What Happens to Mild-to-Moderate Chronic Ischemic Mitral Regurgitation Following Isolated Coronary Artery Bypass Surgery?

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ABSTRACT

Introduction: The aim of this study was to assess the efficacy of isolated coronary artery bypass grafting (CABG) on preoperatively existing mild-to-moderate chronic ischemic mitral regurgitation.

Patients and Methods: A retrospective analysis was conducted on 30 patients who had coronary artery disease and chronic ischemic mitral regurgitation, and underwent isolated CABG at the Department of Cardiovascular Surgery, Kocaeli University, between January 2012 and February 2014. Preoperative demographic and clinical characteristics, as well as postoperative outcomes, were evaluated. The degree of IMR, left ventricular ejection fraction (LVEF), left ventricular end-systolic dimension (LVESD), left ventricular end-diastolic dimension (LVEDD), and left atrial dimension (LAD) were assessed preoperatively, and at the postoperative 12th month.

Results: There was no mortality during the early postoperative period. There were statistically similar measurements for LVEF, LVESD, LVEDD, and LAD between preoperative and postoperative periods ($p> 0.05$). However, a decrease in the degree of IMR was detected during the specified periods ($p< 0.05$).

Conclusion: Isolated CABG can be safely performed in patients with mild/moderate chronic ischemic mitral regurgitation. The efficacy of isolated CABG was demonstrated to improve the degree of mitral regurgitation in selected patients based on echocardiographic measurements.

Key Words: Mitral valve regurgitation; echocardiography; coronary artery bypass surgery

İzole Koroner Arter Bypass Cerrahisinin Ardından Hafif ve Orta Dereceli Kronik İskemik Mitral Yetersizliğine Ne Olur?

ÖZET

Giriş: Hafif/orta mitral yetersizliği (MY) olan hastalarda izole koroner arter bypass grefti (CABG) cerrahisinin etkinliğini değerlendirmek.

Hastalar ve Yöntem: Ocak 2012 ile Şubat 2014 Kocaeli Üniversitesi Kalp Damar Cerrahisi biriminde izole CABG uygulanan 30 hasta retrospektif olarak incelendi. Ameliyat öncesi demografik ve klinik özellikler ile ameliyat sonrası sonuçlar değerlendirildi. Hastaların MY derecesi, sol ventrikül ejeksiyon fraksiyonu (SVEF), sol ventrikül sistol sonu boyut (SVSSB) ve sol ventrikül diyastol sonu boyut (SVDSB), sol atriyum boyutu (SAB) ameliyat öncesi ve ameliyat sonrası 12. ayda kontrol edildi.

Bulgular: Hiçbir hastada mortalite görülmedi. Hastaların ameliyat öncesi ve ameliyat sonrası SVEF, SVSSB, SVDSB ve SAB ölçümlerinde istatiksel olarak benzerlik mevcuttu ($p> 0.05$). Ancak belirtilen periyotlarda hastaların MY derecelerinde azalma tespit edildi ($p< 0.05$).

Sonuç: Hafif/orta mitral yetmezliği bulunan hastalarda izole CABG güvenle uygulanabilir. CABG'nin etkinliği hastaların ekokardiyografik ölçümlerinde özellikle MY derecesinin azalmasıyla olumlu bir şekilde gösterilmiştir.

Anahtar Kelimeler: Mitral kapak yetersizliği; ekokardiyografi; koroner arter bypass cerrahisi

INTRODUCTION

Ischemic mitral regurgitation (IMR) is a common complication after myocardial infarction[1]. There is no consensus on the surgical treatment of patients with coronary artery disease and mild-to-moderate IMR. It was suggested in several studies that isolated coronary artery bypass grafting (CABG) surgery may reduce the degree of IMR by improving left ventricular function[2].

Cite this article as: Durmaz D, Gündöner S, Tekümit H, Berki KT. What happens to mild-to-moderate chronic ischemic mitral regurgitation following isolated coronary artery bypass surgery? Koşuyolu Heart J 2023;26(3):139-144.

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Submitted: 08.09.2023
Accepted: 12.10.2023
Available Online Date: 20.11.2023

Some researchers recommend mitral annuloplasty repair at the time of CABG to directly reduce the degree of IMR[3,4]. However, the addition of mitral valve repair to CABG may increase operative morbidity and mortality rates. The aim of this retrospective study was to evaluate the clinical and echocardiographic results of changes in IMR degree at postoperative one-year in patients who had mild or moderate IMR and coronary artery disease and underwent isolated CABG.

