

Left Ventricle Volume Affects the Result of Mitral Valve Surgery for Idiopathic Dilated Cardiomyopathy to Treat Congestive Heart Failure

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Background. Mitral valve surgery is a recommended treatment for congestive heart failure; however, its effect for idiopathic dilated cardiomyopathy (DCM) with an extremely enlarged left ventricle (LV) is not well documented. We examined our long-term results of mitral valve surgery for idiopathic dilated cardiomyopathy.

Methods. Fifty-five patients of idiopathic dilated cardiomyopathy have undergone mitral valve surgery to treat intractable congestive heart failure since 1998. Forty-two patients were male with an average age of 55. Preoperative New York Heart Association functional class was III in 25, IV in 30, and 19 were dependent on inotropic infusion. The mitral valve was repaired in 37 patients and replaced in 18. The tricuspid valve was repaired in 35 patients and replaced in 3. We divided 46 elective cases into two groups by LV end-systolic volume index.

Results. Postoperatively, an intraaortic balloon pump was required in 2 patients and a left ventricular assist

device in 1; both were emergent cases. Hospital mortality was noted 4.3% in elective cases (2 of 46) and 14.5% in overall cases (8 of 55). One-year, 3-year, and 5-year survival rate of elective cases was 73.3%, 58.2%, and 51.7%, respectively. Left ventricle size has decreased and LV contractility has increased in a small LV group year by year, but those in a large LV volume group have not changed subsequently after surgery. There was a significant difference noted in the survival rate of the two groups divided by LV end-systolic volume index.

Conclusions. Mitral valve surgery for idiopathic dilated cardiomyopathy to treat end-stage heart failure is relatively safe and effective in elective status. However, isolated mitral reconstruction without any other type of surgery may not suffice for an extremely enlarged LV.

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Bolling and colleagues [1, 2] reported that mitral reconstruction could restore left ventricle (LV) function in cardiomyopathy to treat heart failure with severe mitral regurgitation. Mitral ring annuloplasty is a feasible technique and one of the most common practices in our surgical community. The idea that the fixation of mitral regurgitation by means of mitral ring annuloplasty restores LV function seems to be acceptable as nontransplant surgery, especially for intractable heart failure patients. Soon mitral reconstruction has been recognized as one of the most important choices to treat congestive heart failure with severe mitral regurgitation. Since then several reports have followed [3–6].

Last year a Michigan group also published a controversial report that there was no impact on long-term mortality in patients with mitral regurgitation that were surgically corrected [7]. Although there is still a big concern as to how the study was constructed and the reason why the study concluded, we also have encountered diverse outcomes in our practice. Mitral recon-

struction worked very well and restored LV dramatically in some patients, but it did not work so well in others. We wondered why such a simple operation as mitral reconstruction ended up with such diverse results.

In our experience, larger hearts seemed not to respond well to only mitral reconstruction. We retrospectively examined our long-term results of mitral reconstruction for idiopathic dilated cardiomyopathy (DCM).

Patients and Methods

From 1998 to 2005, we performed mitral valve surgery for idiopathic DCM to treat end-stage heart failure in 55 patients at Hayama Heart Center, Japan. This study was not submitted for institutional review board approval because this was a retrospective study with no individual patient identifiers used, and patient consent was waived. Written informed consent for the procedure was obtained from all patients before surgery. There were fifty-five patients in total (42 men and 13 women). The average age was 55 years old, varying from 17 to 77. The cause in this study is exclusively idiopathic dilated cardiomyopathy and does not include any other type of cardiomyopathy.

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Preoperative Clinical Status

All patients suffered from congestive heart failure and were treated by thorough medical treatment, including several cardioprotective agents with temporary convalescence. Most of the patients with intractable heart failure, in spite of optimal medical treatment, were referred to our hospital for further treatment. The duration of heart failure in these patients was an average of 5.5 years, varying from 5 months to 9 years. As cardioprotective agents, all but 4 patients took angiotensin converting enzyme inhibitor or angiotensin receptor blocker. Beta-blockade therapy was introduced to 44 patients, but 19 of these patients were unable to tolerate the agents after several attempts, because of the negative inotropic effects of the beta-blocker.

