SURGICAL TECHNIQUE

A More Comprehensive Left Ventricular Repair for Severely Dilated Cardiomyopathy

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ABSTRACT We report a patient with cardiogenic shock due to severely dilated cardiomyopathy who underwent complex, but comprehensive left ventricle (LV) repair. Preoperative investigation showed marked LV dilatation, poor LV function, severe mitral and tricuspid regurgitation, and total occlusion of two coronary arteries. We urgently performed (1) modified Batista operation which preserves the LV apex, (2) septal anterior ventricular exclusion (SAVE) operation, (3) mitral annuloplasty, (4) tricuspid annuloplasty, and (5) coronary bypass. Postoperative evaluation revealed good graft flow, reduced LV dimension preserving the elliptical shape, improved LV function, and minimal MR. Twenty-six months postoperatively, the patient has minimum clinical symptoms (NYHA: I). doi: 10.1111/j.1540-8191.2006.00170.x *(J Card Surg 2006;21:62-64)*

Severe heart failure due to functional mitral regurgitation (MR) and low left ventricular (LV) function is the end stage of dilated cardiomyopathy (DCM). Its surgical management remains challenging. Here, we report a patient who underwent two different LV repairs (i.e., the apex-sparing partial left ventriculectomy (PLV) and SAVE operation), MAP, and so forth.

PATIENT AND TECHNIQUE

A 54-year-old man was referred to our hospital under intraaortic balloon pumping (IABP) for cardiogenic shock. He had had multiple episodes of congestive heart failure due to ischemic cardiomyopathy and MR for the past 10 years. The current deterioration of heart failure could not be controlled by medication. Echocardiography and left ventriculography (LVG) (Fig. 1A) revealed marked LV dilatation (LV diastolic dimension: 69 mm, LV systolic dimension: 61 mm), very poor LV function (LV ejection fraction: 10%), severe MR, and severe tricuspid regurgitation (TR). Coronary angiography demonstrated total occlusion of the proximal left anterior descending artery (LAD) and the circumflex branch. The right coronary artery was patent. An emergency operation was performed through a median sternotomy. The left internal thoracic artery (LITA) was harvested. After establishing cardiopulmonary bypass, LV wall motion was evaluated by an echocardiographic volume reduction test.[1] LV lateral wall between papillary muscles and extensive antero-septal wall were thin and akinetic even under reduced preload condition. Therefore, we applied two different LV repair procedures. For the beating condition, first we incised the anterior LV wall, inspected the LV cavity and palpated the thickness of LV wall to determine the thin scar area in both the antero-septal and lateral LV wall. We resected the locally akinetic and thin lesion of lateral wall (8 × 4 cm) between two papillary muscles (Fig. 2) from the LV base to middle portion of the LV (i.e., sparing LV apex). This resected area was found not to coincide with the coronary perfusion area. These findings indicated that the etiology of this lesion of lateral wall was nonischemic, which was confirmed by histological examination after the surgery. The LV lateral wall was then closed by two layers, interrupted 3–0 polypropylene mattress sutures and a 1–0 monofilament over and over suture. Then we applied an oval-shaped woven Dacron patch (10 × 3.5 cm) to the border between the intact and akinetic lesion of the antero-septal wall with interrupted 3–0 polypropylene mattress sutures (i.e. septal anterior ventricular exclusion (SAVE) operation). Under aortic cross-clamping, MAP was performed using a 26-mm Cosgrove ring covering the whole posterior annulus and anterior annulus near each trigone and CABG (LITA to LAD). We selected the hemi-ring as the anterior part

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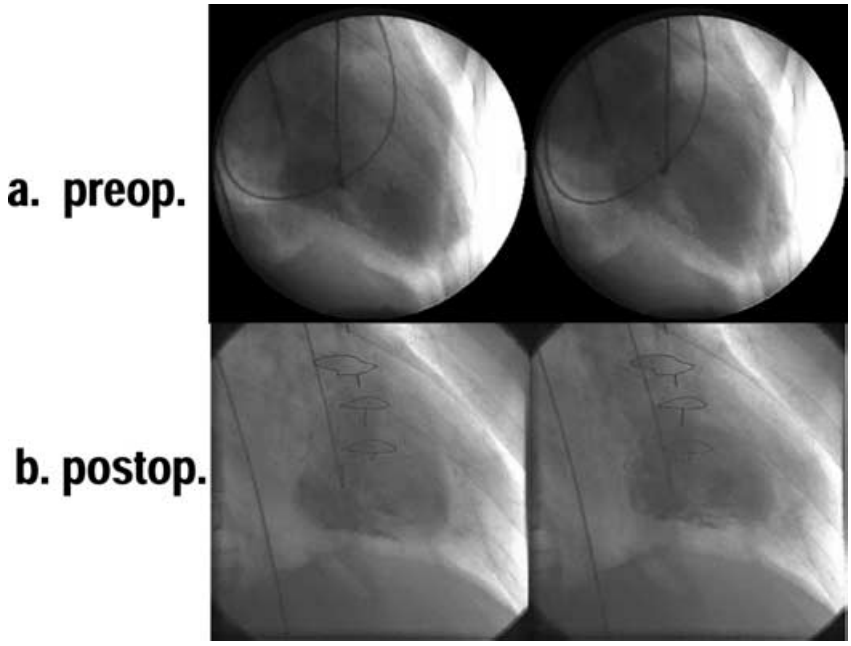

Figure 1. *Preoperative (A) and postoperative (B) LVG. Diastolic frame (left) and systolic frame (right). Postoperative LVG shows improved LV function and reduced LV dilatation.*

of the mitral annulus was not dilated. After releasing the cross-clamp, tricuspid annuloplasty was done using a 28 mm Cosgrove ring. The cardiopulmonary bypass time was 203 minutes and the Aortic cross-clamp time was 81 minutes.

