requiring any transfusion and in the total number of foreign donor blood exposures.

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A novel technique for treatment of mitral valve prolapse/flail

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Mitral valve repair with artificial chordae is a widely accepted procedure for the majority of patients with degenerative mitral regurgitation (MR), rendering good long-term results.¹ A new technique for the treatment of extensive mitral prolapse/flail is described herein.

CLINICAL SUMMARY

After median sternotomy, cardiopulmonary bypass is established between the right atrium and the aorta. The pericardium is opened, and the apex is elevated with stay sutures. A purse-string suture is placed onto the posterior aspect of the left ventricular (LV) apex. The LV apex is punctured with the Seldinger technique through the string suture, and an 8F introducer sheath is placed into the LV cavity. After cross-clamping of the aorta and normothermic cardioplegia, the left atrium (LA) is opened in the usual manner. Two double-armed pledgeted 2-0 Prolene sutures (Ethicon, Somerville, NJ) are passed through the prolapsed/flail leaflet segment and traversed through the LV sheath out of the left ventricle. The heart is deaired, the LA is closed, and

the aortic crossclamp is removed. A custom-made polymer elastic tube of premeasured length and a 2-mm external profile is advanced over the exteriorized suture arms to contact the target leaflet, thereby securing the suture loops to the leaflet on the beating heart and thus replacing intracardiac knotting (Figure 1A). The introducer sheath is removed, and the LV entry site is closed with a custom-made polymer occluder placed over the suture arms. The sutures are pulled and released until a good coaptation of the prolapsed/flail segment is achieved on the beating heart with transesophageal echocardiographic (TEE) guidance (Figure 1B). The exteriorized suture lengths are locked with the separate loop knot and secured to the exterior of the myocardial entry site occluder (Figure 2).

Between March and December 2007, 6 male patients aged 64 to 73 years with extensive prolapse, flail, or both of the posterior (n = 4) and anterior (n = 2) mitral leaflets underwent mitral repair with the described procedure. All 6 patients had significant heart failure (New York Heart Association class III–IV) caused by severe MR 2 to 6 weeks before surgical intervention. Degenerative mitral disease was present in all, although only 1 patient had concomitant coronary artery disease treated with percutaneous intervention. The mitral annulus and the LA were not significantly enlarged in any of the patients. Informed consent was obtained from each patient. The procedure was approved by the institutional review board. No other interventions were performed during the operation. Cardiopulmonary bypass time ranged from 40 to 70 minutes, and aortic cross-clamp time ranged from 5 to 15 minutes. MR was abolished in 2

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FIGURE 1. A, Left ventricular aspect of a porcine heart on the bench showing the tube in situ. B, Transesophageal echocardiographic analysis after repair showing the tube attached to the posterior leaflet. LA, Left atrium; AO, aorta; LV, left ventricle.

patients, reduced to less than grade I in 3 patients, and reduced to grade II in 1 (coronary diseased) patient. Inappropriate leaflet tethering during the procedure resulted in significant residual MR in this patient. No complications occurred. At 6 months' follow-up, MR increased from grade II to grade III in the 1 patient with coronary artery disease, whereas no changes were observed in 5 patients, as seen with TEE analysis. No major events were reported at follow-up.

DISCUSSION

The complexity during insertion of neochordae includes determining chordal length on a nonbeating heart, securing the neochordae to the leaflet, and knot sliding.² The technique here described enables a dynamic adjustment of the chordal length on a beating heart controlled by TEE. External fixation of the neochordae on a beating heart under TEE guidance has been used for the tricuspid valve³ and also for repair of the prolapsed aortic valve leaflet.⁴ Use of the elastic polymer tube that covers the suture loops, longitudinally tightening them to the leaflet, replaces the intracardiac knots. The suture anchorage in the myocardial occluder-type plug contributes to the shock absorption. We used a biocompatible polymer tube, which is used for permanent pacemaker lead insulation and has a well-established safety record. Strong tube attachment to the mitral leaflet and the LV apical endocardium has been reported 10 years after inadvertent pacemaker lead placement through the perforated posterior mitral leaflet.⁵ The expanded polytetrafluoroethylene sutures were not available at our institution. The long-term intracorporeal physical characteristics of the unit composed of 2-0 Prolene suture loops covered with the polymer tube have yet to be investigated. The breaking strength of this unit is about 10 kg. Long-term follow-up and extensive studies are needed to establish the real value

of this technique. Its simplicity might enable less experienced centers to perform isolated chordal replacement,

FIGURE 2. Scheme of the technique. The exteriorized sutures are initially fixated at the desired level, with the preformed loop knot (eg, "bowline") attached to the occluder. This loop knot does not slip. The additional "stopper" knots cannot slide through the solid occluder.

especially in patients with acute onset of MR without annulus enlargement.

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An improved hemostatic aortic anastomotic technique for nondissected aortic aneurysms

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Various anastomotic options have been described for securing native aortic tissue to synthetic graft material.^{1,2} Solutions such as a running Prolene suture (Ethicon, Inc, Somerville, NJ) without felt or bioadhesives have the advantages of being simple and rapid but might suffer from loosening during the creation of the anastomosis. A doubled felt anastomosis with or without glue is very secure and hemostatic but cumbersome to create and leaves an excess amount of foreign material that might elicit an inflammatory reaction³ or cause late problems at the anastomosis. Automatic staplers have been developed but have not had widespread clinical use, partially because of potential problems in atherosclerotic vessels, initial costs, and lack of long-term follow-up.⁴

CLINICAL SUMMARY

We have developed an anastomotic technique that is inexpensive, hemostatic, and minimizes the use of extraneous materials for nondissected aortic tissue. In our technique we use 2 additional sutures to lock an inverting anastomosis in each posterior quadrant.

For both proximal and distal ascending aortic graft anastomoses, a 3-0 pledgeted Prolene suture (4-0 for patients with Marfan syndrome) is used as a horizontal mattress in

the posterior base of the graft and then taken through the native aorta (Figure 1, A) and tied. (The pledget can also be placed inside the aorta and does not affect the technique.) The suture is then run in an inverting manner to the midpoint on each lateral aspect of the graft (3-o'clock and 9-o'clock positions, if the 12-o'clock position is most ventral on the aorta; Figure 1, B), with care taken by the assistant to provide traction while minimizing aortic intimal laceration. At this point, an additional simple 3-0 suture is placed outside-in directly below (dorsal) the exiting point of the original suture (Figure 1, B) and knotted with 4 half-hitches, secured to the original suture, and cut (Figure 1, C). This maneuver locks that section of the posterior anastomosis, limiting maximal tension without loosening the suture line. At this point, the additional suture is run to the 12-o'clock position (Figure 1, D and E). The same procedure is duplicated on the other side of the graft and tied at the 12-o'clock position (Figure 1, F). In this way each quadrant of the graft is locked into place, minimizing the loosening of the suture line and thus minimizing the potential for bleeding. Of course, if a felt pledget is used on the outside of the aorta, this suture technique can still be used to prevent loosening of the suture line.

DISCUSSION

For the last 50 consecutive elective aortic graft cases using this technique, we have not used any felt other than the initial pledget. There have been no reoperations for bleeding and no mortality, and blood products were used in only 8 of 50 patients: 3 patients with fresh frozen plasma and platelets and 5 patients with only exogenous blood averaging 2 units per patient. This inverting anastomotic technique produces no gradient at the anastomosis, as evaluated by using transesophageal echocardiographic analysis. We conclude that it is an easily learned and easily taught technique that results in a hemostatic suture line that can be performed rapidly in the elective aortic aneurysm setting. We have used this most

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