After optimal medical treatment, including the temporary use of drip infusion of catecholamine, the preoperative New York Heart Association (NYHA) functional class and LV function was measured at the stable condition if possible. The preoperative NYHA functional class was class III in 25 patients and class IV in 30 patients. Nineteen patients were intractably dependent on inotropic drip infusion and were unable to be weaned from intravenous administration of catecholamine in spite of optimal medical treatment. Nine of these patients were on pre-shock status and 2 were on intraaortic balloon pump. Subsequently, 9 patients underwent emergent operations. Serum brain natriuretic peptide (BNP) varied widely, even after optimal medical treatment, and the preoperative BNP level just before surgery in an elective 46 patients was 628 ± 420 , from 140 to 1440 pg/mL.

Serial echocardiography is mandatory for all to calculate LV diameter and ejection fraction (EF). Left ventricle volume was measured by biplane, not single plane, with the LV angiogram primarily if the condition of patients allowed or quantitative gated scintigram at rest was subsidiary. Cardiopulmonary exercise examination was carried out to measure oxygen consumption for the relatively stable condition of 12 patients, and maximal oxygen consumption rate was 13.8 ± 1.8 mL/kg/m².

Surgical Technique

The surgical procedure was performed through a median sternotomy in all, and tepid warm blood cardioplegia was delivered through an antegrade route in all, and a retrograde route in addition if needed. The mitral valve was repaired in 37 patients (67%) with a 2 to 4 mm downsized semirigid, full annuloplasty ring, with a mean size of 26 mm, and a supplemental technique such as an artificial chordae implantation or Alfieri stitch in 6 patients. The mitral valve was replaced by a bioprosthesis in 18 patients (33%) with a preserving subapparatus continuity technique. In the very beginning of our experience for extremely enlarged and depressed hearts, we managed to shorten cardiac arrest time and avoid second pump run as much as possible. At first we adopted the replacement often, even for simple annular dilatation without any organic disorder, and then the technique, which has gradually shifted toward a complex one.

Surgical correction of tricuspid valve was required in 38 patients (69%). The tricuspid valve was repaired by a DeVega type of annuloplasty in 23 patients, by the Carpentier's classic ring annuloplasty in 12 patients, and it was replaced in 3 patients with a bioprosthesis. The Maze procedure was added in 8 patients for supraventricular tachyarrhythmia. Since 2001, biventricular resynchronization pacing was installed in 5 patients when the intraventricular conduction disturbance was noted preoperatively.

Follow-up

Most of the survivors returned back to our hospital for routine follow-up of the LV function every 6 months to 1 year. Four patients of survivors were distant from our hospital and were unable to show up routinely, and were therefore telephone interviewed with referring cardiologists. Patients were followed-up for a total 106 patient years, with a mean follow-up among survivors of 29 ± 23 months.

Statistical Analyses

Calculated data of variables were expressed as mean with standard deviation. Variables of two groups were compared by the unpaired *t* test. Correlation between the two groups was calculated by the Spearman's test and patient survival was calculated using the Kaplan-Meier method. For the survival results reported here, all deaths related or unrelated to the cardiac event were regarded as the end points. Differences between the survival rates to groups were assessed by the log-rank test. The *p* value less than 0.05 was considered as statistically significant. Data were analyzed using Statistica 6.1 (StatSoft, Tulsa, OK).

Results

Preoperative measurements are summarized in Table 1. Eight patients were unable to survive surgery in an overall 55 patients. Hospital mortality noted 2 cases (4.3%) in an elective 46 cases, and 6 (67%) in an emergent 9 patients. Survival rate in the elective 46 cases are showed in Figure 1. One-year, 3-year, and 5-year survival rate, including hospital mortality was $73.3 \pm 6.9\%$, $58.2 \pm 8.2\%$, and $51.7 \pm 9.5\%$, respectively. In a long-term survival rate, there was no difference between repair and replacement (*p* = 0.382). Symptoms improved in most of the survivors, and the NYHA functional class changed from 3.5 ± 0.5 to 1.9 ± 0.8 after surgery.

We specifically looked back at the relationship between preoperative LV contractility and LV volume. Left ventricle EF and LV end-systolic volume index (ESVI) were plotted in Figure 2. There was no correlation between LV EF and LV ESVI (*r* = 0.033; *p* = 0.82) in our patient group. Left ventricle volume varied widely with 150 mL/m² in average of LV ESVI from 70 to 270 mL/m². Considering the wide variance of LV volume size, we divided elective 46 patients into two groups by the average value of LV ESVI 150 mL/m². Preoperative measurements in two groups are shown in Table 1. Left

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