haziran 2000 - Mayıs 2012 tarihleri arasında iskemik kalp hastalığı ve orta ila şiddetli iskemik mitral yetersizliği olan ardışık 180 hastaya eş zamanlı CABG ve tam veya kısmi mitral halka anüloplastisi uygulandı. Prospektif olarak toplanan veriler retrospektif olarak erken dönem sonuçlar açısından değerlendirildi.

Bulgular: Ortalama %9.2'lik (dağılım 1.5-62.2) lojistik EurosSCORE değerine kıyasla, 30 günlük mortalite %6.1 olarak bulundu. Yoğun bakımda kalış süresi ortalama 49 (dağılım 4-576) saat, hastanede kalış süresi ortalama 10 (dağılım 0-105) gün idi. Mortalitenin tek bağımsız risk faktörü ileri yaş idi (70 yaşın üzerindeki hastalarda mortalite riski, genç hastalara oranla 7.4 kat fazla bulundu; p=0.006).

Sonuç: İskemik kalp hastalığı olan hastalarda orta ila şiddetli fonksiyonel mitral yetersizlik, KABG ile kombine olarak yapılan mitral kapak tamiri ile kabul edilebilir bir cerrahi risk ile tedavi edilebilir. Ancak, ileri yaş (>70 yıl), 30 günlük mortalite için bağımsız bir risk faktörüdür. Bu durum cerrahi planlama yapılırken göz önünde tutulmalıdır.

Anahtar sözcükler: Koroner arter baypas greftleme; iskemik mitral yetmezlik; mitral kapak tamiri.

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Ischemic mitral regurgitation (IMR) is a complication of coronary artery disease (CAD) that is possibly the product of acute myocardial infarction (AMI). Ischemic mitral regurgitation, which is more of a ventricular disease than a valvular disease, occurs as a result of regional and global left ventricular remodeling after AMI,[1,2] with various series having reported an incidence rate of between 17 and 55%.[3-6]

The decision regarding how to treat IMR during coronary artery bypass grafting (CABG) may be challenging, at least in some cases. Some clinicians advocate mitral valve repair (MVR) in addition to CABG,[7-10] but others disagree with this recommendation because of the high mortality and morbidity risk, especially in some patient subsets such as the elderly and those with low ejection fraction (EF) values and/or multivessel disease.[11,12]

In this retrospective study, the early (postoperative 30-day) results of CABG combined with MVR and the associated risk factors for early mortality and morbidity were evaluated.

PATIENTS AND METHODS

This prospective observational study used data from consecutive open cardiac surgery procedures performed by two surgical and anesthesia teams between 2000 and 2012. A total of 180 patients (130 males and 50 females; mean age 65.2±9.1 years; range 31.8 to 87.2 years) were evaluated.

The demographic characteristics, anamnesis information, preoperative echocardiographic and angiographic findings, European System for Cardiac Operative Risk Evaluation (EuroSCORE) values, operative data, postoperative echocardiologic results, and postoperative mortality and morbidity rates were recorded. For each of the patients, the prospectively recorded data was collected from our electronic database.

Only those patients with an IMR of 3+ or 4+ who also needed CABG were included in our retrospective study. The mitral valves were preoperatively evaluated by transthoracic echocardiography (TTE), and the patients who had undergone mitral valve replacement along with those with organic, degenerative mitral regurgitation were excluded.

Our classification system for the regurgitant lesions of the mitral valve was adapted from the 2014 American College of Cardiology (ACC)/American Heart Association (AHA) Task Force on Practice guidelines[13] in which IMR severity was placed in the trace to mild (2+) category if the small central jet was <4 cm^2 or <20% of the left atrium area, the vena contracta width was <0.3 cm, and the flow convergence was minimal or nonexistent. It was placed in the severe regurgitation (4+) category if the vena contracta width was ≥0.7 cm with a large central mitral regurgitation jet (area <40% of the left atrium) or with a wall-impinging jet of any size, swirling in the left atrium, large flow convergence, systolic reversal in the pulmonary veins, a prominent flail mitral valve leaflet, or a ruptured papillary muscle. If there were mild signs of mitral regurgitation which did not reach the severe level, the severity was characterized as moderate (3+).

