New Method of Posterior Scallop Augmentation for Ischemic Mitral Regurgitation

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We report a new method of posterior middle scallop (P2) augmentation for ischemic mitral regurgitation to achieve deep coaptation. First, P2 was divided straight at the center and partially detached from the annulus in a reverse T shape. A narrow pentagon-shaped section of pericardium was sutured to the divided P2 and annular defect. The tip of the pentagon was attached directly to the papillary muscle, thus creating a very large P2 scallop. A standard-sized ring was placed. We adopted this technique in 2 patients with advanced ischemic cardiomyopathy, and no mitral regurgitation was observed during a 1-year follow-up.

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Recurrence of mitral regurgitation (MR) after ring annuloplasty for ischemic cardiomyopathy frequently occurs. A recent echocardiographic study revealed that posterior leaflet tethering is worsened by restrictive ring annuloplasty [1]. Therefore, posterior leaflet augmentation [2] seems to be a rational adjunct to ring annuloplasty. We developed a simple method to augment the posterior middle scallop (P2) and obtain a large coaptation area that may effectively prevent recurrent MR.

Technique

We applied this method in 2 male patients aged 63 and 62 years. During surgery, a piece of autologous pericardium was harvested and treated with 0.6% glutaraldehyde for 10 minutes. In both patients, the mitral annulus was dilated, and severe leaflet tethering was observed. The leaflets and chordae were structurally intact. The P2 was cut longitudinally at the center from the free edge to the annulus, then partially detached from the annulus toward the lateral and medial sides in a reverse T shape. The annular detachment was about 2.5 cm long. The harvested pericardium was trimmed into a narrow pentagon shape (Fig 1A). The length of the basal edge of the pentagon was adjusted to the length of the detached P2 from the annulus, adding several millimeters as a suture cuff. The shoulder of the pentagon was 30% wider than the base for the purpose of circumferential augmentation of the coaptation zone. The length of each basal side edge was equal to the leaflet height of P2 plus the length of the annular detachment on each side. The upper side edges were adjusted to be 1-cm longer than the original P2 chordal length. The summit of the pentagon pericardium was directly attached to the dorsal surface of the stout anterior papillary muscle using pledget-supported Gore-Tex CV4 suture (W. L. Gore & Associates, Flagstaff, AZ). The angled cut edges of P2 were then sutured to the basal side edges of the

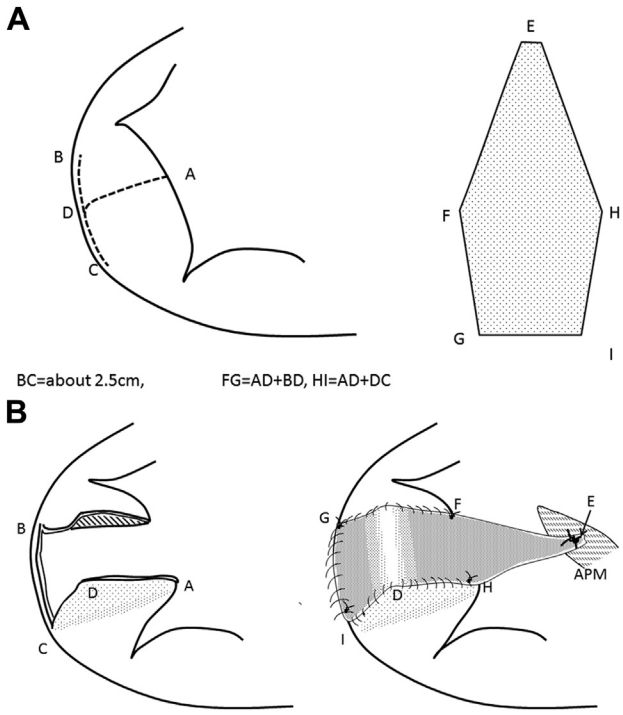

Fig 1. (A) Glutaraldehyde-treated autologous pericardium was trimmed into a narrow pentagon shape. A reversed T-shape incision was made in the P2 scallop. (B) The straight edge of the pericardium was sutured to the angled cut edges of P2. The three-dimensionally reconstructed P2 leaflet bulged toward the center of the valve. The summit of the pericardium was directly attached to the anterior papillary muscle (APM).

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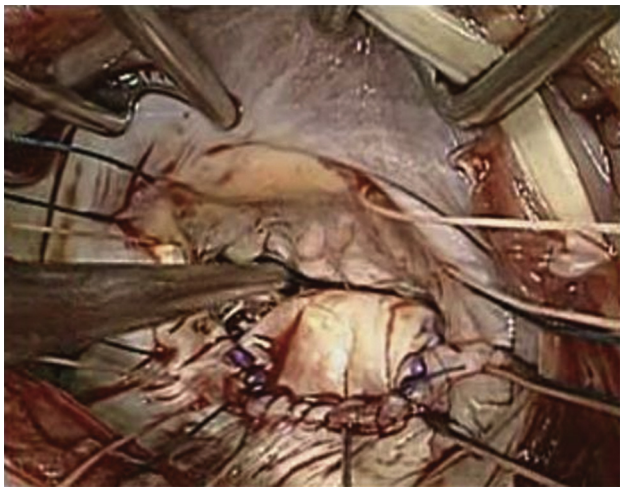

