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Evaluation of Postoperative Mid-Term Outcomes of Patients with Mitral Annular Calcification Undergoing Mitral Valve Replacement

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ABSTRACT

Introduction: Mitral annular calcification (MAC) is a chronic degenerative condition characterized by calcification of the fibrous tissue surrounding the mitral valve. Conditions such as prosthetic valve dehiscence and atrioventricular groove separation may occur in patients with MAC who undergo mitral valve replacement (MVR). The aim of this study was to investigate what measures can be taken in the intraoperative/postoperative period to reduce postoperative paravalvular leak (PVL) rates, complications, mortality and morbidity rates among patients with MAC undergoing MVR.

Patients and Methods: Patients with MAC undergoing MVR in our clinic between January 2014 and December 2017 were retrospectively analyzed. The patients were divided into two groups: patients undergoing MVR and tricuspid valve intervention (Group 1, n= 26, %56.5) and those undergoing MVR, tricuspid valve intervention and additional cardiac procedure (Group 2, n= 20, %43.4). Preoperative, operative and postoperative outcomes of them were compared.

Results: The study included a total of 46 patients, 16 males (34.8%) and 30 females (65.2%). The mean age of patients was 62 ± 11.6. The analysis of intraoperative data showed that cross-clamp time and cardiopulmonary bypass time in Group 2 were significantly longer than other group (p< 0.001). In the postoperative period, postoperative day 0 and total drainage amount, blood product requirement, development of postoperative acute kidney injury, hemodialysis/hemofiltration requirement, and need for extracorporeal membrane oxygenation (ECMO) and inotropic treatment were found to be significantly higher in Group 2. In the postoperative echocardiography data, no significant difference was found between the two groups in terms of PVL rates.

Conclusion: Cross-clamp time and cardiopulmonary bypass time were found to be higher in patients with MAC receiving both MVR and additional procedure compared to those who underwent MVR and more complications were observed in these patients. Additional surgical procedures did not affect paravalvular leak rates and mortality rates among the patients with MAC.

Key Words: Mitral annular calcification; mitral valve replacement; paravalvular leak.

Mitral Anüler Kalsifikasyonu Olup Mitral Kapak Replasmanı Yapılan Hastaların Postoperatif Orta Dönem Sonuçlarının Değerlendirilmesi

ÖZ

Giriş: Mitral anüler kalsifikasyon (MAK), mitral kapağı çevreleyen fibröz dokunun kalsifikasyonuyla karakterize kronik dejeneratif noninflamatuvar bir durumdur. MAK (+) olup mitral kapak replasmanı (MVR) yapılan hastalarda protez kapak dehissensi, atriyoventriküler oluk ayrışması gibi durumlar görülebilir. Bu çalışmada, MAK (+) olup MVR yapılmış hastaların kendi arasında postoperatif dönemdeki paravalvüler kaçak (PVL) oranlarını, komplikasyonlarını, mortalite ve morbiditeyi azaltmak için intraoperatif/postoperatif ne gibi önlemler alınabileceğinin araştırılması amaçlanmıştır.

Hastalar ve Yöntem: 2014 Ocak ile 2017 Aralık arasında kliniğimizde, MAK olup MVR yapılmış olan hastalar retrospektif olarak incelendi. Hastalar, MVR ile birlikte triküspit kapağa müdahale edilen (Grup 1, n= 26, %56.5) ve MVR ile triküspit kapağa müdahale ve ek kardiyak prosedür uygulanan hastalar (Grup 2, n= 20, %43.4) olmak üzere iki gruba ayrıldı. Bu hastalara ait preoperatif, operatif ve postoperatif sonuçlar karşılaştırıldı.

