Case Series

Transventricular Mitral Valve Repair

in Patients with Acute Forms of Ischemic Mitral Regurgitation

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Transventricular mitral valve surgery combined with left ventricular restoration avoids atriotomy and provides a larger operative field. We describe a series of 5 patients in whom we performed transventricular mitral valve repair by various techniques, such as band annuloplasty, papillary muscle reattachment, chordal cutting, and edge-to-edge repair.

The more acute forms of ischemic mitral regurgitation, as found in our patients, can coexist with post-myocardial infarction contained rupture or post-myocardial infarction ventricular septal rupture. Because these patients already have an indication for ventriculotomy, concomitant transventricular repair of the mitral valve can render a separate atriotomy unnecessary and thereby shorten the duration of cardiopulmonary bypass. Moreover, in patients with acute presentations, the absence of atrial dilation (this last associated with chronic cases) might make transventricular repair a better choice than the more difficult atrial approach. ***(Tex Heart Inst J 2014;41(3):312-5)***

Key words: *Acute disease; annuloplasty; chordae tendineae/surgery; echocardiography, transesophageal; mitral valve annuloplasty; mitral valve insufficiency/surgery; myocardial infarction/complications; myocardial ischemia/surgery; papillary muscles/surgery; transventricular repair; ventricular dysfunction, left/surgery*

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Transventricular mitral valve (MV) surgery combined with left ventricular (LV) restoration avoids atriotomy and provides a larger operative field. In general, simple repair techniques (papillary muscle imbrication, annuloplasty, or edge-to-edge repair) or valve replacement have been performed from the ventricular side.[1-3] In this report, we describe a case series of 5 patients in whom we performed various MV repair techniques directly through the LV.

Case Reports

Patient 1

A 57-year-old man presented with severe dyspnea in association with a huge apicoposterolateral LV aneurysm, severe mitral regurgitation (MR) (Fig. 1), LV ejection fraction (LVEF) of 0.30, and occlusion of the left circumflex coronary artery. After 3 days of hospitalization with intra-aortic balloon pump support, the patient underwent emergent surgery because of sudden cardiac arrest. Median sternotomy revealed a contained rupture of the LV aneurysm in the region of the shoulder. While the patient was under cardiopulmonary bypass (CPB) via bicaval cannulation, we entered the LV aneurysm, extracted intra-aneurysmal thrombus, and found the mitral apparatus on the ventricular side to be a clear mirror image of the mitral apparatus on the atrial side. We then performed posterior band annuloplasty with a Teflon strip, cut the 4 secondary chordae of the posterior leaflet, and plicated the P2 segment in a triangular fashion—all directly through the LV.

For the band annuloplasty, we first placed double-needle ETHIBOND 2-0 pledgeted sutures through the annulus from the ventricular side into the atrial side, exercising extreme caution to avoid interference of the sutures with the chordae and papillary muscles. We placed a Teflon band (approximately 4 cm in length) in the subannular position and passed the sutures through the annulus and then through the corresponding segment of band from the atrial side into the ventricular side. The sutures were tightened and tied on the ventricular side (Figs. 2 and 3). An endoaneurysmorrhaphy was performed, and the rupture sites were plicated (Fig. 4). Coronary artery bypass grafting (CABG) was not performed. Echocardiograms showed minimal MR and intact ventriculoplasty (Fig. 5). The patient experienced an uneventful postoperative hemodynamic recovery and displayed mild MR on the occasion of the 3-month

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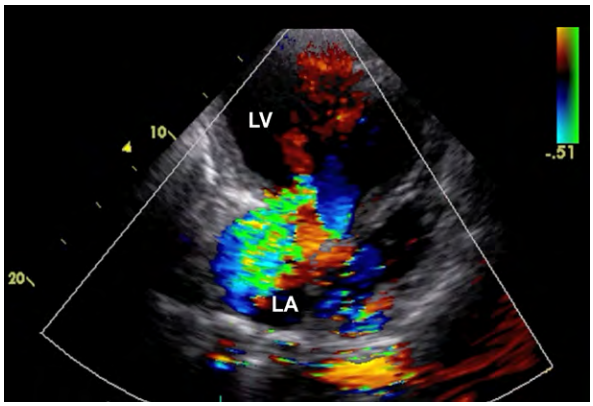


Fig. 1 *Patient 1. Preoperative transthoracic color-flow Doppler echocardiogram shows severe mitral regurgitation.*

LA = left atrium; LV = left ventricle

Supplemental motion image is available for Figure 1.