During the cardiopulmonary bypass (CPB), the mean arterial pressure and CPB pump flow were set between 50-80 mmHg and 2.2-2.5 L/m^2, respectively. Moderate hypothermia (32 °C) was also maintained, and myocardial viability was preserved via antegrade cold hyperkalemic crystalloid cardioplegia (Plegisol®, Abbott Laboratories, Abbott Park, IL, USA) except for the patients with a left ventricular ejection fraction (LVEF) of less than 25% whose antegrade and retrograde blood cardioplegia was associated with the terminal warm blood cardioplegia that was used. All patients were preoperatively and postoperatively evaluated via transesophageal echocardiography (TEE) in the operating room, and complete or partial mitral ring annuloplasty was performed on all of the patients. The decision regarding whether or not to implant a complete or partial ring was made by the surgeon according to the TEE findings and the perioperative macroscopic evaluation of the mitral valve.

Statistical analysis

The statistical analysis was performed using the SPSS version 11.0 software program (SPSS Inc., Chicago, IL, USA), and the data was presented as percentages or mean ± standard deviation (SD). Univariate comparisons were computed using a chi-square test or Fisher's exact test for categorical variables and t tests for continuous variables. Any factor with a p value of <0.1 on the univariate analysis was then entered into a multiple logistic regression analysis. A p value of <0.05 was considered to be significant.

RESULTS

The demographic and perioperative variables are shown in Table 1. The mean number of distal anastomoses that were performed was 3.1 (range 1-6), with 120 mitral valves being repaired with a complete ring and 60 with a partial ring (Table 2). Additional

Table 1. Risk factors for mortality after combined coronary bypass and mitral reduction annuloplasty (univariate analysis)

	Mortality (–) (n=169)			Mortality (+) (n=11)			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Mean age (years)			64.7±9.9			72.8±8.2	<0.001
Preoperative creatinine levels (mg/dL)			1.0±0.8			1.0±0.3	>0.05
Preoperative hematocrit levels			39.3±4.8			37.4±4.5	>0.05
Preoperative hematocrit levels of <35%		16.6			36.4		>0.05
Amount of erythrocyte suspension transfused (units)			1.1±0.3			4.0±0.3	0.003
Postoperative drainage (mL)			705±396			1107±679	0.001
Cardiopulmonary bypass time (minutes)			108±30			139±43	0.003
Cross-clamp time (minutes)			78±23			96±30	>0.05
Body mass index			28.5±4.3			26.9±3.5	>0.05
EuroSCORE			6.5±2.6			9.4±2.3	>0.05
Gender							
Female	46	27.2		4	36.4		>0.05
New York Heart Association of ≥3	65	38.5		6	54.5		>0.05
Preoperative congestive heart failure	24	14.2		3	27.3		>0.05
Previous open heart surgery	3	1.8		1	9.1		>0.05
Smokers (current)	25	14.8		0	0		>0.05
Hypertension	115	68.0		7	63.6		>0.05
Diabetes mellitus	42	24.9		2	18.2		>0.05
Chronic obstructive heart disease	20	11.8		2	18.2		>0.05
Preoperative atrial fibrillation	19	11.2		2	18.2		>0.05
Ejection fraction of <50%	144	85.2		8	72.8		>0.05
Nonelective surgery	11	6.5		0	0		>0.05

SD: Standard deviation; EuroSCORE: European System for Cardiac Operative Risk Evaluation.

procedures were performed on 43 patients along with the CABG and MVR (Table 3). Furthermore, no additional repair techniques, such as posterior leaflet plication or the Alfieri stitch, were used to treat the IMR.

The preoperative echocardiographic evaluation revealed that 78% of the patients (n=142) had an IMR of 3+, whereas for 22% (n=38), it was 4+. In the postoperative evaluation, 90 patients (50%) had no mitral insufficiency, 76 (42%) had an IMR of 1+ IMR, and 14 (8%) had an IMR of 2+ (Figure 1).