Fig 2. Intraoperative view. The P2 scallop was enlarged with the pericardium.

pericardium with 5-0 polypropylene sutures. The angled cut edges of P2 and the straight edges of the pericardium conformed well because the separated P2 scallops tilted up laterally and the pericardium was bent according to the P2 angle (Fig 1B). Thus, the augmented P2 leaflet bulged toward the center of the mitral orifice, creating a deeper coaptation with the anterior leaflet. The original P2 leaflet edge was advanced toward the apex, and the tethering was thus resolved. Finally, the basal edge of the pericardium was sutured to the mitral annulus. Figure 2 shows an intraoperative photograph after patch augmentation. A regular-sized prosthetic ring was selected. A 32-mm Carpentier-Edwards Physio II ring (Edwards Lifesciences, Irvine, CA) was used in 1 patient, and a 30-mm ring in the other. The first patient underwent concomitant tricuspid annuloplasty, coronary bypass, and left ventriculoplasty. The second patient underwent tricuspid annuloplasty. Both patients recovered uneventfully. Preoperatively, the left ventricular end-diastolic diameter (LVDd) was 68 and 58 mm, and the end-systolic diameter (LVDs) was 58 and 49 mm. The mitral valve coaptation depth [3] was 13 and 12 mm, and the end-systolic interpapillary muscle distance [4] was 25 and 23 mm, respectively. These indices strongly implied that annuloplasty alone would have been insufficient [3, 4]. In the first patient, the postoperative coaptation depth decreased to 3 mm, and the coaptation length was 14 mm (Fig 3A; Fig 3B); in the second patient, these values were 1 and 15 mm, respectively. The patients were followed up 17 and 13 months postoperatively. The last echocardiographic examination performed 14 and 12 months postoperatively showed an LVDd of 60 and 53 mm and an LVDs of 50 and 44 mm. The estimated mitral valve area was 4 and 5 cm^2, respectively. The MR was trivial in both patients. Both are in New York Heart Association functional class I.

Comment

Posterior leaflet augmentation for ischemic MR is usually performed by placing an oval pericardium after detaching the posterior leaflet from the annulus between P2 and P3 [2]. However, the P3 leaflet is sometimes hypoplastic and fragile, and placement of a long suture line between the leaflet and pericardial patch may be time consuming; furthermore, only longitudinal augmentation is obtained. We previously reported a reconstruction technique using the pericardium for structural mitral diseases [5] and applied a similar method to ischemic MR.

We augmented the P2 scallop longitudinally and circumferentially to obtain deeper coaptation at the center of the valve because according to Gogoladze and colleagues [6] the coaptation length is predominantly decreased in the A2 and P2 area in patients with functional MR. After P2 augmentation, the mitral valve was rather bicuspidized, different from a functionally monocuspid valve after simple annuloplasty. A standard-sized ring was adequate in both cases and provided a sufficient postoperative mitral valve area.

The coaptation length of 14 to 15 mm in our patients was far deeper than the normal value of 5 mm in the A2 and P2 region [6]. This length seemed robust enough to protect against possible future progression of left ventricular dilatation.

Potential drawbacks of this technique are inflow obstruction by a flat pericardium, risk of systolic anterior movement of the valve, and limited pericardial longevity. Therefore, proper sizing of the pericardium and careful follow-up are necessary. Ischemic MR with highly

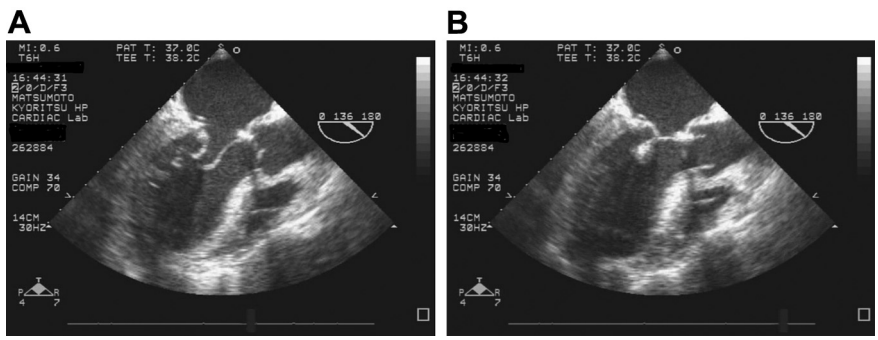

Fig 3. Postoperative long-axis view of the mitral valve in (A) diastole and (B) systole (transesophageal echocardiogram). (A) Enlarged P2 scallop has an adequate valve opening. (B) The A2 and P2 leaflets coapted near the mitral annular plane, and the coaptation was very deep.

progressed left ventricular remodeling was successfully repaired by P2 scallop augmentation.

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