Restrictive Mitral Annuloplasty for Functional Mitral Regurgitation in Patients With End-Stage Cardiomyopathy
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Functional mitral regurgitation (FMR) is frequently observed in patients with advanced ischemic or non-ischemic dilated cardiomyopathy (DCM), and is associated with poor outcomes. In cases of end-stage cardiomyopathy, global left ventricular (LV) remodeling results in LV dilatation and lateral displacement of both papillary muscles. The papillary muscles are pulled towards the posterior wall and the apex, which causes tethering of the mitral leaflets and their apical displacement. This is the resultant mechanism of the leaflet coaptation failure seen in cases with FMR. The morbidity and mortality of patients with LV dysfunction and FMR remains high despite improvements in medical management. Therefore, mitral valve reconstruction has evolved as a surgical alternative to treat FMR and heart failure refractory to medical treatment. Since Bolling et al initially reported acceptable outcomes of surgical treatment for severe MR in patients with end-stage cardiomyopathy in 1995, restrictive mitral annuloplasty (MAP) has become the conventional and preferred approach for surgical management of patients with FMR.

The aim of restrictive MAP is to improve leaflet coaptation by reducing the anteroposterior diameter of the mitral annulus. There are several reports of favorable outcomes of restrictive MAP for patients with FMR. According to a recent study, Romano and Bolling reported the outcomes of over 200 patients who had undergone restrictive MAP for end-stage cardiomyopathy and severe MR. In their literature, the mean follow-up period was 49 months, with 1-, 2-, and 5-year actuarial survival of 82%, 71%, and 52%, respectively, with all patients in New York Heart Association (NYHA) class I or II at 7 years of follow up. Bax et al reported an early mortality of 5.6% with an 84% survival at 2 years in 51 patients with ischemic LV dysfunction and severe MR undergoing coronary artery bypass grafting and restrictive MAP, placing patients in a significantly improved NYHA class, from 3.4±0.8 to 1.3±0.4. Additionally, Westenberg et al reported a 1-year survival of 90% with the NYHA class improving from 3.2±0.4 to 1.2±0.9 in 20 patients with non-ischemic DCM and severe MR undergoing isolated restrictive MAP.

In addition to the satisfactory improvement in clinical symptoms, previous studies have demonstrated LV reverse remodeling and improvement in LV ejection fraction (EF) following restrictive MAP. Bax et al reported that LV end-systolic and end-diastolic dimensions significantly decreased from 51±10 to 43±12 mm and from 64±8 to 58±11 mm, respectively, at 2 years follow up. More recently, Westenberg et al reported an increase in LVEF from 37±5% to 55±10% and a significant decrease not only in LV end-systolic and end-diastolic volumes but also in LV mass at 1 year follow up in 18 patients with non-ischemic DCM and FMR undergoing restrictive MAP. Thus, there have been several reports on surgical outcomes of restrictive MAP, however, the long-term effects of restrictive MAP on hemodynamics and LV function in patients with FMR have not been fully investigated.

In this issue of the Journal, Kainuma et al reported on the long-term clinical, acute hemodynamic, and serial echocardiographic results of restrictive MAP in patients with FMR. There were 3 operative deaths; the actuarial survival rate free from all deaths was 78±5% at a 5-year follow up in 44 patients who underwent restrictive MAP for FMR. Improvement in the NYHA class and a decrease in serum brain natriuretic peptide level were seen at 1 year after surgery, which persisted for 5 years postoperatively. A novel aspect of Kainuma et al’s study was the detailed assessment of acute hemodynamic changes in cardiac catheterization. In their study, cardiac catheterization performed 1 month after surgery revealed a significant decrease in LV volume and improvement in LVEF, and a significant decrease in LV end-diastolic pressure, pulmonary capillary wedge pressure, and pulmonary arterial pressure (PAP). There are few reports evaluating in detail acute hemodynamic changes by cardiac catheterization before and after restrictive MAP. In addition, Kainuma et al evaluated the LV function and reverse remodeling following restrictive MAP by serial echocardiographic studies. At discharge, LVEF improved from 27±6% to 37±9%, and LV end-diastolic and end-systolic diameter decreased from 68±6 to 62±6 mm and from 57±7 to 50±9 mm, respectively. These improvements were sustained during the entire follow-up period. The findings in their study were almost in line with that of previous studies. Moreover, their study demonstrated that preoperative pulmonary hypertension (systolic PAP >60mmHg) was the significant predictor for postoperative adverse cardiac events. It is widely known that pulmonary hypertension predicts morbidity and mortality in patients with...
ischemic or idiopathic DCM, and Kainuma et al’s study proved that pulmonary hypertension is also predictive of adverse outcomes after restrictive MAP for patients with advanced cardiomyopathy and FMR.

Although restrictive MAP, using an undersized ring, is beneficial for the management of FMR, several problems concerning this procedure have been reported. Kuwahara et al reported surgical annuloplasty further worsened posterior leaflet tethering, which is related to persistent or recurrent MR in patients with ischemic/functional MR. In contrast, Magne et al discovered a high incidence of functional mitral stenosis (MS) after restrictive MAP for ischemic MR, which has been associated with higher PAP and worsened functional capacity. More recently, Kubota et al described functional MS developing even in patients who had undergone surgical annuloplasty without downsizing; such functional MS significantly worsened during physical exercise. They emphasized diastolic subvalvular tethering by LV remodeling restricted mitral leaflet opening, which resulted in functional MS, in the presence of annular size reduction. Further investigation is required to determine to what extent functional MS and consequent higher PAP, caused by restrictive MAP, negatively impacts clinical outcomes.

In conclusion, although some clinical problems remain to be solved, restrictive MAP is a relatively simple and effective surgical procedure for the treatment of FMR in patients with end-stage cardiomyopathy. This procedure provides sustained improvement of hemodynamics and LV function with acceptable morbidity and mortality persisting long after the surgery.

References