Table 2. Rings used for mitral annuloplasty

	n	%
Duran AnCore® Band	60	33.3
Carpentier-Edwards Physio Annuloplasty Ring	3	1.7
Cosgrove-Edwards Annuloplasty Ring	20	11.1
Duran AnCore® Ring	19	10.6
SJM™ Séguin Semi-Flexible Annuloplasty Ring	49	27.2
SJM™ Rigid Saddle Ring	9	5.0
Sorin Biomedica Sovering® Annuloplasty Ring	12	6.7
SJM Tailor™ Annuloplasty Ring	8	4.4

SJM: St. Jude Medical.

The 30-day mortality rate, either in the hospital or after discharge, was 6.1% (n=11). The univariate risk analysis revealed that advanced age (>70 years old) was a risk factor for mortality after the CABG and MVR were performed (p<0.001) and that CPB duration, blood transfusion, and postoperative drainage significantly increased the mortality rate (p<0.03, p<0.03, and p<0.01, respectively) (Table 1). With the multivariate statistical analysis, the only independent risk factor for postoperative mortality was advanced age [odds ratio (OR) 7.5; 95% confidence interval (CI) 1.4-39.1; p<0.001) (Table 4).

Table 3. Additional surgical procedures

	n
Tricuspit annuloplasty	17
Left atrial ablation	8
Left ventricular aneurysm repair	8
Ascending aorta replacement	6
Atrial septal defect repair	2
Bentall procedure	2

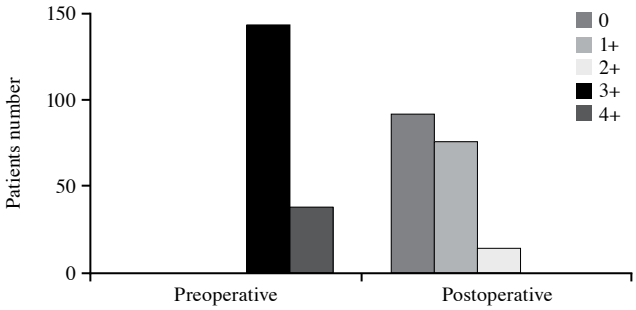

Figure 1. Pre- and postoperative ischemic mitral regurgitation status distribution.

DISCUSSION

In CAD patient populations, choosing the correct operative strategy for IMR is critical. Sirivella and Gielchinsky[7] reported that in patients who undergo surgery for CAD and IMR, optimal mitral valve function improves the quality of life (QoL) and increases functional capacity. Moreover, in the early postoperative period, successful mitral valve surgery is needed to maintain optimal mitral valve function. In addition, Benedetto et al.[8] showed that CABG performed concomitantly with MVR may be essential in order to have optimal mitral valve function in patients who undergo surgery for CAD and IMR, especially in the early postoperative period.

In our series, the mean number of distal anastomoses (3.1) should be considered as full revascularizations, and it is possible that the IMR might have been corrected naturally via ventricular reverse modeling these patients in the late postoperative period. However, in the early postoperative period, many variables can affect IMR, which can result in an increased need for medication and higher morbidity while decreasing the patients' functional capacity and QoL. Similar to the study by Prifti et al.,[9] we emphasized the importance and positive effects of MVR. In contrast, Paperella et al.[10] pointed out that IMR is a negative prognostic factor for CAD patients, especially in the early postoperative period, which conveys the idea that a repair was necessary. With regard to late postoperative mitral function, in patients with an IMR of >2+, it has been suggested that the IMR be repaired in order to accelerate the reverse modeling of the left ventricle, improve the patients' functional capacity, and increase their QoL.[11,13] Furthermore, we believe that in addition to MVR, full revascularization may have played an important role in the late-term morbidity results of other series.[9-11,13]

The above data shows that IMR in CABG candidates presents a challenging scenario. Hence, when deciding on the best operative strategy, the question of whether it is safe to perform MVR on all patient subsets must be answered.

