Original Article

Comparison of Clinical Outcomes Following Mitral Valve Repair and Replacement in Ischemic Mitral Valve Regurgitation

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Objective: To compare clinical outcomes following mitral valve repair (MVP) to those after mitral valve replacement (MVR) in patients with ischemic mitral valve regurgitation.

Materials and Methods: The authors retrospectively analyzed data of patients with ischemic mitral valve regurgitation that underwent MVR or repair concomitant with coronary artery bypass graft at Khon Kaen University's Srinagarind Hospital and Queen Sirikit Heart Center between January 2006 and December 2016.

Results: Postoperative results, including duration of ventilator support, incidence of post-operative bleeding, arrhythmia, sepsis, stroke, ICU length of stay, and hospital length of stay, in the two groups were similar, as were early and late postoperative mortality.No patients in the MVR group experienced post-operative valve failure compared to 8% of patients in the MVP group, who had residual moderate to severe mitral valve regurgitation and required reoperation.

Conclusion: There was no significant difference in terms of survival or postoperative outcomes between the two groups. However, the MVR group had better long-term survival and lower rate of reoperation.

Keywords: Ischemic mitral valve regurgitation, Mitral valve replacement, Mitral valve repair, Coronary artery bypass graft

Received 19 Nov 2019 | Revised 2 Mar 2020 | Accepted 3 Mar 2020

J Med Assoc Thai 2020;103(7):620-5
Website: http://www.jmatonline.com

Myocardial infarction is a leading cause of death around the world[1,2], and 30% to 50% of survival patients develop ischemic mitral regurgitation (IMR)[3]. IMR patient is associated with a worse prognosis following myocardial infarction[4-6] and has a five-year mortality of 62%[7,8]. A previous randomized controlled trial found that the mortality rate in patients with moderate or severe mitral valve regurgitation that underwent mitral valve surgery and coronary artery bypass surgery (CABG) was lower than those who underwent CABG alone, but not to a significant extent[9].

Currently, mitral replacement and mitral valve repair (MVP) are the two types of mitral valve surgery performed in patients with IMR. Goldstein et al conducted a randomized controlled trial comparing mitral valve replacement (MVR) and MVP in patients with severe IMR and found no significant difference in two-year mortality but a significantly higher recurrence rate of moderate or severe mitral regurgitation (MR) over two years in the repair group than in the replacement group, leading to a higher incidence of heart failure (HF) and repeat hospitalizations[10]. However, some studies have found better outcomes in patients who undergo MVP rather than replacement[11,12] in terms of decrease post-operative mortality. MVP has also been found to be more effective in elderly patients[11]. The question as to which procedure is more effective remains

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How to cite this article:

Chotivanich W, Karunasumetta C, Mala R, Stapholdeja K. Comparison of Clinical Outcomes Following Mitral Valve Repair and Replacement in Ischemic Mitral Valve Regurgitation. J Med Assoc Thai 2020;103:620-5.

doi.org/10.35755/jmedassocthai.2020.07.10867

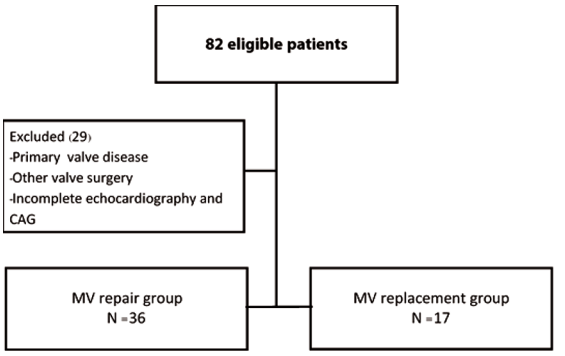

Figure 1. Study protocol.

inconclusive, as neither has consistently resulted in better patient outcomes across studies.

According to the latest guidelines for the management of coronary artery disease, additional mitral surgery is the recommended treatment for patients with chronic symptomatic or severe ischemic mitral valve regurgitation[13-21]. In the present study institute, the authors prefer to perform mitral valve surgery concomitant with CABG in patients with moderate to severe ischemic mitral valve regurgitation. In the past, most patients received MVR, but in recent years, the rate of MVP has been increasing due to improvements in surgical techniques and outcomes.

Objective

The aim of the present study was to compare the surgical outcomes of MVP and valve replacement in patients diagnosed with coronary artery disease and ischemic mitral valve regurgitation.