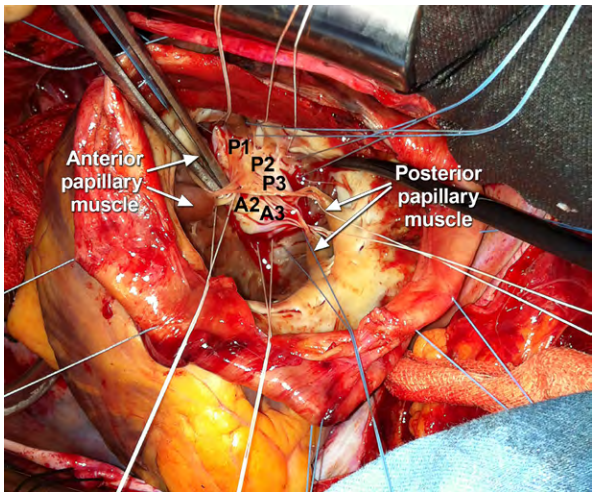


Fig. 2 *Patient 1. Intraoperative photograph shows subannular position of the sutures for Teflon-band annuloplasty.*

A2–3 = anterior leaflet segments; P1–3 = posterior leaflet segments

follow-up echocardiogram. His cardiac function was New York Heart Association (NYHA) class II at that same appointment.

Patient 2

A 74-year-old woman was transferred to our center with a diagnosis of posterior post-myocardial infarction ventricular septal rupture (post-MI VSR), in association with a posterior LV aneurysm, severe MR, LVEF of 0.30, and multivessel coronary artery disease (CAD). After placing an intra-aortic balloon pump for 2 days, we entered the aneurysm and closed the VSR with a 3 × 5-cm GORE-TEX® patch (W.L. Gore & Associates, Inc.; Flagstaff, Ariz), with the patient under CPB via bicaval cannulation.

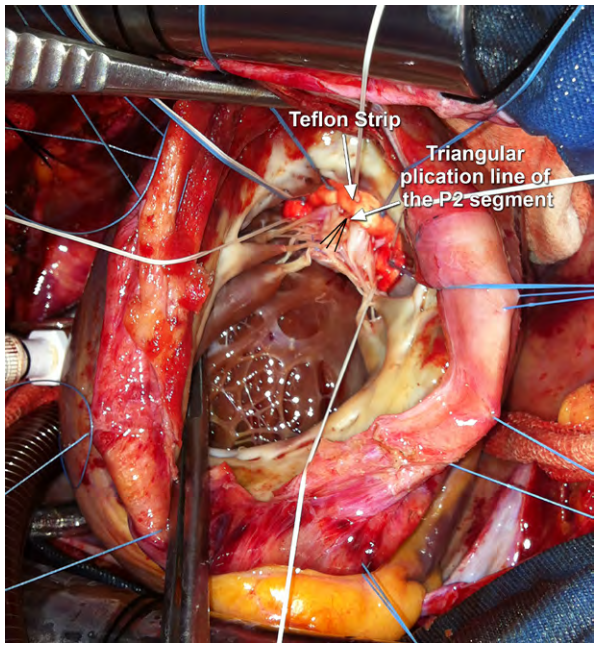


Fig. 3 *Patient 1. Intraoperative photograph shows final appearance of the band annuloplasty.*

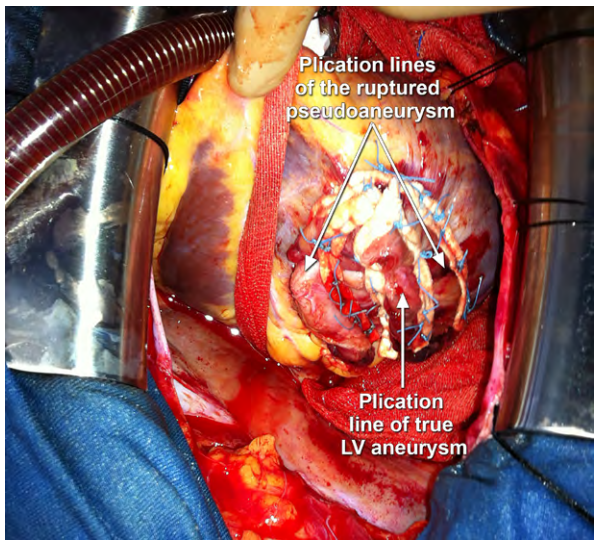


Fig. 4 *Patient 1. Intraoperative photograph shows left ventricular (LV) plication lines at the end of surgery.*

Although the base of the posterior papillary muscle was incompletely ruptured and necrotic (Fig. 6), we judged the healthy surrounding tissue to be sufficiently firm and used GORE-TEX pledgeted suture to reattach the papillary muscle 1 cm below the ventriculotomy site (Fig. 7). We then plicated the aneurysm and performed CABG to the left anterior descending coronary artery (LAD), the first obtuse marginal branch, and the right coronary artery. Intraoperative transesophageal echocardiograms (TEE) showed mild MR with no residual shunting. Our patient was discharged from the hospital

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on the 6th postoperative day, and upon 2-month follow-up echocardiography she displayed mild MR. Her functional class was NYHA II at the 2-month follow-up appointment.