PATIENTS and METHODS

A retrospective analysis of 30 patients with mild/moderate chronic IMR was performed among 298 patients who underwent isolated CABG between January 2012 and February 2014 in the Cardiovascular Surgery Clinic of Kocaeli University Faculty of Medicine. This study was approved by Kocaeli University Clinical Ethics Committees on 30.12.2014 with KOÜKAEK: 2014/353 certificate number.

Preoperative echocardiography was performed within one week before surgery to determine the etiology and degree of IMR. Patients with mild or moderate IMR were included in the study. The exclusion criteria were determined as an absence of sinus rhythm, severe valvular stenosis, mitral valve pathologies due to prolapse, rheumatic, endocarditis, annular calcification, leaflet damage, history of reoperation, and unstable clinical conditions. Standard transthoracic echocardiography with Philips IE 33 system (S5-1 probe, 2.5-5.5 MHz; Philips Healthcare, Andover, Mass) was performed preoperatively and at postoperative 12th month. Left ventricular ejection fraction (LVEF), left ventricular end-systolic diameter (LVESD), left ventricular end-diastolic diameter (LVEDD), and left atrial diameter (LAD) were evaluated. IMR was assessed according to the diagnostic criteria of the European Society of Echocardiography.

Clinical data were recorded as age, sex, arterial blood pressure, arterial hypertension, dyslipidemia, diabetes, smoking, New York Heart Association (NYHA) functional class, outcome (survival or death), length of intensive care unit or hospital stay, and major complications related to the operation, including respiratory complications, neurological complications (stroke or transient ischemic attack), and low cardiac output before or after surgery.

Regarding perioperative variables, low cardiac output syndrome was defined as the need for an intra-aortic balloon pump. Transient ischemic attack (TIA) was defined as a transient neurological event with loss of neurological function during less than 24 hours. Pneumonia and atelectasis have been defined as respiratory complications. Renal complication was defined as the need for dialysis after CABG, and serum Cr >1.8 mg/dL.

Standard median sternotomy was performed under general anesthesia in all patients. After appropriate anticoagulation with 400 IU/kg heparin, cardiopulmonary bypass (CPB) was initiated by cannulation of the ascending aorta and right atrium. All patients were monitored with moderate hypothermia (28-32 °C) and myocardial protection was achieved with antegrade-retrograde combined isothermic blood cardioplegia. Mean arterial pressure was maintained between 60 and 80 mmHg during CPB.

All data were analyzed using the SPSS 20.0 package program and were expressed as mean ± standard deviation. The Chi-square test was used for categorical data analysis. The difference between preoperative and postoperative values was evaluated by the Paired-t test for numerical variables with normal distribution, and the Wilcoxon test for numerical variables without normal distribution. Values of $p< 0.05$ were considered statistically significant.

RESULTS

Patient's Data

CABG procedure was performed with cardiopulmonary bypass in 30 patients. The mean age was 62.6 ± 6.4 years. Baseline demographic data and EF values of the patients are presented in Table 1.

Operative Data

There was no mortality in any patient. The mean cardiopulmonary bypass (CPB) and aortic cross-clamp times (ACC) were 74 ± 24 minutes and 50 ± 16 minutes, respectively. One patient underwent reoperation due to bleeding at the postoperative 5th hour. In one patient, an intraaortic balloon pump was administered because of low cardiac output. Operative data of the patients are shown in Table 2.

Echocardiographic results

Echocardiography was performed in all patients preoperatively, and at 12 months postoperatively. No statistical difference was found in the LVEF, LVEDD, LVESD, and LAD measurements of the patients preoperatively, and at 12 months postoperatively ($p> 0.05$). However, a statistical difference was found in terms of the degree of MR in the preoperative and postoperative 12th-month periods ($p< 0.05$) (Table 3).