Materials and Methods

The present research was a retrospective cohort study conducted at Srinagarind Hospital and Queen Sirikit Heart Center of the Northeast at Khon Kaen University's Faculty of Medicine. The study protocol was approved by the University's Ethics Board (HE581205).

The authors collected data from patients age over 18 years old diagnosed with coronary artery disease with moderate to severe IMR that underwent MVP or MVR concomitant with coronary artery bypass grafting. The exclusion criteria were primary valve disease, other concomitant cardiac surgery, and incomplete records. Medical records of 82 patients between January 2006 and December 2016 were reviewed, and 29 were excluded because they did not meet the eligible criteria. There were 36 patients in the MVP group and 17 in the MVR group. The study protocol is shown in Figure 1.

Demographic, laboratory, non-invasive imaging, echocardiography, cardiac catheterization, pre- and peri-operative, postoperative complication, hospital stay, and follow-up data were collected. Patient characteristics are shown in Table 1.

Operative technique

All the patients received the same general anesthesia and median sternotomy. Intraoperative transesophageal echo was used to evaluate mitral valve function. The left internal mammary artery (LIMA) was harvested in all patients, and the greater saphenous vein or radial artery was harvested depending on the conditions and indications of each patient. Standard cardiopulmonary bypass (CPB) was established, and heparin was given to achieve an activated clotting time (ACT) greater than 480 seconds. Systemic mild hypothermia (body temperature 32°C to 34°C) was induced. The aortic cross-clamp was applied, and the antegrade cardioplegia was used as needed. When distal anastomosis was completed, the left atrium was opened, and the mitral valve was assessed. MVP or replacement was performed depending on the surgeon's preference. The patient was rewarmed, and then the aorta was partially clamped for proximal anastomosis. Following anastomosis of the grafts, mitral valve function was re-evaluated by transthoracic echocardiogram. Only mild mitral valve regurgitation was considered acceptable after repair. CPB was discontinued and protamine was used to achieve heparin reversal.

Follow-up data

The data were reviewed for functional class, transthoracic echocardiography findings, LVEF, regional wall motion abnormalities, and residual MR.

Definitions

Ischemic mitral valve regurgitation is defined as mitral valve regurgitation caused by chronic changes in left ventricular structure and function due to ischemic heart disease.

A coronary bypass graft is a procedure that using a vein graft or arterial graft conduit to creates new routes around narrowed and blocked coronary arteries for increasing blood supply to heart muscle.

MVP is a surgical procedure used to improve the function of a pathologic mitral valve of the heart.

MVR is a procedure whereby the diseased mitral

Table 1. Demographic data

Characteristics	Repair group (n=36) n (%)	Replacement group (n=17) n (%)	p-value
Age (years); mean±SD	62.4±7.67	63.7±9.16	0.619
Sex: male	19 (52.78)	13 (76.47)	0.137
Cr (mg/dL); mean±SD	1.7±1.22	2.7±2.15	0.037
HT	24 (66.67)	9 (52.94)	0.375
DM	17 (47.22)	6 (35.29)	0.555
COPD	1 (2.78)	2 (11.76)	0.238

Cr=creatinine; HT=hypertension; DM=diabetes mellitus; COPD=chronic obstructive pulmonary disease; SD=standard deviation

Table 2. Pre-operative echocardiography and coronary angiography

Characteristics	Repair group (n=36) n (%)	Replacement group (n=17) n (%)	p-value
TVD	31 (86.11)	13 (76.47)	0.445
DVD	5 (13.89)	4 (23.53)	0.638
Severe MR	19 (52.78)	11 (64.70)	0.736
EF (%); mean±SD	42.54±17.60	55.07±19.44	0.035

TVD=triple vessel disease; DVD=double vessel disease; MR=mitral valve regurgitation; EF=ejection fraction; SD=standard deviation

valve of a patient's heart is replaced by either a mechanical or tissue (bioprosthetic) valve.

Statistical analysis

Continuous variables were presented as means with standard deviation or medians with interquartile ranges. Categorical variables were presented as numbers or percentages. The Student's t-test was used for normally distributed variables, and the Mann-Whitney test was used for those with non-normal distribution. Both were applied to compare continuous variables. Chi-square tests and Fisher's exact tests were used for the comparison of categorical variables. The Cox regression model was used to evaluate the association between risk factors and hospital mortality. A p-value smaller than 0.05 was considered significant. Statistical analyses were performed by using Stata, version 13.0 (StataCorp LP, College Station, TX, USA).

