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ORIGINAL ARTICLE

Surgical Management of Severe Ischaemic Mitral Regurgitation

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Background Coronary artery bypass graft surgery (CABG) with mitral valve surgery is undisputed in severe ischaemic mitral regurgitation (IMR) treatment, but the controversy is whether mitral valve replacement (MVR) or mitral valvuloplasty (MVP) should be used.

Methods Data was collected from 130 cases of severe IMR patients who underwent CABG and MVP or MVR from June 2010 to June 2015 to compare the short-term efficacy of CABG with MVP or MVR in the treatment of severe IMR patients. There were 70 cases in the MVP group and 60 in the MVP group. The postoperative major cardiac cerebral vascular events and left ventricular ejection fraction (LVEF), left ventricular end-systolic diameter (LVESD), and left ventricular end-diastolic diameter (LVEDD) were recorded.

Results Eleven patients died in hospital, the remaining patients were followed up for 12 months; 18 patients died. The cumulative survival rate and the major cardiac cerebrovascular events were not significantly different. There was no significant change in LVEF, but LVEDD, LVESD and systolic pulmonary artery pressure (sPAP) improved significantly, and there was no difference between the groups. In the MVR group, the rate of postoperative moderate or severe mitral regurgitation patients was significantly less than that in the MVP group.

Conclusion The short-term survival rate, reversal of left ventricular remodelling and major cardiac or cerebrovascular events post-CABG combined with MVP were not significantly different to those with CABG combined with MVR in the treatment of severe IMR, but long-term efficacy remains to be observed.

Keywords Ischaemic mitral regurgitation • Mitral valve repair • Coronary artery bypass grafting • Left ventricular remodelling • Cardiac surgery

Introduction

Ischaemic mitral regurgitation (IMR) is caused by left ventricular remodelling after myocardial infarction, which is accompanied by left ventricular chamber and mitral annular expansion, apical and lateral migration of papillary muscles, leaflet tethering, and impaired valve closure. These processes lead to the displacement of the valve leaflets, and different degrees of mitral regurgitation, which subsequently affects the volume of the left ventricle, after-load and the rhythm of the heart. The intrinsic structure of the valve is normal, while the pathological change is in the myocardium rather than in the valve itself. Therefore, the treatment of IMR is different from the primary or degenerative mitral regurgitation [1].

There has always been controversy in IMR treatment, for patients with moderate IMR, the contention is between

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revascularisation surgery to restore the geometry of the valve alone or concomitant with valve repair. In patients with severe IMR, the performance of coronary artery bypass graft surgery (CABG) with mitral valve surgery is undisputed, but controversy exists as to whether mitral valve replacement (MVR) or mitral valvuloplasty (MVP) should be used [2]. Guidelines recommend application of MVP or MVR with sparing subvalvular apparatus to treat patients with severe IMR, but do not state which is better, MVP or MVR, because of the lack of clinical evidence [3,4]. In a recent systematic review, Rao et al. summarised the previous literature and found that CABG concomitant with MVP could provide lower operative mortality and higher long-term survival rate. But the report also mentioned that the conclusion was not absolute, because many previous studies were not uniform [5]. Additionally, Acker reported the first prospective randomised study to compare MVP with MVR for severe IMR. The conclusion was that there was no significant difference in left ventricular remodelling, hospital mortality, and 12-month survival rate and clinical outcomes between the two surgical approaches [6]. However, long-term clinical follow-up studies showed that there was lower occurrence rate for CABG with MVR with respect to recurrent mitral regurgitation, heart failure, atrial fibrillation, and readmission. There have been several reports outlining the advantages and experience with the two surgical approaches [1,7,8].

In this study, we assessed the surgical risk and clinical efficacy of CABG, either with MVP or MVR, in patients with severe IMR.

Materials and Methods

Patients

A retrospective analysis was conducted in 130 patients with severe IMR who underwent CABG concomitant with either MVP or MVR between June 2010 and June 2015. Of these patients, 70 were included in the MVP group, and 60 were included in the MVR group. Ischaemic mitral regurgitation was classified as either Carpenter type I or type IIIb, i.e., IMR was caused by annular dilatation, papillary muscle displacement, or abnormal valve leaflet motion rather than intrinsic structural lesions or chordae tendineae rupture.

Severe IMR was diagnosed by preoperative transthoracic Doppler ultrasound [9]. According to the diagnostic criteria, the mitral regurgitation orifice area should be no less than 0.4 cm^2. When the mitral regurgitation orifice area is less than 0.4 cm^2, other relevant diagnostic parameters should be considered to confirm the diagnosis, including the ratio of the mitral regurgitation orifice area to the left atrial area, the width of vena contracta, the systolic pulmonary venous flow waveform, and the left atrial diameter. The preoperative left ventricular ejection fraction (LVEF), the left ventricular end-systolic diameter (LVESD), and the left ventricular end-diastolic diameter (LVEDD) were documented concurrently. Exclusion criteria include recent myocardial infarction (within 30 days), LVEF <30%, emergency surgery, simultaneous aortic valve surgery and mitral structural abnormalities.

Surgical Procedures

The surgeon decided to perform CABG concomitant with either MVP or MVR according to their experience and preoperative clinical data. All procedures were performed on cardiopulmonary bypass (CPB). Cardiac arrest was induced with antegrade cardioplegia. The anastomosis of the vein graft to the distal coronary artery was performed first, followed by MVR or MVP. The stitch method and the type and size of the replacement valve and the annuloplasty rings were selected by the surgeons. The subvalvular apparatus preserving procedure was utiliseded during MVR, where the anterior leaflet was incised to prevent outflow tract obstruction and the posterior leaflet was preserved. We chose the valve according to the age – bioprosthetic valves were for patients older than 60 years, while mechanical valves were used for younger patients. A rigid ring was used in the patients who underwent MVP. The diameter of the annuloplasty rings was smaller than that of the mitral valve annulus. Following MVP or MVR, the incisions in the atrial septum and atrium were closed and the anastomosis of the vein graft proximally to the ascending aorta was performed. Finally, the internal mammary artery was anastomosed to the left anterior descending coronary artery.

Aspirin, lipid-lowering agents, β-receptor blockers, and an angiotensin-converting enzyme inhibitor (ACEI) were routinely administered to all patients and combined with various treatments for individual cardiac conditions. Transthoracic Doppler echocardiography was performed every six months to monitor LVEF, LVEDD and LVESD during follow-up. Major complications and adverse cardiac and cerebrovascular events were documented, including the mortality rate, stroke, re-do mitral valve surgery, hospitalisation due to heart failure, New York Heart Association (NYHA) classification, recurrent mitral regurgitation, and readmission.

Statistical Analysis

All data are expressed as the mean ± standard deviation (M ± SD) or as the median. An independent sample t-test was used to compare the continuous variables between the two groups; a chi-squared test was used to compare the frequencies between the two groups. The pre and postoperative left ventricular remodelling index were compared using a paired sample t-test. A Kaplan-Meier survival curve was used to analyse postoperative survival and other time-related events. A log-rank test was used to examine the significant differences.

Variables examined by logistic regression analysis in terms of risk factors of the surgical procedure included the following: age, weight, diabetes, hypertension, atrial fibrillation, myocardial infarction, elevated creatinine, stroke, mitral valve repair or replacement, LVEF, intra-aortic balloon pump (IABP; preoperative and operative), cardiopulmonary bypass time, aortic cross-clamping time and ICU stay. All

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