Bulgular: Çalışma 16 erkek (%34.8) ve 30 kadın (%65.2), toplam 46 hasta üzerinde yapılmıştır. Hastaların ortalama yaşı 62 ± 11.6 yıldır. İntraoperatif verilere bakıldığında; Grup 2'de kros klemp süresi ve kardiyopulmoner baypas süresi Grup 1'e göre anlamlı olarak daha uzun bulunmuştur (p< 0.001). Postoperatif dönemde Grup 2'de postoperatif sıfırıncı gün ve toplam drenaj miktarı, kan ürünü ihtiyacı, postoperatif akut böbrek yetmezliği gelişimi ve hemodiyaliz/hemofiltrasyon ihtiyacı, ECMO ve inotrop gereksinimi anlamlı olarak daha yüksek bulunmuştur. Postoperatif ekokardiyografi verilerinde ise iki grup arasındaki PVL oranları arasında anlamlı fark saptanmamıştır.

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Sonuç: Mitral anüler kalsifikasyon olup MVR ile birlikte ek prosedür yapılan hastalarda MVR yapılan hastalara göre kros klemp süresi ve kardiyopulmoner baypas süresi daha yüksek saptanmış olup bu grupta postoperatif dönemde daha fazla komplikasyon görülmüştür. Ek cerrahi prosedürlerin PVL ve mortalite oranları üzerine etkisi yoktur.

Anahtar Kelimeler: Mitral anüler kalsifikasyon; mitral kapak replasmanı; paravalvüler kaçak.

INTRODUCTION

Mitral annular calcification (MAC) is a chronic degenerative non-inflammatory condition characterized by calcification of the fibrous tissue surrounding the mitral valve. The prevalence of MAC is estimated to be 3-9% in patients undergoing mitral valve replacement (MVR)[1]. Increased cardiovascular diseases, diseases of the mitral valve, arrhythmias, and incidence of sudden cardiac death have been found to be associated with MAC[2]. Performing MVR in the presence of MAC is estimated to be associated with poor surgical outcomes. The presence of MAC can damage the fixation sutures of the mitral prosthetic valve, leading to paravalvular leakage and worsening of the patient's clinical condition[3]. In some centers, an approach involving the complete resection of calcification and reconstruction of a new annulus from the pericardium is used for MVR. However, these approaches are not widely used and there are doubts that they increase the surgical risk[4]. MacVaugh et al. explained the fatal complications developed in patients with MAC undergoing MVR in detail[3]. These results are still associated with conditions that can be fatal if not noticed in time, such as severe circumflex artery injury and atrioventricular groove separation in the posterior commissure. Considering these issues, some researchers have obtained promising outcomes by adopting an approach involving a mild decalcification application and then, prosthetic valve implantation[5]. In this study, we aimed to compare the postoperative echocardiography (Echo) results, paravalvular leak (PVL) rates, complications, and mortality rates of patients with MAC undergoing MVR and tricuspid valve intervention with those of patients who underwent MVR, tricuspid valve intervention, and additional surgical procedure.

PATIENTS and METHODS

A total of 890 patients undergoing mitral valve intervention between January 2014 and December 2017 at the University of Health Sciences Kosuyolu High Specialty Training and Research Hospital Cardiovascular Surgery clinic were retrospectively evaluated. A total of 48 patients were found to be positive for MAC through the examination of postoperative Echo results and operation notes. Two of these patients were excluded from the study because they were operated for infective endocarditis, all patients were included in the case under elective conditions. It was observed that the tricuspid valve was intervened in all patients with MAC undergoing MVR. The patients were divided into two groups: those undergoing MVR and tricuspid valve intervention (n= 26, 56.5%, Group 1) and those undergoing MVR + tricuspid valve intervention + additional surgical procedure (n= 20, 43.5%, Group 2). In Group 2, as additional surgical procedures, nine patients underwent coronary artery bypass grafting (CABG), three patients underwent aortic valve replacement (AVR), one patient underwent sutureless AVR, two patients underwent AVR + CABG, two patients underwent AVR + Marrow procedure, two patients underwent Bentall-De Bono procedure and one patient underwent Marrow procedure.