Table 1. Patient data

Patients (n= 30)	n/%	Mean ± SD	Range
Age		62.6 ± 6.4	(51-74)
Gender (Male)	21 (70%)		
BSA (m^2)		1.79 ± 0.47	(1.65-2.04)
Euro-Score		7.8 ± 3.1	(6.4-11)
Hypertension	16 (53.3%)		
COPD	3 (10%)		
Diabetes mellitus	14 (46.7%)		
Smoking	12 (40%)		
NYHA class III-IV	14 (46.6%)		
Use of SVG	30 (100%)		
LVEF	30 (100%)		
<35%	5 (16.6%)		
35-50%	21 (70%)		
>50%	4 (13.3%)		
MR (2+) (Mild to Moderate)	24 (80%)		
MR (1+) (Mild)	6 (20%)		

BSA: Body surface area, COPD: Chronic obstructive pulmonary disease, NYHA: New York heart association, SVG: Saphenous vein graft, MR: Mitral regurgitation.

Table 2. Operative data

Variables (n= 30)	n/%	Mean ± SD	Range
CPB (min)		74 ± 24	(50-98)
ACC (min)		50 ± 16	(35-66)
Mechanical Ventilation (hrs.)		10.5 ± 2.8	(7.1-18.5)
ICU stay (hrs.)		21.6 ± 5.8	(14-27)
Discharge (days)		7.6 ± 2.9	(5-10)
Drainage (mL)		320 ± 125	(250-600)
Bleeding Revision	1 (3.3%)		
LCOS	1 (3.3%)		
• IABP	1 (3.3%)		
Renal Complication	2 (6.7%)		
• Dialysis	1 (3.3%)		
• Creatinine >1.8 mg/dl	1 (3.3%)		
Neurological Complication	1 (3.3%)		
• TIA	1 (3.3%)		
Respiratory Complication	2 (6.7%)		
• Atelectasis	1 (3.3%)		
• Pneumonia	1 (3.3%)		
ECMO	0		
Mortality	0		

CPB: Cardiopulmonary bypass, ACC: Aortic cross-clamp, ICU: Intensive care unit, IABP: Intra-aortic balloon pump, ECMO: Extracorporeal membrane oxygenation, TIA: Transient ischemic attack.

Table 3. Echocardiographic results

Variable		Echocardiography (Preoperative)	Echocardiography (Postoperative one yr.)	p
Patients		**n= 30**	**n= 30**	
LVEF (%)	Mean ± SD Range	46.1 ± 5.7 (30-60)	48.1 ± 4.3 (35-60)	0.244
LVEDD (cm)	Mean ± SD Range	5.23 ± 0.65 (4.7-5.5)	5.29 ± 0.64 (4.9-5.6)	0.567
LVESD (cm)	Mean ± SD Range	3.60 ± 0.82 (3.4-4.4)	3.58 ± 0.92 (3.2-4.4)	0.897
LAD (cm)	Mean ± SD Range	4.35 ± 0.4 (4.00-4.40)	4.45 ± 0.4 (4.30-4.70)	0.077
MR	Mean ± SD	1.8 ± 0.4	1.33 ± 0.47	0.034*

LVEF: Left ventricular ejection fraction, LVEDD: Left ventricular end diastole dimension, LVESD: Left ventricular end systolic dimension, LAD: Left atrial dimension, MR: Mitral regurgitation, *: p< 0.05.

DISCUSSION

Ischemic mitral regurgitation (IMR), often referred to as functional mitral regurgitation, is mitral regurgitation that occurs as a result of myocardial ischemia or infarction. By definition, the mitral valve leaflets are structurally normal in IMR. IMR is due to the malcoaptation of the leaflets, and a consequence of acute papillary muscle dysfunction or changes in geometry with left ventricular remodeling[5,6].

Mitral valve insufficiency is a functional problem that occurs in 30% to 50% of patients with myocardial infarction (MI)[7]. Geometric remodeling of the left ventricle displaces the papillary muscles and subsequently affects the chordae tendineae, leading to valvular insufficiency. Echocardiographic evaluation of ischemic MR includes measurement of MR severity, assessment of leaflet and chordal pathology, assessment of papillary muscles, assessment of left ventricular global and regional function, left ventricular ejection fraction, left ventricular wall motion, and dimensions[8].

The majority of these patients have 1+ to 2+ mitral regurgitation, without evidence of heart failure[9-14]. Optimal management of IMR remains elusive. Although concomitant severe (3+ and 4+) IMR should be managed surgically at the time of CABG, the optimal management of mild to moderate (1+, 2+) IMR remains controversial[5].

