Reducing the posterior wall length by using a small endoventricular patch for ischemic mitral regurgitation

Hiroshi Tanaka, MD, Kenji Okada, MD, Keitaro Nakagiri, MD, Yujiro Kawanishi, MD, Masamichi Matsumori, MD, and Yutaka Okita, MD, Kobe, Japan

Surgical treatment of ischemic mitral regurgitation remains controversial. We report 2 cases of ischemic mitral regurgitation complicated with a posterior basal aneurysm successfully treated with a small endoventricular patch to reduce the infarct posterior length.

Clinical Summaries

PATIENT 1. A 58-year-old man was referred to our institution for ischemic heart disease. Coronary angiography revealed a severe 3-vessel disease. Echocardiography demonstrated a moderate mitral regurgitation and a localized posterior basal aneurysm. The anterior wall motion was normal, and the cause of mitral regurgitation was leaflet tethering 10 mm in depth, mainly in the posterior leaflet retracted by the posterior papillary muscle (Figure 1, A).

At the time of surgical intervention with cardiopulmonary bypass, the aorta was clamped, and cardioplegic arrest was obtained. The left ventriculotomy was made through the aneurysm parallel to the posterior descending artery. The endocardial boundary between the infarction and the normal myocardium was distinct, and the orifice of the aneurysm was 3×4 cm in size. The posterior papillary muscle was not involved in the infarction. A 2×3 -cm triangular woven Dacron patch (Hemashield patch, Boston Scientific) was sutured to the mitral annulus cranially, to the posterior wall laterally, and to the septum medially with 4-0 polypropylene (Prolene, Ethicon) sutures. The ventriculotomy was closed with 3-0 polypropylene (Prolene) sutures. The left atrium was opened, and a mitral annuloplasty ring (Physio-ring, 26 mm, Edwards Lifesciences) was sutured to the annulus. Echocardiography 2 weeks (Figure 1, B) and 4 months (Figure 1, C) after surgical intervention revealed no mitral regurgitation and no leaflet tethering, and the patient is asymptomatic.

PATIENT 2. An 80-year-old man was referred for ischemic mitral regurgitation. The left ventriculogram showed a localized posterior basal aneurysm with an orifice of 4×6 cm and normal anterior wall motion. Preoperative echocardiography demonstrated tethering of the posterior mitral leaflet, and the depth of tethering was 10 mm. He was treated surgically with a small endoventricular patch, 3×5 cm in size, and mitral annuloplasty. Postoperative echocardiography 2 years after the operation showed only trivial mitral regurgitation.

Discussion

Not only ring annuloplasty but also additional procedures to correct the left ventricular geometry are required to achieve a better long-term outcome for ischemic mitral regurgitation.¹ Apical displacement of papillary muscles caused by ischemic cardiomyopathy leads to tethering of the chords and decreased leaflet coaptation. Papillary muscle approximation, infarct plication, and exclusion of infarct area have been reported for patients with ischemic cardiomyopathy involving the anterior wall to correct the displacement.² On the contrary, Frater and colleagues³ described that localized posterior infarction caused failure of posterior ventricular shortening, which brought about ischemic mitral insufficiency. For this pathology, “geometric endo-ventricular patch repair of inferior left ventricular scars” was introduced; however, the details of the mechanism of correction for mitral regurgitation were not described.⁴ Kron and associates⁵ have introduced a procedure in which a suture between the

From the Department of Cardiovascular, Thoracic, and Pediatric Surgery, Kobe University Hospital, Kobe, Japan.

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Address for reprints: Hiroshi Tanaka, MD, Kobe University Hospital, Department of Cardiovascular, Thoracic, and Pediatric Surgery, 7-5-2, Kusunoki-cho, Chuo-ku, Kobe, Japan (E-mail: hirot@ams.odn.ne.jp).

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Figure 1. A, Preoperative echocardiogram showing a posterior basal aneurysm (*white arrow*) and severe mitral regurgitation caused by the posterior mitral leaflet tethering retracted to the posterior papillary muscle during systole 10 mm in depth (*white line*). B and C, Postoperative echocardiography showing no tethering of the posterior mitral leaflet. The *white arrow* indicates the endoventricular patch. Dd, Dimension diastole; Ds, dimension systole; FS, fractional shortening.