We compared cross-clamp and cardiopulmonary bypass time, inotropic agent usage, IABP and ECMO requirement, intraoperative mortality, paravalvular leak rates, postoperative complications, postoperative mortality, preoperative and postoperative echo between the two groups.

The preoperative echo data examined included ejection fraction (EF), left ventricle end-systolic and end-diastolic diameters, interventricular septum diameter, mitral valve area in the presence of mitral stenosis and pulmonary artery pressures. For the postoperative echo examination, echos taken between the third and ninth postoperative months were found and postoperative EF, left ventricular end-systolic and end-diastolic diameters, interventricular septum diameter, mitral valve gradient, pulmonary artery pressures and the presence of paravalvular leak were evaluated.

Operative Approach

Preoperative and perioperative surgical protocol and the anesthesia induction and maintenance were performed in accordance with the standard procedures. Aortic arterial cannulation and bicaval venous cannulation were performed with the standard median sternotomy approach. In redo patients (n= 9, 19.6%), right femoral arterial and venous cannulation was performed. Antegrade cardioplegia cannula was placed in the aorta and since surgical teams used different methods, retrograde cardioplegia cannula was placed from the coronary sinus in some patients (n= 30, 65.2%). Following cardiopulmonary bypass (CPB), aortic cross-clamping was performed.

Moderate hypothermia was applied to the patients. During cross-clamping, blood pressure was maintained to be 60-80 mmHg. Antegrade cardioplegia was given intermittently. Cardioplegia was delivered continuously via the coronary sinus in patients with a retrograde cannula. Standard left atriotomy

incision was made. Mitral valve surgery examination was performed. Then, mitral valve excision was performed and calcifications in the mitral annulus were removed. Pledgeted 2-0 sutures were used in the mitral annulus to place the prosthetic valve intraocularly. Then, the left atriotomy was closed. After performing the additional procedures required, the cross-clamp was removed. After sufficient cardiac output was achieved, CPB was ended.

Statistical Analysis

Statistical analysis was performed using SPSS version 21.0 software. In the evaluation of the data, descriptive statistical methods such as mean and standard deviation were used for quantitative variables. Categorical variables were given as frequency percentages. T-test and Mann-Whitney U test were used to compare quantitative parametric and non-parametric data between the groups whereas the Chi-square test was used to compare qualitative data. A p value of < 0.05 was considered statistically significant.

RESULTS

Of the 46 patients included in the study, 16 (34.8%) were male and 30 (65.2%) were female. The mean age of the patients was 62 ± 11.6 years. When the patients were evaluated in terms of accompanying diseases, 15 (32.6%) patients had diabetes mellitus, 30 (65.2%) patients had hypertension, 17 (37%) patients had chronic obstructive pulmonary disease, 5 (10.9%) patients had history of cerebrovascular events, and 1 (2.2%) patient had a history of dialysis for chronic renal failure (Table 1).

Mitral valve pathology requiring intervention was isolated mitral insufficiency in 29 (63%) patients, isolated mitral stenosis in 5 (10.9%) patients, and both of them in 12 (26.1%) patients. The MAC was located posteriorly in 34 (73.9%) patients, anteriorly + posteriorly in 7 (15.2%) patients, anteriorly in 2 (4.3%) patients, laterally in 1 (2.2%) patient and was in the form of blocks in 2 (4.3%) patients. There was no significant difference between the two groups in terms of MAC localization (Table 2).

When the operative data of the patients were examined, the mean cross-clamp time was found to be 123.3 ± 57.5 minutes whereas the CPB time was 183.8 ± 93.7 minutes. When the two groups were compared, the cross-clamp time in Group 1 was 89.1 ± 25.4 minutes, while it was 167.7 ± 57.7 minutes in Group 2. There was a statistically significant difference between the groups in terms of CPB time (137.5 ± 38.8 minutes in Group 1 and 243.9 ± 107.9 minutes in Group 2) ($p< 0.001$) (Table 3).