In patients with acute post-infarction angina with 1+ or 2+ MR, urgent myocardial revascularization is indicated to relieve angina and prevent infarct spread. Thrombolysis or percutaneous coronary intervention is usually performed to prevent the progression of IMR or the development of congestive heart failure[6]. Important factors to consider when intervening for (1+), (2+) IMR include the impact of CABG alone on the progression of IMR, the impact of CABG with and without MV intervention on survival, the additional risk of MV intervention during CABG, and the decision for valve repair or replacement[5].

To assess MR levels on echocardiography, MR is classified as mild(1+), mild to moderate (2+), moderate (3+), and severe (4+). Although mitral valve repair concomitant with CABG may improve functional capacity and MR severity in advanced MR[15], the appropriate surgical approach for mild to moderate MR is still controversial. It has been reported that successful revascularization may also be favorable for mitral valve function in patients with MR, associated with a reduction in left ventricular size, increased mitral valve closure forces, improved papillary-muscle synchrony, and increased myocardial contractility[16].

In this study, we analyzed the changes in mitral valve and left ventricular structures preoperatively and one year postoperatively in patients with mild/moderate IMR who underwent isolated CABG. Due to its efficacy and safety, there are many studies aiming to evaluate the effects and outcomes of adding mitral valve intervention to CABG or performing isolated CABG. Fattouch et al. found that adding mitral valve repair to CABG was associated with efficacy, improvement in the percentage of LVEF in NYHA functional class, and reduction in the degree of mitral regurgitation, left ventricular end-diastolic and end-systolic diameters, pulmonary artery pressure and left atrial size[3].

Those who advocate the conservative approach of revascularization alone without treatment of the IMR argue that revascularization will improve regional wall motion abnormalities, and papillary muscle function, and potentially correct IMR[11,17,18].

Moreover, some data suggest that survival and long-term functional status are not improved with concomitant MV interventions[19,20]. Previous studies suggest that CABG alone improves IMR grade and functional status[11,17,18].

Kim et al. found similar five-year survival with combined mitral valve repair and revascularization compared to revascularization alone in patients with MR[21]. In addition, a 2009 meta-analysis reported no survival benefit of adding mitral valve intervention to CABG[22]. In another study, Sun et al. stated that the outcomes of patients with moderate MR are associated with LVEF and post-infarction timing, and that isolated CABG is an effective approach in patients with good LVEF and early post-infarction intervention[23].

In this retrospective analysis, 30 patients were evaluated preoperatively and at 12 months postoperatively. There was no statistically significant difference between the preoperative EF, LVEF, LVEDD, LVESD and LAD values and the postoperative 12-month values. This is a positive result in terms of complications related to prolonged cardiopulmonary bypass and aortic clamping times due to the addition of mitral valve repair to CABG. In addition, the preoperative MR grade of the patients was found to have regressed according to the 12-month postoperative examination. This suggests that the approach applied in patients with mild to moderate MR is correct.

CONCLUSION

In conclusion, our approach showed that patients with mild to moderate MR are likely to benefit from isolated CABG and is in line with similar studies. We believe that isolated CABG may improve mitral regurgitation in cases of mild to moderate MR. However, the limiting factors of this study include its single-center and retrospective nature, potentially impacting generalizability.

There are no randomized trials showing a survival benefit with mitral valve repair/replacement in IMR. The similarity of outcomes between surgical and medical treatment suggests that the pathophysiology of IMR and left ventricular remodeling needs to be better understood.

Mild (1+) IMR should be left alone, unless: (1) preoperative signs and symptoms are suggestive of periods of more severe mitral regurgitation; and (2) intraoperative TEE demonstrate anatomical findings requiring MVR (i.e., significant annular dilatation, leaflet tenting)[5]. We believe a randomized trial investigating the clinical outcomes and survival benefits of mitral valve surgery for IMR is warranted.

Ethics Committee Approval: This study was approved by the Kocaeli University Clinical Research Ethics Committee (Decision no: 25/13, Date: 30.12.2014).

Informed Consent: This is retrospective study, we could not obtain written informed consent from the participants.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept/Design - DD; Analysis/Interpretation - HT; Data Collection - SG; Writing - DD; Critical Revision - KTB; Final Approval - DD; Statistical Analysis -SG; Overall Responsibility - DD.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declare that this study has received no financial support.

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