Management of concomitant mild to moderate functional mitral regurgitation during aortic valve surgery for severe aortic insufficiency

Ju Yong Lim, MD,[a] Sung Ho Jung, MD,[a] Joon Bum Kim, MD,[a] Cheol Hyun Chung, MD,[a] Jae Won Lee, MD,[a] Hyun Song, MD,[b] and Suk-Jung Choo, MD[a]

Objectives: The optimal management of mild to moderate functional mitral regurgitation (FMR) during aortic valve replacement (AVR) for severe aortic insufficiency (AI) is poorly defined. We aimed to investigate the fate of FMR after AVR with or without concomitant mitral annuloplasty (MAP) and to identify the risk factors and clinical implications of persistent FMR.

Methods: Between June 1996 and August 2011, 155 patients with mild to moderate FMR undergoing AVR for severe AI were reviewed. The preoperative MR grade was mild in 101 patients (65%) and moderate in 54 patients (35%). Persistent FMR was defined as MR grade remaining the same or increased on the last follow-up echocardiogram.

Results: The mean follow-up duration was 4.5 ± 3.9 years. FMR improved in 88% of the patients. On multivariate analysis, left ventricular end-diastolic dimension (LVEDD) reduction after AVR was identified as the only predictor for FMR improvement ($P = .004$; hazard ratio, 0.927; confidence interval, 0.881 to 0.977). Concomitant MAP did not show additional benefit in preventing persistent FMR ($P = .35$). Although no survival difference was observed between the patients with and without persistent FMR ($P = .78$), persistent FMR was associated with greater heart failure events ($P < .001$).

Conclusions: Mild to moderate FMR as a result of severe AI improved with AVR in most patients with or without concomitant MAP. Poor postoperative LVEDD reduction was the only risk factor for persistent FMR. Because persistent FMR tended to be associated with heart failure events, close echocardiographic monitoring and proactive medical management are recommended in patients showing poor LVEDD reduction after AVR. (J Thorac Cardiovasc Surg 2014;148:441-6)

Functional mitral regurgitation (FMR) is a common finding in aortic valve disease patients.[1,2] However, adequate guidelines for its management during aortic valve surgery are lacking.[3] Although previous studies have investigated the fate and clinical impact of mild to moderate FMR in patients undergoing aortic valve replacement (AVR), they were mostly conducted mostly in patients with aortic valve stenosis[4-8] and the literature addressing the fate of FMR specifically in the setting of severe aortic insufficiency (AI) has been limited. Even less is known about the outcome and the potential benefits of concomitant mitral annuloplasty.[9] Therefore, we sought to investigate the following: (1) the fate of mild to moderate FMR after AVR for severe AI, (2) the effect of concomitant mitral annuloplasty (MAP) in the management of mild to moderate FMR, and (3) the risk factors and clinical implications of persistent FMR.

PATIENTS AND METHODS

Patients

Between June 1996 and August 2011, 779 patients underwent AVR for predominantly severe AI. Patients who had trivial (1+) or severe (4+) FMR, MR caused by structurally abnormal mitral valve and subvalvular apparatus such as rheumatic or degenerative pathology, and ischemic MR with regional wall motion abnormality were excluded. Based on this criteria, a total of 155 patients with predominantly severe AI with mild to moderate functional MR constituted the subject of the present study. Clinical characteristics and echocardiographic and surgical data were obtained retrospectively by reviewing the patients' medical records. The present study was approved by the Asan Institutional Review Board with waiver of individual patient consent.

Echocardiographic FMR Grading and Follow-up Evaluation

Transthoracic and transesophageal echocardiography were performed preoperatively in all of the patients to assess the etiology and severity of the MR. FMR was defined as central MR caused by tethering and fluttering in the absence of morphologic abnormalities of the mitral leaflets such as thickening or calcification. Any MR with regional left ventricular wall motion abnormality, suggesting an ischemic etiology, also was excluded. MR

From the Department of Thoracic and Cardiovascular Surgery,[a] Asan Medical Center, University of Ulsan, College of Medicine, Seoul, Korea; and Department of Thoracic and Cardiovascular Surgery,[b] The Catholic University of Korea, Seoul St. Mary Hospital, Seoul, Korea.

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Address for reprints: Suk-Jung Choo, MD, Asan Medical Center, University of Ulsan College of Medicine, 388-1 Pungnap-Dong Songpa-Gu, Seoul 138-736, South Korea (E-mail: sjchoo@amc.seoul.kr).

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Abbreviations and Acronyms

AI = aortic insufficiency
AVR = aortic valve replacement
CHF = congestive heart failure
FMR = functional mitral regurgitation
LVEDD = left ventricular end-diastolic dimension
LVESD = left ventricular end-systolic dimension
MAP = mitral annuloplasty

grade was assessed by measuring the maximum color flow Doppler regurgitant jet area from the left ventricle to the left atrium during the systolic phase on a 4-chamber or 2-chamber view. The FMR was graded as none (0), trivial (1+), mild (2+), moderate (3+), or severe (4+) on an ordinal scale. All of the patients had a postoperative transthoracic echocardiogram before being discharged. Follow-up echocardiography was performed 6 months or 1 year after surgery in 88% of the patients. Biannual echocardiographic follow-up evaluation was recommended after the first year.