The amount of drainage was found to be significantly lower for both day 0 drainage and total drainage volumes in Group 1 ($p= 0.011$ and $p< 0.001$, respectively). Furthermore, the patients in Group 1 required less erythrocyte suspension,

Table 1. Demographic features and additional diseases of patients

Parameters	Total (n= 46)	Group 1 (n= 26)	Group 2 (n= 20)	p value
Age (years)	62 ± 11.6	62.2 ± 9.2	61.7 ± 14.3	0.535
Gender				0.057
Male (n, %)	16 (34.8)	6 (23.1)	10 (50)	
Female (n, %)	30 (65.2)	20 (76.9)	10 (50)	
BMI (kg/m²)	29.9 ± 5.6	30.1 ± 5.2	29.7 ± 6.3	0.557
Diabetes mellitus (n, %)	15 (32.6)	12 (46.2)	3 (15)	**0.025**
Hypertension (n, %)	30 (65.2)	15 (57.7)	15 (75)	0.222
Smoking (n, %)	7 (15.2)	3 (11.5)	4 (20)	0.682
COPD (n, %)	17 (37)	8 (30.8)	9 (45)	0.322
Hemodialysis (n, %)	1 (2.2)	0	1 (5)	0.435
Hyperlipidemia (n, %)	9 (19.6)	5 (19.2)	4 (20)	0.151
Cerebrovascular accident (n, %)	5 (10.9)	1 (3.8)	4 (20)	1
Preoperative rhythm				**0.048**
Sinus rhythm (n, %)	25 (54.3)	11 (42.3)	14 (70)	
Atrial fibrillation (n, %)	20 (43.5)	15 (57.7)	5 (25)	
Pace maker rhythm (n, %)	1 (2.2)	0	1 (5)	
Previous MI (n, %)	9 (19.6)	4 (15.4)	5 (25)	0.472
Previous cardiac operation (n, %)	9 (19.6)	7 (26.9)	2 (10)	0.262

BMI: Body mass index, COPD: Chronic obstructive pulmonary disease, MI: Myocardial infarction.

Table 2. Preoperative and postoperative echocardiography values

Parameters	Total (n= 46)	Group 1 (n= 26)	Group 2 (n= 20)	p value	Parameters	Total (n= 46)	Group 1 (n= 26)	Group 2 (n= 20)	p value
Ejection fraction (%)	56.6 ± 9.1	58.6 ± 7.1	54 ± 10.9	0.159	Postoperative EF (%)	52.5 ± 11.1	54.8 ± 7.6	48.7 ± 14.6	0.307
Left ventricular end-systolic diameter (cm)	3.6 ± 0.8	3.5 ± 0.6	3.7 ± 1	0.614	Postoperative LVESD (cm)	3.3 ± 0.8	3.2 ± 0.6	3.6 ± 1.1	0.589
Left ventricular end-diastolic diameter (cm)	5.2 ± 0.8	5.1 ± 0.6	5.3 ± 0.9	0.874	Postoperative LVEDD (cm)	4.9 ± 0.6	4.8 ± 0.5	5 ± 0.9	0.905
Pulmonary arterial pressure (mmHg)	52.4 ± 18.1	55.4 ± 15	48.7 ± 21.2	0.224	Postoperative PABs (mmHg)	38.8 ± 16	33.6 ± 11.1	47 ± 19.4	0.069
Interventricular septum (cm)	1.1 ± 0.2	1.1 ± 0.2	1.2 ± 0.3	0.144	Postoperative IVS (cm)	1.1 ± 0.1	1.1 ± 0.1	1.1 ± 0.2	0.877
Mitral valve area (cm^2)	1.4 ± 0.6	1.5 ± 0.7	1.3 ± 0.3	0.865	Postoperative MR (degree)	0.2 ± 0.8	0.2 ± 0.6	0.3 ± 1.1	0.741
Localization of MAC (n, %)				0.768	Postoperative MV Gradient (mmHg)	6.5 ± 3.1	6 ± 2.5	7.4 ± 3.7	0.076
Posterior (n, %)	34 (73.9)	19 (73.1)	15 (75)		Postoperative PVL (n, %)	4 (8.6)	1 (3.8)	3 (15)	0.254
Anterior (n, %)	2 (4.3)	1 (3.8)	1 (5)		Valve thrombus	0	0	0	
Anterior + posterior (n, %)	7 (15.2)	3 (11.5)	4 (20)						
Block (n, %)	2 (4.3)	2 (7.7)	0						
Lateral (n, %)	1 (2.2)	1 (3.8)	0						