Figure 2. A, Preoperative. Posterior basal aneurysm causing dislocation of the posterior papillary muscle from the mitral leaflet, which provokes leaflet tethering (*small arrow*). The *white arrow* indicates mitral regurgitation. B, Postoperative. A small-sized patch applied to the aneurysm prevents the posterior papillary muscle from moving away from the mitral leaflet.

posterior papillary muscle and the mitral annulus is shortened to alleviate tethering of the posterior mitral leaflet for this entity. In our cases preoperative echocardiography revealed a localized ventricular aneurysm that protruded during systole, preventing the papillary muscle toward the mitral annulus. The leaflet coaptation depth was 10 mm in each case, and myocardial contraction, except for aneurysm, was almost normal. Papillary muscle shortening

during systole has been reported to be 2 to 4 mm in length, which is thought to be disregarded for contribution to the leaflet tethering. Therefore, the leaflet tethering would be mainly contributed by papillary muscle dislocation in these cases. We applied a small endoventricular patch, which would secure more physiologically for a longer time than Kron's procedure, to reduce 1 cm in length longitudinally and laterally the infarct posterior wall (Figure 2).

This technique could be useful for ischemic mitral regurgitation in patients who have localized dyskinesis in the posterior left ventricular wall.

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The intraoperative “ink test”: A novel assessment tool in mitral valve repair

Ani C. Anyanwu, MD, FRCS, and David H. Adams, MD, New York, NY

Mitral valve repair is the established therapy of choice for most patients with mitral regurgitation. Assessment of repair quality traditionally relies on visual inspection, saline testing, and transesophageal echocardiography (TEE). Although invaluable in assessing valve competency, the saline test is limited because it does not provide confirmation of the surface of coaptation; a valve that is competent on saline testing might actually have a minimal surface of coaptation or excess anterior leaflet tissue below the closure line. Although TEE might demonstrate such imperfections (specifically inadequate zone of coaptation or a tendency for systolic anterior motion), there is an understandable reluctance to reinstitute cardiopulmonary bypass to address such TEE findings if the valve is otherwise competent. Such a strategy, however, leaves some patients with an inadequate surface of coaptation and might be one explanation for recurrent mitral regurgitation.¹ There is a need for a technique that allows the surgeon to confirm the amount of leaflet tissue below the valve closure line before weaning from cardiopulmonary bypass. We describe a simple “ink test,” which allows an accurate assessment (and optimization) of the surface of coaptation during mitral valve reconstruction.

Technique

At completion of valve reconstruction, a saline test is performed by using a bulb syringe to inject saline into the ventricular cavity until the mitral leaflets are distended and in an approximate systolic position. Assuming no residual leaks are identified (which should first be corrected by appropriate techniques), the detached tip of a surgical gentian violet marking pen (Codman, Raynham, Mass) is held with a clamp and used to mark the line of closure from the anterior to the posterior commissure, leaving a residual reference line on both leaflets (Figures 1, A, and 2, A). Optimally, one should see a symmetric line of closure displaced toward and parallel to the posterior aspect of the annuloplasty ring. The saline is then aspirated from the ventricle, allowing inspection of each leaflet. The height of the residual leaflet below the marked closure line represents the leaflet available to create the surface of coaptation (Figure 1, B, and 2, B). This unmarked zone is examined. In an optimal repair there should be more than 4 mm of leaflet beyond the marked line (because some ink enters the coaptation zone, the ink test underestimates the true coaptation surface by a few millimeters). In the case of minimal tissue identified beyond the closure line, adjunct techniques are applied to improve the surface of coaptation, such as further leaflet mobilization by cutting secondary chordae, downsizing of the annuloplasty ring, and cleft closure. The ink test also allows confirmation that no more than 1 cm of anterior leaflet tissue is below the coaptation line (Figures 1, B). Because excessive anterior leaflet tissue distal to the coaptation line can predispose to systolic anterior motion, if identified, this should be corrected by height reduction of either leaflet.

Discussion

An adequate mitral valve repair should result in a competent valve with a symmetric line of closure and adequate surface of coaptation. Symmetry of the closure line and competency are demonstrable on saline testing.² Our ink test provides further clarification of the quality of repair by confirming an optimal surface of coaptation below the closure line (a 1-mm coaptation surface might be “competent” but not optimal). An adequate surface of coaptation is essential for a durable

From the Department of Cardiothoracic Surgery, Mount Sinai Hospital, New York, NY.

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Address for reprints: David H. Adams, MD, Department of Cardiothoracic Surgery, Mount Sinai Medical Center, 1190 Fifth Ave, Box 1028, New York, NY 1028 (E-mail: David.Adams@mountsinai.org).

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