Surgical Techniques

Aortic valve replacement was performed by any 1 of 4 surgeons. Aortobicaval cannulation was used in a routine manner, with institution of antegrade and retrograde cardioplegia under mild hypothermia. All of the patients underwent AVR with either a mechanical or bioprosthetic valve as appropriate for the patient's age and clinical condition. Valve size was determined by intraoperative visual inspection of the aortic annulus and sizing of the left ventricular outflow tract. During this study period, there were no specific guidelines available for MAP. As a result, the decision to perform a concomitant MAP as well as choosing the type of mitral annuloplasty ring was left to the surgeon's discretion. The determination of ring size was based on the intercommissural distance and the anterior mitral valve leaflet height.

Follow-up Evaluation

Data collection was performed until October 2011 through interviews during regular outpatient clinic visits or by telephone inquiry. Follow-up evaluation was complete in 92% of the patients. Early mortality was defined as in-hospital death or death within 30 days of surgery. Mortality was categorized as cardiac or noncardiac based on the contents of the medical records. All deaths were considered to be of cardiac origin unless a noncardiac origin was established.

The primary study end point was cardiac death. The secondary end points included changes in the FMR grade after AVR and new-onset congestive heart failure (CHF) events (death or readmission caused by CHF) during the follow-up period. FMR was documented as either improved or persistent. Persistent FMR was defined as an MR grade that either remained the same or was aggravated in the last echocardiographic follow-up evaluation from the preoperative finding.

Statistical Analysis

Categoric variables are presented as frequencies and percentages, and continuous variables are expressed as the mean ± standard deviation. Cumulative incidence rates of individual and composite outcomes were estimated by the Kaplan-Meier method and compared by the log-rank test. To reduce the impact of treatment selection bias and confounding potential in this observational study, we performed a rigorous adjustment for significant differences in patient characteristics by using Cox proportional-hazards regression models. Results were expressed as hazard ratios with 95% confidence intervals. All reported P values are 2-sided, and P values less than .05 were considered statistically significant. SAS software version 9.1 (SAS Institute, Inc, Cary, NC) was used for statistical analysis.

RESULTS

Preoperative Characteristics and Surgical Data

The preoperative clinical characteristics are shown in Table 1. The mean age of the patients was 56 ± 14 years. Severe AI was the predominant aortic valve pathology in all of the patients, with only 2 patients showing mixed aortic valve disease. Grade 2+ FMR was observed in 101 patients (65%) and grade 3+ FMR was observed in 54 patients (35%). The mean left ventricular end-systolic dimension (LVESD) and left ventricular end-diastolic dimension (LVEDD) were 50.5 ± 11.0 mm and 69.5 ± 9.4 mm, respectively. MAP was performed in 22 patients (Table 2); preoperative FMR grade was 3+ in 19 patients (86%). The mean MAP ring size was 30.6 ± 2.9 mm.

Clinical Outcomes

There were 4 early deaths (2.6%). Two of them occurred in patients who had received concomitant MAP for preoperative FMR grade 3+. The mean follow-up duration was 53.5 ± 47 months. There were 22 late mortalities (14.2%), of which 3 were caused by cancer-related complications (1 advanced gastric cancer and 2 lung cancers). Therefore, the overall cardiac-related mortality rate was 12.5%. CHF events occurred in 4 patients. Two of the patients were rehospitalized with aggravated dyspnea and showed symptomatic improvement with medical management, but the other 2 patients who had very low postoperative left ventricular ejection fraction (ejection fraction, 16%) died of CHF 4 and 9 years after AVR. There were 7 reoperations during the follow-up period. Most of the reoperations were for aortic valve–related problems such as endocarditis or paravalvular leakage.

Changes in Echocardiographic Data After AVR

Postoperative echocardiographic follow-up evaluation was performed over a mean follow-up duration of 24.3 ± 11.8 months. The changes in the FMR during the follow-up period are shown in Figure 1. FMR improved after aortic valve surgery in 88% (133 of 151) of the patients and persisted in 12% (18 of 151). When comparing the FMR from the preoperative state, 84% (83 of 99) of the patients with grade 2+ FMR and 96% (50 of 52) of the patients with grade 3+ FMR showed improvement. The mean LVESD and LVEDD also improved from 50.5 ± 11.0 mm and 69.5 ± 9.4 mm to 36.3 ± 10.4 mm and 52.4 ± 8.6 mm, respectively. Among the 20 surviving patients who underwent concomitant MAP, FMR persisted in 1 patient.