Benefits of Early Surgery on Clinical Outcomes After Degenerative Mitral Valve Repair

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Background. This study aimed to evaluate the clinical trends of mitral valve repair for degenerative mitral regurgitation and the benefit of early surgical intervention on repair durability in a high-volume center.

Methods. From January 2003 to December 2015, 1,903 consecutive patients with severe degenerative mitral regurgitation underwent mitral valve repair at our institution. The timing of surgical intervention was evaluated by guideline-related indications including symptoms, atrial fibrillation, left ventricular dysfunction, and pulmonary hypertension. Clinical outcomes and risk factors for recurrent mitral regurgitation were analyzed.

Results. Over 13 years from 2003 to 2015, trends of preoperative characteristics demonstrated that the proportion of asymptomatic patients substantially increased. The 8-year overall survival, freedom from reoperation for mitral valve, and freedom from recurrent mitral regurgitation were 96%, 96%, and 85%, respectively. Ejection fraction less than 60%, left ventricular end-diastolic dimension greater than 60 mm, isolated anterior leaflet lesion, and intraoperative mild residual mitral regurgitation were independent predictive factors for recurrent mitral regurgitation. The incidence of recurrent mitral regurgitation was significantly lower in the early intervention group (3% versus 18%, $p < 0.01$). In subgroup analysis of asymptomatic patients, the incidence of recurrent mitral regurgitation was significantly lower in patients without guideline-related indications (3% versus 31%, $p < 0.0001$).

Conclusions. Early surgical intervention for severe degenerative mitral regurgitation before symptoms, atrial fibrillation, and ventricular dysfunction are associated with excellent clinical outcomes. Besides complexity of leaflet lesion and repair quality, surgical timing also significantly affects repair durability. Early surgical intervention should therefore be recommended to reduce recurrent mitral regurgitation.

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Degenerative mitral valve (MV) disease is the most common cause of mitral regurgitation (MR) [1]. Mitral valve repair is the gold standard for degenerative MR and is recommended by the current guidelines for the management of valvular heart disease [2–4]. However, the optimal timing for MV repair is controversial [5, 6]. Previous studies have demonstrated that compared with watchful waiting, early surgical intervention for degenerative MR significantly improves early and long-term survival [7, 8]. Accordingly, the new update of the American College of Cardiology/American Heart Association guideline recommends that surgery should be performed before left ventricular (LV) dysfunction (class IIa) [4] in experienced centers.

The spectrum of mitral disease in China is different from that in Western developed countries. Rheumatic mitral stenosis used to be the primary cause of mitral disease. However, the prevalence of degenerative mitral disease has significantly increased in recent years. Application of MV repair began relatively late in China. However, benefits from the advanced experiences accumulated by large-scale centers in Western developed countries suggest that excellent outcomes of MV repair for degenerative MR could be rapidly achieved in China.

This study aimed to evaluate the clinical trends of MV repair for degenerative MR in a Chinese high-volume center. By analyzing clinical outcomes and risk factors of recurrent MR, we further assessed the benefits of early surgical intervention on repair durability.

Patients and Methods

The study protocol was approved by the Ethics Committee of Zhongshan Hospital of Fudan University. Informed consent was obtained from each patient.

Patients

From January 2003 to December 2015, profiles of all patients with degenerative MR who underwent MV surgery

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at our institution were analyzed. Patients who underwent MV replacement were excluded, and 1,903 consecutive patients who underwent MV repair were included. Preoperative characteristics, operative details, and perioperative results were acquired retrospectively. The degree of MR was assessed according to transthoracic echocardiography and transesophageal echocardiography (TEE), and was confirmed by surgical inspection. The trends of preoperative profiles over 13 years were assessed.