In their retrospective study, Talwalkar et al.,[14] found a higher perioperative mortality rate and lower five-year survival rate in patients with an EF of <35%, and they also noted severe dyspnea and orthopnea in these patients. In another study by Dahlberg et al.[15] that involved elderly patients, they determined that an EF of <35% along with the presence of three or more vessel diseases or symptoms of congestive heart failure were negative prognostic factors for patients that had undergone CABG combined with MVR or replacement, irrespective of the surgical procedure that had been performed on the mitral valve. In our elective case group, the patients' EF, preoperative symptoms, and number of diseased vessels had no impact on the early postoperative outcomes or the morbidity and mortality rates, and we believe that our preoperative approach might have been the reason. We premedicated the patients with an EF of <35% and symptoms of congestive heart failure, which resulted in an improved preoperative symptomatic status before surgery. It is also possible that the use of preoperative levosimendan for our patients with an EF of <30% may have also affected the results.

Table 4. Risk factors for mortality after combined coronary bypass and mitral reduction annuloplasty (multivariate analysis)

	Mortality (–) (n=169)	Mortality (+) (n=11)			
	%	%	p	OR	95% CI
Cardiopulmonary bypass time >120 minutes	26.9	54.5	NS	2.5	0.7-9.6
Age (>70 years)	36.7	81.8	<0.001	7.5	1.4-39.1
Blood transfusion (≥1 Unit)	58.6	18.2	NS	3.4	0.6-18
Postoperative drainage (>1000 mL)	14.8	13.8	NS	2.9	0.6-12.8

OR: Odds ratio; CI: Confidence interval; NS: Not significant.

Some studies have also mentioned that the emergency status of the operations was a prognostic factor after CABG and MVR.[14,15] Moreover, in other trials, diabetes mellitus (DM) and preoperative renal insufficiency were reported to increase the risk of early mortality,[16-18] but these had no effect in our study. However, this could be due to the relatively small number of patients in our series, but there is no guarantee that a larger sample size would have yielded different results.

Advanced age (>70 years), CPB duration, and postoperative drainage and transfusion were univariate risk factors in our study, and we believe that all of these variables, except for advanced age, are important no matter what surgical technique is utilized. In addition, we do not believe it is possible to determine which variables can increase morbidity and mortality preoperatively. In addition, we found that advanced age was the only common predictive multivariate risk factor when we compared the results of our study with others.[16-18] This is crucial because this information could be used when choosing the appropriate surgical option in order to decrease early postoperative morbidity and mortality.

Previously published studies have also emphasized the importance of MVR for achieving optimal postoperative mitral valve function.[8-10] In our study, 92% of the patients (n=166) had no mitral regurgitation or only an IMR of 1+ postoperatively, thus proving that the preoperative pathologies of mitral regurgitations were ischemia, which primarily results in annular enlargement. Therefore, using either complete or partial ring annuloplasty without any additional repairs for the mitral valve was appropriate for these patients.

Our study had some limitations. For example, we included no mid- or long-term results for the patients; hence, we can make no claims that these mitral valve procedures would be effective over a prolonged period of time. In addition, new studies which compare early-, mid-, and long-term results between two groups of patients (CABG alone vs. CABG + MVR) who undergo surgery for CAD and IMR will be more descriptive than ours. Hence, we suggest that future studies should be comprised of larger patient populations so that the early prognostic factors can be properly identified.

In our clinic, complete or partial mitral annuloplasty performed concomitantly with CABG is the norm for patients undergoing CABG with an IMR of 3+ or higher. We believe that the results for this study show that in the early postoperative period, our patients either gained optimal valve function or avoided residual mitral regurgitation by this type of surgery. As a result, the patients' functional capacity and QoL also improved. Moreover, the need for postoperative medication was reduced because of the decreased likelihood of potential adverse events associated with the prescribed medications. Finally, because advanced age was a negative predictive factor for mortality and morbidity in the early postoperative period in our study, we recommend that only CABG be performed on patients over the age of 70 who otherwise needed surgery for CAD and IMR when they were younger.

Declaration of conflicting interests

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