MAC: Mitral annular calcification, EF: Ejection fraction, LVESD: Left ventricular end-systolic diameter, LVEDD: Left ventricular end-diastolic diameter, TR: Tricuspid regurgitation, PABs: Pulmonary arterial pressure, IVS: Interventricular septum, LA: Left atrium, MR: Mitral regurgitation, MV: Mitral valve, PVL: Paravalvular leakage.

Table 3. Operative data of the patients

Parameters	Total (n= 46)	Group 1 (n= 26)	Group 2 (n= 20)	p value
Cross-clamp time (min)	123.3 ± 57.5	89.1 ± 25.4	167.7 ± 57.7	**< 0.001**
Cardiopulmonary bypass (min)	183.8 ± 93.7	137.5 ± 38.8	243.9 ± 107.9	**< 0.001**
Conversion from MV repair to MVR (n, %)	3 (6.5)	2 (7.7)	1 (5.5)	1
Valve Choice				0.373
Mechanical valve (n, %)	33 (71.7)	20 (76.9)	13 (65)	
Biological valve (n, %)	13 (28.3)	6 (23.1)	7 (35)	
Valve size (mm)	27.6 ± 4.8	28.6 ± 2.2	26.3 ± 6.7	0.142
Inotropic support (n, %)	35 (76.1)	16 (61.5)	19 (95)	**0.013**
Intra-aortic balloon pump (n, %)	1 (2.2)	0	1 (5)	0.435
ECMO (n, %)	0	0	0	
Intraoperative mortality (n, %)	0	0	0	

MV: Mitral valve, MVR: Mitral valve replacement, ECMO: Extracorporeal membrane oxygenation.

whole blood, fresh frozen plasma, and platelet suspension in the postoperative period. The difference between the groups was statistically significant (Table 4).

The first 30-day mortality rate was found to be 4.3% (n= 2), and mortality after 30 days was also found to be 4.3% (n= 2), and the total mortality rate was 8.7% (n= 4). Although the rate of mortality and total mortality within the first 30 days and after 30 days were higher in Group 2, the difference between the groups was not statistically significant (Table 4).

After 3 and 9 months the operation, two-dimensional transthoracic echocardiography data showed that mean ejection fraction 52.5 ± 11.1%, left ventricular end systolic diameter was 3.3 ± 0.8 cm, left ventricular end diastolic diameter was 4.9 ± 0.6 cm, pulmonary artery pressure during rest was 38.8 ±

