# Transapical mitral replacement with anterior leaflet splitting: A novel technique to avoid left ventricular outflow tract obstruction

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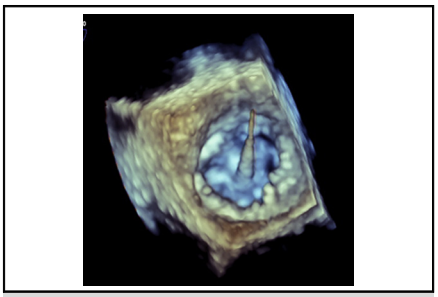


A 3D echo view of anterior mitral leaflet perforation from the left atrial aspect.

**Central Message**

Transcatheter mitral valve replacement may pose a risk of left ventricular outflow tract obstruction in some patients. A novel approach to preventing this complication is described.

See Editorial Commentary page XXX.

▶ Video clip is available online.

For high-risk patients with mitral disease, transapical mitral valve replacement (TAMVR) is a therapeutic option.[1] A known complication of TAMVR, however, left ventricular outflow tract (LVOT) obstruction (LVOTO), occurs in as many as 22% of cases.[2-6] Laceration of the anterior mitral leaflet (AML) to prevent this complication has been described.[7] We report a novel technique that uses transapical retrograde AML splitting to prevent LVOTO.

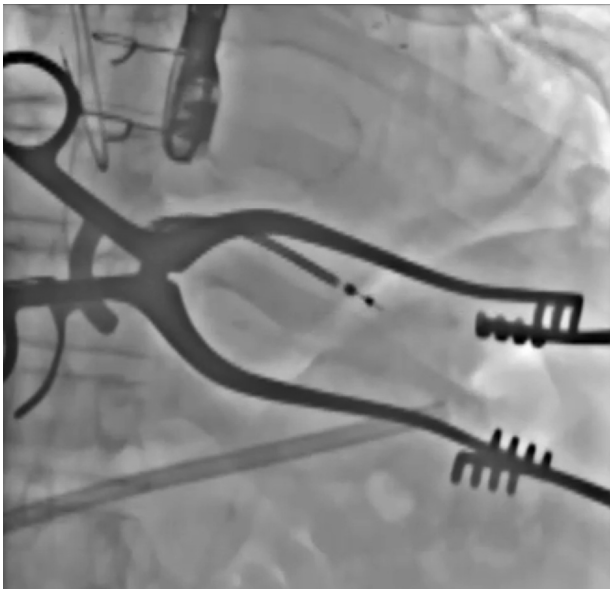
## CLINICAL SUMMARY

An 81-year-old man with previous coronary artery bypass grafting and mitral repair, chronic kidney disease, pulmonary hypertension, and atrial fibrillation was seen with New York Heart Association functional class III to IV symptoms. Echocardiography demonstrated previous mitral repair with a posterior band, nonfunctional posterior leaflet, and 1.5-cm anteriorization of the band. Mitral regurgitation was 4+ (vena contracta, 2-3 × 20 mm; area, 40 $mm^2$; effective regurgitant fraction, 58%). Echocardiographic analysis showed that the patient had a probable 29-mm annuloplasty band and borderline mitral stenosis (valve area, 2.6 $cm^2$ by planimetry; mean gradient, 3.7 mm Hg). Anterior mitral length was 28 mm; the aorto mitral annular (AMA) angle was 110°; and the LVOT diameter was 2.3 cm. Other findings included a left ventricular ejection fraction of 50%, moderate functional tricuspid regurgitation, and a right ventricular systolic pressure of 44 mm Hg. Angiography demonstrated a patent left internal thoracic artery—left anterior descending coronary artery graft, occluded vein grafts, and collateralization to the right coronary artery and circumflex coronary artery territories. The Society of Thoracic Surgeons predicted risk of operative mortality was 14.5%.

## TECHNIQUE

After double-lumen endotracheal intubation, femoral vessels were cannulated with 6F sheaths, and the artery was prepared with a preclosure device. Transthoracic ultrasonography demonstrated the optimal intercostal space for left ventricular apex access. The left lung was deflated, and a 4th intercostal minithoracotomy incision was made. The apex was indented with the surgeon's finger. Transesophageal echocardiography (TEE) demonstrated the position that would allow coaxial alignment with the AML (Video 1). Two purse-string sutures were placed at this site.

Cardiopulmonary bypass (CPB) was planned because of the anticipated acute severe coronary artery with this technique. After heparinization, femoral sheaths were exchanged for CPB cannulas. Before CPB was instituted, the apex was punctured at the center of the purse-string sutures with a long 18-gauge pericardiocentesis needle, which was advanced through the AML into the left atrium under TEE guidance (Video 1 and Figure 1). The AML puncture



**VIDEO 1.** Identifying the apical site and apical puncture through the anterior mitral leaflet. Video available at: http://jtcvsonline.org.