Results

There were no differences in terms of demographic data between the 36 patients in the MVP group and the 17 in the MVR group with the exception of creatinine level, which was higher in the replacement group. In both groups, the mean age of the patients was 63 years, and most patients were male (Table 1).

There were also few significant differences in terms of pre-operative echocardiography and coronary angiogram results, as shown in Table 2. Most patients in both groups had triple vessel disease involvement. More patients in the replacement group had severe mitral valve regurgitation, but the difference was not statistically significant. However, ejection fraction (EF) was significantly lower in the repair group.

Intraoperative time, aortic cross-clamp time and CPB time in the two groups were similar (Table 3).

Postoperative data are shown in Table 4. There were no differences in the rates of intraaortic balloon pump (IABP) and extracorporeal membrane oxygenation (ECMO) used between the two groups, and the those of post-operative complications, including bleeding, arrhythmia, sepsis, and stroke were similar. Hospital and intensive care unit (ICU) length of stay was non-significantly higher in the repair group. There were no mitral valve complications that required further operation in the MVR group, but two patients in the MVP group developed moderate residual MR, which warranted conservative treatment. Three patients had severe residual MR, two of whom required reoperation, which resulted in in-hospital death.

The mortality rate at 1 year, 5 years, and 10 years did not differ significantly between the two groups

Table 3. Intra-operative data

Operative data	Repair group (n=36) Mean±SD	Replacement group (n=17) Mean±SD	p-value
Operative time (minute)	302.1±80.29	341.7±83.93	0.105
AOX time (minute)	97.5±22.82	106.4±35.44	0.587
CPB time (minute)	137.1±39.25	160.2±53.26	0.176

AOX=aortic cross clamp; CPB=cardiopulmonary bypass, SD=standard deviation

Table 4. Postoperative data

Post-operative	Repair group (n=36) n (%)	Replacement group (n=17) n (%)	p-value
Post-operative IABP	11 (30.56)	7 (43.75)	0.367
Post-operative ECMO	2 (5.71)	1 (6.25)	>0.999
Post-operative bleed	1 (2.86)	3 (18.75)	0.086
Arrhythmia	17 (47.22)	5 (31.25)	0.368
Sepsis	11 (30.56)	4 (25.00)	0.752
Stroke	3 (8.33)	1 (6.25)	>0.999
Residual moderate to severe MR	5 (13.89)	0 (0.00)	0.634
Length of ICU stay; median (IQR)	10.1 (5 to 22)	6.3 (3 to 20)	0.733
Length of hospital stay; median (IQR)	21.5 (10 to 45)	15.8 (8 to 42)	0.626

IABP=intraaortic balloon pump; ECMO=extracorporeal membrane oxygenation; MR=mitral valve regurgitation; ICU=intensive care unit; IQR= interquartile range

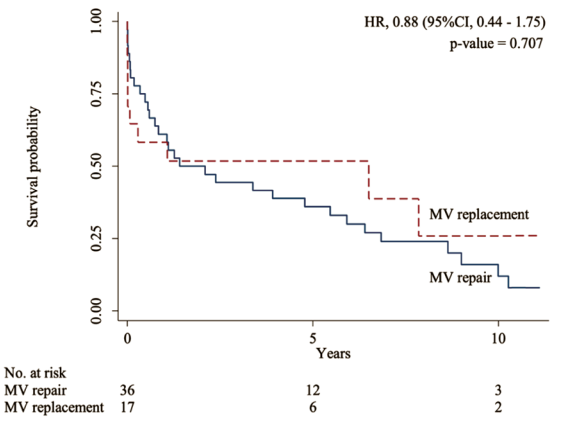

Figure 2. Kaplan-Meier estimation of survival following CABG and mitral valve surgery; 95% CI 0.44 to 1.75.

(Figure 2), but 10-year survival was non-significantly higher in the mitral replacement group (26% versus 10%). No patients required reoperation within 10 years in either group.

Discussion

IMR is one possible complication following ischemic heart disease, with an incidence of around 17% to 40%[8]. IMR may be due to primary disease at the valvular leaflet or chordae such as ruptured chordae or papillary muscle. It can also occur due to changes in left ventricular geometry, that made the subvalvular tethering and cannot make the good coaptation while closing or opening, which is accepted as term of functional MR[22,23].