Table 4. Postoperative data, complications and mortality rates

Parameters	Total (n= 46)	Group 1 (n= 26)	Group 2 (n= 20)	p value
Postoperative day 0 drainage (ml)	475 (IR 500)	300 (IR 325)	650 (IR 437,5)	**0.011**
Total drainage (ml)	850 (IR 975)	525 (IR 575)	1150 (IR 1350)	**< 0.001**
Transfusion of erythrocyte suspension	5.9 ± 11.2	1.1 ± 1	12.2 ± 15	**< 0.001**
Transfusion of whole blood	0.4 ± 0.6	0.1 ± 0.4	0.7 ± 0.8	**0.018**
Transfusion of fresh frozen plasma	5.1 ± 11.8	1.1 ± 0.9	10.3 ± 16.7	**< 0.001**
Transfusion of platelet suspension	0.7 ± 2.3	0	1.7 ± 3.2	**0.003**
Ventilation (hours)	14.1 ± 8.5	14.5 ± 10.2	13.6 ± 4.6	0.576
Intensive Care Unit stay (hours)	92.2 ± 100.4	81.7 ± 53	105.8 ± 140.8	0.921
Hospital stay (days)	13.6 ± 7.9	12.1 ± 4.7	16.5 ± 12.1	0.409
Inotropic agents (n, %)	39 (84.8)	19 (73.1)	20 (100)	**0.014**
IABP (n, %)	8 (17.4)	2 (7.7)	6 (30)	0.062
ECMO (n, %)	4 (8.7)	0	4 (20)	**0.030**
Postoperative arrhythmia (n, %)	24 (52.2)	13 (50)	11 (55)	0.736
Postoperative transient pacemaker required (n, %)	18 (39.1)	11 (42.3)	7 (35)	0.615
Acute renal failure (n, %)	22 (47.8)	9 (34.6)	13 (68.4)	**0.025**
Hemodialysis/Hemofiltration required (n, %)	11 (23.9)	3 (11.5)	8 (42.1)	**0.033**
Pulmonary complications (n, %)	22 (47.8)	11 (42.3)	11 (57.9)	0.302
Wound site infections (n, %)	8 (17,.4)	5 (19.2)	3 (15.8)	1
Permanent pacemaker (n, %)	1 (2.2)	0	1 (5.3)	0.422
Sepsis (n, %)	3 (6.5)	1 (3.8)	2 (10)	0.253
First 30 day mortality (n, %)	2 (4.3)	0	2 (10)	0.184
>30 day mortality (n, %)	2 (4.3)	1 (3.8)	1 (5)	1
Total mortality (n, %)	4 (8.7)	1 (3.8)	3 (15)	0.303

IABP: Intra-aortic balloon pump, ECMO: Extracorporeal membrane oxygenation.

16 mmHg. Postoperative PVL was detected in 4 (8.6%) patients and there was no difference statistically between the two groups (Table 2).

DISCUSSION

Mitral annular calcification may prevent the proper placement of the sutures and the prosthetic valve to fit into the annulus and it may further increase the risk of paravalvular leakage and valve dehiscence. This is a different study in terms of evaluating patients with MAC undergoing MVR in our clinic. Unlike other studies, we compared patients with MAC among themselves in this study. As a result of the research, the patients with MAC undergoing MVR + tricuspid valve intervention + additional surgical procedure were found to have significantly longer cross-clamp time and CPB time compared to the other group. In this group, the amount of drainage, blood product transfusion, ECMO and inotropic agent requirement, AKI, and hemodialysis/hemofiltration requirement were significantly higher in the postoperative period. There is no difference in paravalvular leak rates between the two groups.

In the presence of MAC, the frequency of atrial fibrillation (AF) increases in the normal population. MAC increases the risk of AF by expanding the left atrium, interrupting interatrial and intraatrial conduction pathways and causing defects in the conduction system[6,7]. The number of patients with preoperative AF in Group 1 was significantly higher than Group 2. In a study by Ben-Avi et al., the rate of preoperative AF was reported to be 14% in patients who were positive for MAC and underwent MVR, while we found it 43% in this workout[8].

We showed that the MAC rate was 5.7% among all patients who underwent MVR. In a study by Fusini et al., 24% of patients undergoing mitral valve surgery were reported to have MAC[9].

Mitral annular calcification can also cause mitral stenosis. Surgical treatment is still the gold standard since these patients are not suitable for percutaneous mitral balloon valvotomy and transcatheter implantable valve technologies developing in recent years are still on trial. Moreover, MAC has also been found to be associated with atherosclerosis and increased