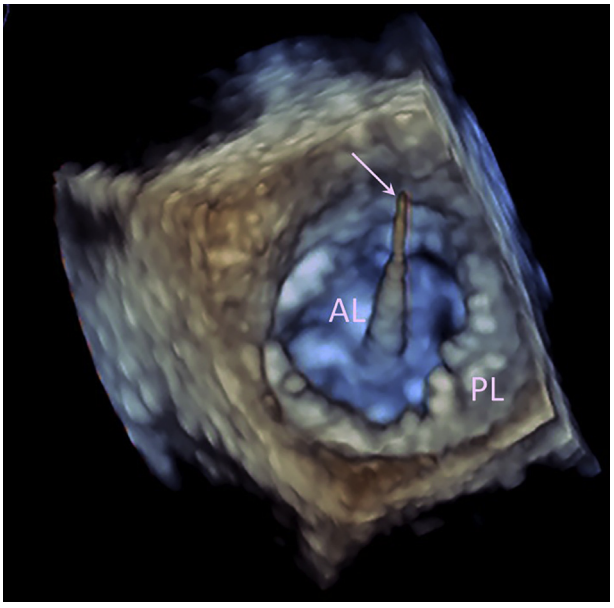



**FIGURE 2.** Three-dimensional echocardiographic view of leaflet perforation from the left atrial aspect. The *arrow* indicates the needle. *AL*, Anterior leaflet; *PL*, posterior leaflet.

site was at the point midway between the base and the tip of the A2 portion (Figure 2). The tethered leaflets facilitated retrograde puncture by preventing prolapse into the atrium and providing stability.

An 0.035-inch stiff J-wire was inserted through the needle and, under TEE and fluoroscopic guidance, advanced into the right superior pulmonary vein. The apical site was serially dilated, and the transapical delivery sheath was placed. The balloon-expandable 29-mm Sapien valve (Edwards Lifesciences, Irvine, Calif) was prepared and mounted on the delivery system.

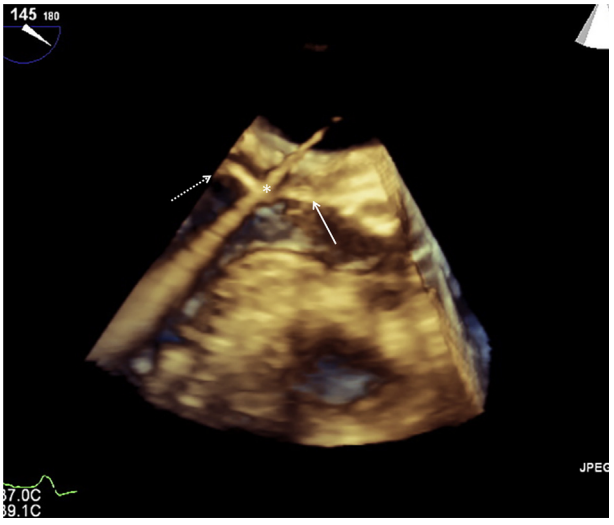



**FIGURE 1.** Three-dimensional echocardiographic view of the anterior mitral leaflet perforation with a long 18G needle. The *dotted arrow* indicates the free edge of the AML; the *solid arrow* indicates the annular attachment of the AML; and the *asterisk* indicates perforation at the midpoint of A2.

CPB was initiated (Video 2). The coplanar view of the annulus was established under fluoroscopic guidance, with the mitral band used as a marker. A 20-mm balloon was advanced over the wire, inflated within the AML under rapid ventricular pacing (Figures 3 and 4), and deflated and withdrawn. This maneuver caused the AML to separate from the annulus (Figure 4). The hemodynamic effects of the resultant severe mitral regurgitation were mitigated by CPB. The delivery system was advanced over the guidewire, and the valve was deployed with rapid ventricular pacing. The ventricular portion was balloon dilated with an additional 4 mL of contrast.

The patient was weaned from CPB, and the valve was assessed. Intraoperative TEE demonstrated the LVOT area to be 0.7 × 2.2 cm (area, 1.5 $cm^2$), with a mean gradient of 7 mm Hg. The mitral valve area by planimetry was 2.5 $cm^2$ (indexed area, 1.2 $cm^2/m^2$), and the mean transvalvular gradient was 2.8 mm Hg. There was trivial paravalvular leak, and there was no evidence of systolic anterior motion. CPB was briefly resumed for apical catheter removal; after removal, it was discontinued and the cannulas were removed. After drain placement, the incision was anesthetized and closed.

After treatment of pneumonia and adrenal insufficiency, the patient was discharged on postoperative day 10 without peripheral vascular or cerebrovascular complications. Echocardiography at 1 month demonstrated a mean LVOT gradient of 3 mm Hg and mild paravalvular leak.