The patient recovered slowly but steadily. IABP was weaned on POD #5, extubated on POD #13, and discharged on POD #38. The postoperative evaluation revealed good LAD flow through LITA graft, reduced LV dimension (LVDd: improved from 69 to 61 mm) preserving the elliptical shape, improved LV function (EF: from 10 to 32%), and minimal MR and TR (Fig. 1B). Twenty-six months postoperatively, the patient is doing well and has minimum clinical symptoms (NYHA: I).

DISCUSSION

This case report describes a patient who underwent two different LV repairs for severely DCM. Endoventricular circular patch plasty was reported by Dor et al. for treatment of LV apex aneurysm and substituted for linear resection surgery with better results.[2] In cases of extensive antero-septal myocardial infarction from LV base to the apex, the original Dor procedure might deteriorate LV function since the purse-string suture of the border zone and the round-shape patch might deform the LV geometry from elliptical to spherical by making an excessive reduction of longitudinal dimension. To overcome this problem in ischemic DCM, we have been performing the SAVE operation, which was initially developed for idiopathic DCM by modifying the Dor procedure (interrupted mattress suture instead of purse-string suture; not round but oval patch prosthesis).[1]

Batista et al. reported PLV, which resects the lateral wall to reduce diameter and wall tension of the LV that follows Laplace's law.[3] Suma et al. reported good clinical results of this surgery by evaluating an akinetic lesion under volume-unloading condition with intraoperative echocardiography,[1] although this operation is no longer performed in most units of cardiac surgery due to unpredictable results. Recently, McCarthy et al. invented a unique new device that was designed to create a modified bilobular shape with a smaller radius that reduced LV wall stress, and improved LV systolic function.[4] The surgical strategy with this new device, Myosplint, could be recognized as a way to restore LV geometry. On the basis of anatomical understanding of LV structures,[5] we reported that the apex-sparing PLV yields better outcomes than the apex-sacrificing PLV in DCM animals[6] and we applied this modified Batista operation to four nonischemic DCM patients (age: 40 to 74). All of them survived and are doing well (on the average, NYHA from 3.5 to 2.0 at follow-up of 21 months, LVDd: 71 to 57 mm, LVEF 21 to 34%). We believe that both SAVE and modified Batista operations, which we have performed in this case, are LV repair surgeries that are highly oriented to restoration of LV geometry/structure.

Functional MR is another incremental risk for those DCM patients. Many authors reported that not only annular dilatation but LV remodeling plays an important role in deteriorating mitral valve coaptation.[7] Lateral shift of papillary muscles and widening of LV wall between the two papillary muscles due to LV remodeling pull down the leaflets (i.e., tethering). In this context, LV repair surgery that restores LV geometry improves mitral valve coaptation. Moreover, as we reported,[8] MAP intrinsically decreases the LV base's dimension. In this patient, three procedures are considered to contribute

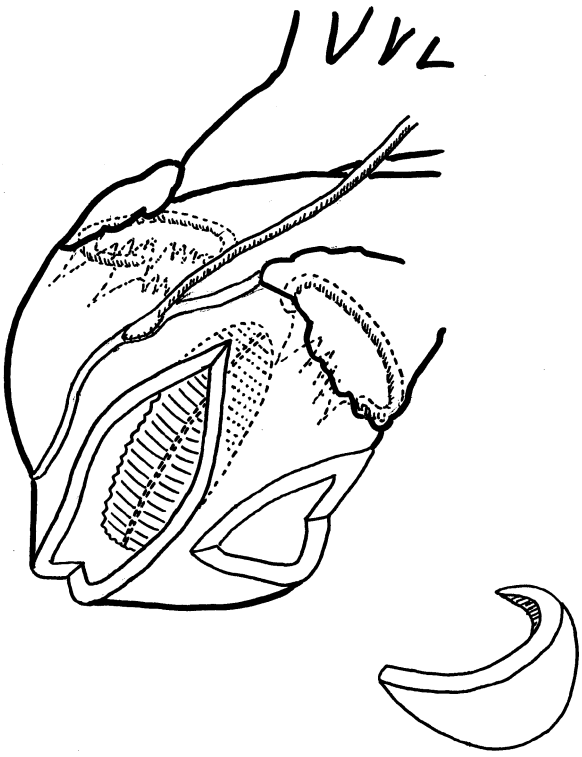

Figure 2. *Schematic drawing of the complex, but comprehensive left ventricle (LV) repair; (1) modified Batista operation which preserves the LV apex, (2) septal anterior ventricular exclusion operation, (3) mitral annuloplasty, (4) tricuspid annuloplasty, and (5) coronary bypass.*

to mitral valve coaptation: (1) SAVE operation by restoring LV geometry, (2) the apex-preserving PLV by reducing the distance between the two papillary muscles, and (3) MAP by decreasing the mitral annular dimension. These three procedures also play an important role in reducing LV volume and thereby improving LV function, SAVE operation and the apex-preserving PLV at the mid-portion and MAP at the base of LV.

In conclusion, we performed two different LV repairs plus MAP on a patient with severely DCM, with an excellent outcome (no residual MR and improved LV function). As far as we know, this is the first report on a patient with two different LV repairs for DCM, hence we reported this case of complex but comprehensive LV repair.

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