cardiovascular risk factors[10]. Considering all these factors together, surgical risk increases due to the increase of additional risk factors and complications such as paravalvular leakage, atrioventricular groove separation and embolization of calcium deposits in the presence of MAC. Complete decalcification of the mitral annulus takes time. It may disrupt the structural integrity of the heart, as well as increase the possibility of damage to the circumflex artery and separation of the left ventricle. On the other hand, mild decalcification and annular reconstruction techniques can be used to reduce the possibility of paravalvular leakage in the following periods in patients with MAC who will undergo mitral valve surgery. There is no consensus yet on how much decalcification should be done. In a recent study that the calcification was completely removed and then, annular reconstruction using a pericardial patch followed by supra-annular mitral valve replacement or mitral ring annuloplasty was performed, it was reported that the operative mortality (there was no mortality within 30 days, in-hospital mortality rate was 6.6%) and morbidity rates were acceptable and the mid-term outcomes were favorable[11]. In the present study, it was found that the annulus corresponding to the P3 segment was supported by Teflon felts in one patient and the posterior annulus was strengthened with a pericardial patch for another one. Other patients underwent varying degrees of decalcification and standard MVR.

The localization and amount of MAC also affect mitral valve surgery outcomes. Localization is mostly in the posterior annulus. We couldn't find the information about the amount of MAC in the Echo data; therefore, evaluation could only be made for localization. Posterior MAC was detected in 73.9% of the patients whereas anterior and posterior MAC and block-shaped MAC in 15.2% and 4.3%, respectively. There was no statistically significant difference between mortality rates according to MAC localization. In another work by Saran N et al., it has been reported that 80% of patients had posterior, 54% had commissural, 31% had anterior and 20% had block-type MAC[12]. In some studies, calcification has been classified as mild if it is 1-4 mm and as severe if it is greater than 4 mm. Fox et al. showed that in which patients with MAC were followed for up to 16 years, they reported that each 1-mm increase in MAC increased the risk of cardiovascular diseases by 9%, deaths due to cardiovascular diseases by 12%, and all-cause mortality by 9%[13].

Currently, standard MVR mortality rates range from 1% to 6%[14]. We found that the 30-day and total mortality rates were 4.3% and 8.7%, respectively. In a study by Ben-Avi et al., no difference was reported between the early mortality and morbidity rates of patients undergoing mild decalcification and supra-annular prosthetic valve implantation compared to those of patients without MAC who underwent MVR and the in-hospital mortality rate was reported to be 5% in both groups[8].

In another workout in which MVR was performed without a pericardial patch, MVR was accomplished by leaving the left atrial wall between the prosthetic valve ring and calcified annulus; and the in-hospital mortality rate was reported to be 28%[15]. The outcomes obtained from different surgical procedures are different and there is a need for further studies to determine the most suitable surgical procedure for MAC.

The most important limitation of our study is the decrease in the strength of the statistical values obtained due to the low number of patients. Furthermore, the number of cases has differed between the groups since it is a single-center retrospective study. The preoperative and postoperative functional capacities of the patients could not be compared because of the retrospective nature of the research.

CONCLUSION

The presence of MAC makes the mitral valve surgery challenging and increases the risk of complications in the postoperative period. Surgical interventions to be practiced in addition to MVR in patients who have MAC, increase cross-clamp and CPB time. Furthermore, the amount of postoperative drainage, blood product transfusion, ECMO and inotropic requirement in the postoperative period, AKI incidence and hemodialysis/hemofiltration requirement are higher in these patients. We found that additional surgical procedures did not affect paravalvular leak rates among the patients with MAC.

There is a need for detailed and extensive studies with a larger population. Moreover, the patients with MAC scheduled for MVR should be carefully evaluated in the preoperative period, localization, size, and spread of MAC should be investigated and imaging methods should be used if necessary, and the most appropriate surgical procedure should be decided accordingly. Although there are many studies for the most appropriate surgical procedure, a patient-based decision-making process can be considered as the most correct option.

Ethics Committee Approval: This study was approved by Kartal Kosuyolu High Specialization Training and Research Hospital Ethics Committee (2018/2/55, Date: 23.02.2018).