The incidence of IMR has been increasing in accordance with the increasing rate of ischemic heart disease in the populations around the world. IMR is the second most common cause of valvular disease in Europe[22] and Asia[24], and has a major impact on prognosis and survival in patients with ischemic heart disease. Current data suggests that IMR increases the mortality rate significantly in ischemic heart patients[22]. Baumgartner et al found the survival rate to be 40% in patients with moderate to severe IMR, 62% in those with mild IMR, and 84% in those without IMR[23]. Tcheng et al found that one-year mortality after an acute myocardial infarction was 11% in patients without IMR, 22% in those with mild IMR, and 52% in those with moderate to severe IMR[8].

Most patients with mild (less than 2+ to 3+) IMR have been shown to improve IMR after coronary

revascularization[19]. However, those with moderate to severe IMR do not improve with coronary revascularization alone[8,18], and residual moderate to severe IMR have a major impact on patient survival[6]. Recent studies[8,21] and current guidelines thus support performing mitral valve correction with simultaneous coronary revascularization in these patients. The two options for mitral valve correction are MVP and MVR. The benefit of MVP is that it preserves patient's valve, negating the need to undergo reoperation for prosthetic valve in valve degeneration or valve related complications. However, MVP is more complicated and must be performed by an experienced surgeon to decrease postoperative complications. It also has higher rates of valve failure and residual MR.

The present study found no significant difference in terms of mortality rate or postoperative complications (use of mechanical support, bleeding, arrhythmia, sepsis, stroke, length of ICU, and hospital stay) between the MVP and MVR groups. However, the MVP group had a higher rate of valve failure that required reoperation. The present result is consistent with those of previous studies[11,12,25], which found that long-term survival outcomes were non-significantly better in patients that underwent MVR rather than MVP. According to these studies, patients who underwent MVP had higher rates of moderate or severe recurrent MR, which resulted in serious HF events and higher readmission rates for cardiovascular causes. As in the present study, patients who underwent MVP also had higher rates mitral valve complications. However, some studies have reported that MVP results in better surgical outcomes, especially in elderly patients[11,12]. Gaur et al[11] demonstrated that the operative mortality of MVR patients was significantly higher, and that these patients also had a higher incidence of stroke and significantly longer ICU and hospital stays. Dayan et al[12] reported that MVP was associated with lower operative mortality but higher recurrence of regurgitation in patients with IMR, but no differences were found regarding survival, NYHA class, or functional indicators. As the current data remain inconclusive, MVP is recommended for IMR in high-volume and experienced centers to decrease the rates of MR recurrence and reoperation.

The authors found that the long-term survival of patients that underwent MVR was non-significantly higher than those who underwent MVP (26% versus 12%). The present result is consistent with those of other studies[26]. Thourani et al[26], for example, reported that ten-year survival in patients who underwent MVR with CABG was similar to that of MVP patients (34% and 28%, respectively). Independent predictors of long-term mortality included advanced age, urgent or emergent status, female gender, diabetes mellitus, greater bodyweight, HF, decreasing EF, concomitant CABG, and MVR.

There were some limitations to the present study. One was the retrospective design, making it difficult to control for confounding factors, especially variations in MVP technique among surgeons, which has a major effect on both early and long-term surgical outcomes. In addition, the small sample size made it difficult to make distinctions between the two groups in terms of outcomes, and unable to identify risk factors that relate to the results.

Conclusion

There were no significant differences in surgical outcomes between the two groups. However, the MVR group had a lower rate of valve failure and better long-term survival rate.

What is already known on this topic?

Patients who have moderate to severe ischemic mitral valve regurgitation should receive mitral valve surgery and coronary artery bypass graft simultaneously. However, differences in outcomes between MVP and replacement in patients with ischemic mitral valve regurgitation remain inconclusive.

What this study adds?

The surgical outcomes of mitral valve repair and mitral replacement were comparable. There were no significant differences in terms of survival or postoperative complications. However, the mitral valve replacement group had better long-term survival and a lower rate of valve failure that requires reoperation.

Acknowledgement

The present research was supported by the Khon Kaen University Cardiovascular and Thoracic Surgery Research Group.

Conflicts of interest

The authors declare no conflict of interest.

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