Patient 3

A 64-year-old man presented with dyspnea and chest pain. He was found to have a posterior LV aneurysm, severe MR, an LVEF of 0.37, and multivessel CAD. With the patient under CPB via bicaval cannulation, we entered the LV aneurysm.

Because TEE showed chordal tethering, we cut 4 secondary chordae of the posterior leaflet. We then plicated the aneurysm and performed CABG to the LAD, the right marginal branch, and the 1st and 2nd obtuse marginal branches. Intraoperative TEE showed mild-to-moderate MR. Discharged from the hospital on the 7th postoperative day, the patient was well at his 6-month follow-up evaluation, with no deterioration in the degree of his MR. His functional class was NYHA class II at that time.

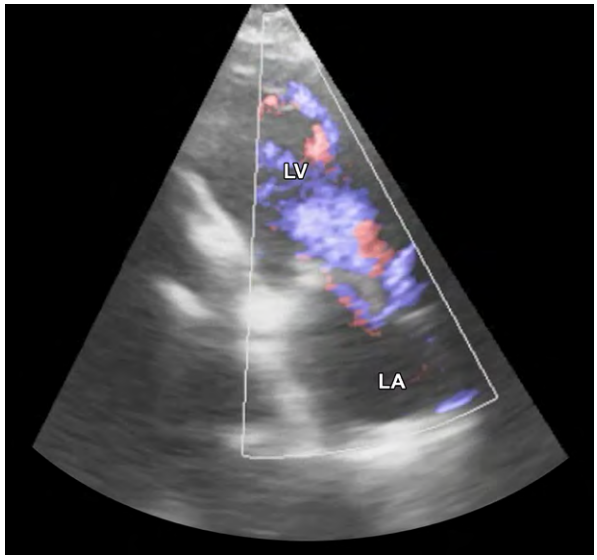


Fig. 5 *Patient 1. Postoperative transthoracic color-flow Doppler echocardiogram shows minimal mitral regurgitation.*

LA = left atrium; LV = left ventricle

Supplemental motion image is available for Figure 5.

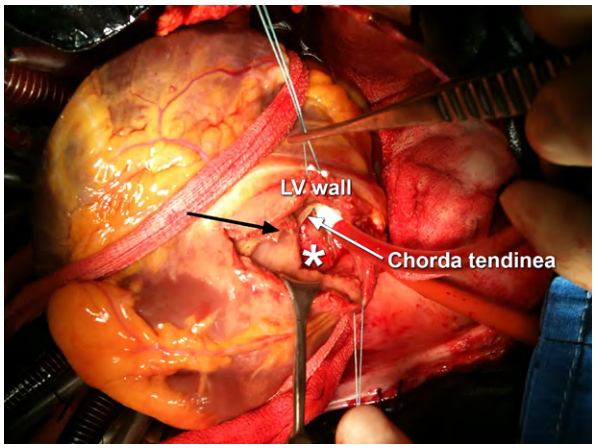


Fig. 6 *Patient 2. Intraoperative photograph shows partial rupture of posterior papillary muscle (black arrow).*

** = ventricular septal rupture; LV = left ventricular*

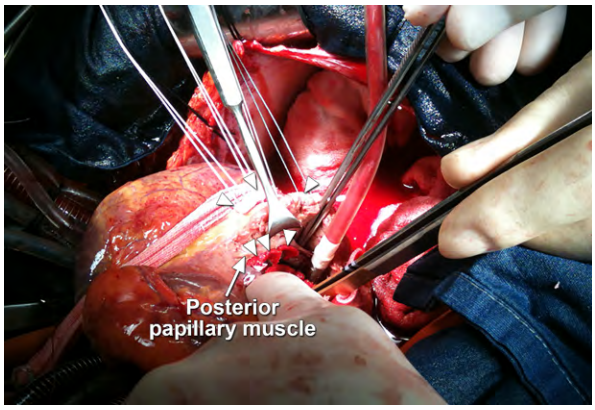


Fig. 7 *Patient 2. Intraoperative photograph shows reattachment of the posterior papillary muscle. Arrowheads point to pledgeted sutures.*