The timing of surgical intervention was assessed by five variables: heart failure symptoms; ejection fraction (EF); LV end-systolic dimension; atrial fibrillation (AF); and pulmonary hypertension. The early intervention group included patients without any of the variables, namely, heart failure symptoms, EF less than 60%, LV-end systolic dimension greater than 40 mm, preoperative AF, and pulmonary hypertension. Patients with any one of these five factors were considered the watchful waiting group. The incidence of recurrent MR during follow-up was compared between the two groups. In addition, subgroup analysis of asymptomatic and mildly symptomatic patients (New York Heart Association [NYHA] functional class I to II) was further performed. In this subgroup, the incidence of recurrent MR was compared between patients without any guideline-related indications and patients with any of the above indications.

Follow-up information was obtained through the outpatient department, referring cardiologists, and telephone contact. Profiles of overall survival, reoperation for MV, and recurrent MR were obtained and analyzed. Recurrent MR was defined as moderate or severe MR detected by transthoracic echocardiography during follow-up. The degree of MR was recorded as none or trivial, mild, moderate, or severe.

Operative Technique

All procedures were performed by 23 surgeons at our institution. Operation volumes of different surgeons are shown in Table 1. Intraoperatively, TEE was routinely performed to evaluate MV lesions. Proper repair techniques were performed according to surgical inspection and TEE results. Quadrangular or triangular resection of prolapsed leaflet, artificial chordal reconstruction using expanded polytetrafluoroethylene sutures, and commissural closure were primary leaflet repair techniques. An artificial annuloplastic band or ring was routinely implanted in 98.2% of patients.

Routine intraoperative TEE was performed subsequent to separation from cardiopulmonary bypass. Intraoperative revision was necessary for moderate or severe residual MR. Residual mild regurgitation was generally considered acceptable and did not require revision. Patients with moderate/severe tricuspid regurgitation or dilation of the tricuspid annulus (more than 40 mm) generally underwent additional tricuspid valvuloplasty. The maze procedure was electively performed in patients with AF. Other concomitant procedures were performed accordingly, including coronary artery bypass graft surgery, aortic valve replacement, and aortic surgery.

Table 1. Operation Volumes of Different Surgeons

Operation Volume	Surgeons (n = 23)
>900	1
100–200	4
50–100	3
10–50	8
<10	7

Statistical Analysis

Continuous variables are expressed as mean ± SD, and categoric variables as counts and percentages. The Kaplan-Meier method was used to compute survival curves. All patients were stratified by NYHA functional class, preoperative AF, LVEF, LV end-systolic dimension, and pulmonary artery systolic pressure. The log rank χ^2 test was used to compare differences between the stratified subgroups. The Cox proportional hazards survival model was used to determine univariate and multivariate predictors of all-cause death and recurrent MR. Potential predictors of recurrent MR were tested in a univariable fashion, and variables with p less than 0.1 were included into the final Cox proportional hazards survival analysis. Hazard ratio with the corresponding 95% confidence interval were calculated. A p value less than 0.05 was considered significant. All statistical analyses were conducted using IBM SPSS Statistics 22.0 software (IBM Corporation, Armonk, NY).

Results

Trends Over 13 Years

From 2003 to 2015, the number of MV repairs practiced at our institution linearly increased. The trends of preoperative characteristics and echocardiographic profiles over 13 years are shown in Figure 1. From 2003 to 2015, mean age gradually increased from 49.5 to 56 years; an increasing proportion of patients (29.3% to 44%) were asymptomatic or mildly symptomatic (NYHA functional class I to II) on presentation. The proportion of patients with AF decreased from 31.7% to 15.4%. Trends of echocardiography indicated that mean LV dimension, left atrial dimension, and pulmonary artery systolic pressure gradually decreased over 13 years. Baseline clinical characteristics are shown in Table 2.

Operative Details and Perioperative Results

Operative details are shown in Table 3. Minimally invasive MV repair began in 2009, and since then, the proportion of patients who underwent minimally invasive surgery has substantially increased. Leaflet resection remained the primary repair technique, but its application gradually decreased over 13 years. Artificial chordal reconstruction was mainly used to repair anterior leaflet prolapse, and its application remained constant over the years. Commissural closure, which is simple and effective in commissural lesion, has become an important repair technique in recent years.