Informed Consent: Informed consent was obtained.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept/Design - SG, VB, MY; Analysis/Interpretation - SG; Data Collection - SG; Writing - SG; Critical Revision - VB, MY; Statistical Analysis - SG; Overall Responsibility - SG; Final Approval - All of authors.

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

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REFERENCES

1. Deluca G, Correale M, Ieva R, Del Salvatore B, Gramenzi S, Di Biase M. The incidence and clinical course of caseous calcification of the mitral annulus: a prospective echocardiographic study. J Am Soc Echocardiogr 2008;21:828-33. [Crossref]
2. Quick E, Byard RW. Mitral annulus calcification and sudden death. J Forensic Leg Med 2013;20:204-6. [Crossref]
3. MacVaugh H 3rd, Joyner CR, Johnson J. Unusual complications during mitral valve replacement in the presence of calcification of the annulus. Ann Thorac Surg 1971;11:336-42. [Crossref]
4. Carpentier AF, Pellerin M, Fuzellier JF, Relland JY. Extensive calcification of the mitral valve anulus: pathology and surgical management. J Thorac Cardiovasc Surg 1996;111:718-30. [Crossref]
5. Takahashi Y, Sasaki Y, Hattori K, Kato Y, Motoki M, Morisaki A, et al. Successful surgical treatment for total circumferential aortic and mitral annulus calcification: application of half-and-half technique. Gen Thorac Cardiovasc Surg 2016;64:418-21. [Crossref]
6. Fox CS, Parise H, Vasan RS, Levy D, O'Donnell CJ, D'agostino RB, et al. Mitral annular calcification is a predictor for incident atrial fibrillation. Atherosclerosis 2004;173:291-4. [Crossref]
7. Pekdemir H, Cansel M, Yagmur J, Acikgoz N, Ermis N, Kurtoglu E, et al. Assessment of atrial conduction time by tissue Doppler echocardiography and P-wave dispersion in patients with mitral annulus calcification. J Electrocardiol 2010;43:339-43. [Crossref]
8. Ben-Avi R, Orlov B, Sternik L, Kogan A, Kuperstien R, Shalabi A, et al. Short- and long-term results after prosthetic mitral valve implantation in patients with severe mitral annulus calcification. Interact CardioVasc Thorac Surg 2017;24:876-81. [Crossref]
9. Fusini L, Ghulam Ali S, Tamborini G, Muratori M, Gripari P, Maffessanti F, et al. Prevalence of calcification of the mitral valve annulus in patients undergoing surgical repair of mitral valve prolapse. Am J Cardiol 2014;113:1867-73. [Crossref]
10. Adler Y, Fink N, Spector D, Wiser I, Sagie A. Mitral annulus calcification-a window to diffuse atherosclerosis of the vascular system. Atherosclerosis 2001;155:1-8. [Crossref]
11. Uchimuro T, Fukui T, Shimizu A, Takanashi S. Mitral valve surgery in patients with severe mitral annular calcification. Ann Thorac Surg 2016;101:889-95. [Crossref]
12. Saran N, Greason KL, Schaff HV, Cicek SM, Daly RC, Maltais S, et al. Does mitral valve calcium in patients undergoing mitral valve replacement portend worse survival? Ann Thorac Surg 2019;107:444-52. [Crossref]
13. Fox CS, Vasan RS, Parise H, Levy D, O'Donnell CJ, D'Agostino RB, et al. Mitral annular calcification predicts cardiovascular morbidity and mortality: the Framingham Heart Study. Circulation 2003;107:1492-6. [Crossref]
14. O'Brien SM, Shahian DM, Filardo G, Ferraris VA, Haan CK, Rich JB, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 2-isolated valve surgery. Ann Thorac Surg 2009;88:23-42. [Crossref]
15. d'Alessandro C, Vistarini N, Aubert S, Jault F, Acar C, Pavie A, et al. Mitral annulus calcification: determinants of repair feasibility, early and late surgical outcome. Eur J Cardiothorac Surg 2007;32:596-603. [Crossref]