Patient 4

An 84-year-old woman presented with severe dyspnea. She was found to have an apical post-MI VSR with a large apical LV aneurysm, severe MR, an LVEF of 0.28, and 2-vessel CAD. With the patient under CPB via bicaval cannulation, we entered the aneurysm and extracted intra-aneurysmal thrombus. Because TEE showed that the MR originated from the A2–P2 segments, we performed edge-to-edge repair with a Prolene 4-0 pledgeted suture, approximately 0.5 cm from the edges. The apical VSR was repaired by using a 3 × 4-cm GORE-TEX patch, the aneurysm was plicated, and CABG to the 1st and 2nd obtuse marginal branches was performed. Intraoperative TEE showed moderate MR. The patient was discharged from the hospital on the 10th postoperative day and had moderate MR on 4-year follow-up echocardiograms. Her functional class was NYHA II at 4-year follow-up.

Patient 5

An 81-year-old woman presented with pulmonary edema. She was found to have a posterior LV aneurysm, severe MR, an LVEF of 0.38, and 2-vessel CAD. With the patient under CPB via bicaval cannulation, we entered the LV aneurysm and cut 3 secondary chordae of the posterior leaflet. We then plicated the aneurysm and performed CABG to the LAD and the 2nd obtuse marginal branch. Intraoperative TEE showed mild MR. Our patient was discharged from the hospital 6

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days after the operation and was well at her 2-month follow-up evaluation, with no deterioration in the degree of her MR. Her functional class was NYHA II on that occasion.

Discussion

Our case series shows that, in selected patients, various MV repair techniques can be performed efficiently from the ventricular side.

Ischemic MR is related to changes in LV geometry, with subsequent displacement of the subvalvular apparatus, annular dilation, and restrictive leaflet motion—which in turn can result in loss of normal coaptation.[4] In a more acute form, as found in our patients, ischemic MR can coexist with post-MI contained rupture or post-MI VSR. Because these patients already have an indication for ventriculotomy, concomitant transventricular repair of the MV can render a separate atriotomy unnecessary and thereby shorten the duration of CPB. Moreover, in patients with acute presentations, the absence of atrial dilation (this last associated with chronic MR) might favor transventricular repair over the more difficult atrial approach.[2]

Although annuloplasty treats the annular component of ischemic MR, regurgitation can persist or recur after annuloplasty because that procedure alone does not sufficiently relieve the tethering of the leaflets by the remodeled ventricle.[5] Cutting the badly positioned secondary chordae has been shown to direct the movement of the leaflets through the coaptation line and improve coaptation by relieving the leaflet tethering.[6] At the discretion of the surgeon, we have combined band annuloplasty with chordal cutting and triangular plication, as we did in Patient 1, with an excellent result. In another 2 patients, chordal cutting alone was satisfactory to maintain normal coaptation.

The most important aspect of transventricular annuloplasty is close attention to suture management. In performing the transventricular approach, one finds that the anterior and posterior leaflet chordae and the papillary muscles can interfere with the annuloplasty sutures. If the problem is unrecognized, it can lead to persistent MR, because movement of the leaflets is restricted.

Edge-to-edge repair, an attractive option for repair of ischemic MR, can be performed via the transventricular approach during LV restoration. Sartipy and colleagues[3] showed that transventricular edge-to-edge repair without annuloplasty is fairly durable in conjunction with LV restoration; however, edge-to-edge repair should, when feasible, be combined with annuloplasty to increase leaflet coaptation.[7] In Patient 4, leaflet coaptation was re-established by edge-to-edge repair only; because of the patient's high-risk profile, we did not perform additional annuloplasty.

Transventricular papillary muscle reattachment was performed in Patient 2. Papillary muscle reattachment is usually performed in patients with post-MI papillary muscle rupture.[8] The durability of a repair that requires suturing onto friable infarcted tissue is a special concern, but if the papillary muscle is not completely necrotic and there is enough adjacent healthy tissue, reattachment can provide a satisfactory repair and avoid the necessity of replacement.

The primary concern about MV repair is the durability of that repair. At the 10-year follow-up evaluation, severe MR has been reported in 5% to 10% of patients with myxomatous valves; moderate or worse MR has been reported in 20% to 30% of patients with functional or ischemic MR at the 1- to 5-year follow-up.[9] In our patients, only short-term results are reported except for Patient 4, who had favorable 4-year follow-up results. All patients with repaired MVs should be monitored closely for possible recurrence of MR.

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