Surgical treatment of residual systolic anterior motion after otherwise successful percutaneous transluminal septal myocardial ablation: A case report

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Hypertrophic obstructive cardiomyopathy (HOCM) is characterized by asymmetrically distributed left ventricular hypertrophy, often accompanied by left ventricular outflow tract obstruction (LVOTO).¹ LVOTO in patients with HOCM commonly exists in addition to mitral valve abnormalities, such as increased mitral leaflet area, length, and laxity, along with anterior displacement of the papillary muscles.² These abnormalities predispose toward systolic anterior motion (SAM), which is a protrusion of the anterior mitral valve leaflet into the left ventricular outflow tract, adding to the severity of LVOTO and a variable degree of mitral regurgitation.

FIGURE 1. Echocardiographic images. A, Preoperative transesophageal echocardiogram of the mitral valve. Arrow shows systolic anterior motion of anterior mitral valve leaflet in late systole. B, Preoperative transthoracic echocardiogram indicating an adequate trough of the ventricular septum. C, Post-operative epicardial echocardiographic 4-chamber view demonstrating patch of anterior mitral valve leaflet. D, Six-month postoperative M-mode echocardiogram of left ventricular outflow tract indicating neither systolic anterior motion nor left ventricular outflow tract obstruction.

Septal myectomy is regarded as the standard invasive therapy to reduce septal thickness and left ventricular outflow tract gradient.¹ Percutaneous transluminal septal myocardial ablation (PTSMA) is a nonsurgical technique that reduces septal thickness by injecting ethanol into 1 or more septal branches of the left anterior descending coronary artery.³ This results in local myocardial infarction, followed by septal thinning, left ventricular outflow tract widening, and left ventricular outflow tract gradient reduction. Treatment of the septal hypertrophy alone does not change the mitral valve apparatus, however, and may lead to residual SAM. As such, mitral valve leaflet extension has been performed to address the abnormal motion of the mitral valve in systole and contributes to the reduction of LVOTO.⁴

The aim of this report is to stress the importance of surgical extension of the anterior mitral valve leaflet in addition to myectomy as a treatment of LVOTO in patients with HOCM. This report further illustrates that residual LVOTO after PTSMA can be treated with an isolated mitral valve leaflet extension.

CLINICAL SUMMARY

A 44-year-old man with HOCM was admitted to our hospital with persistent LVOTO caused by residual SAM (Figure 1, A) after treatment with a myectomy by means of PTSMA in 2005. Symptoms of persisting fatigue presented in 2007, and an exercise echocardiogram demonstrated SAM. In 2010, the patient was referred to our clinic for surgical treatment. Informed consent was obtained from the patient. The septal trough caused by PTSMA could not be improved without compromising conduction and septal integrity (Figure 1, B). We performed an extension of the anterior mitral valve leaflet with an autologous glutaraldehyde-treated pericardial patch.⁴ The patch was placed across the bending point of the mitral valve where SAM was maximal to stiffen the buckling anterior mitral valve leaflet. The patch extended the width but not the length of the anterior mitral valve leaflet, which shifted the centrally attached secondary chordae laterally. Finally, because force produced by blood flow against the leaflet is proportional to its area, the increased leaflet was pressed posterior, with a decrease in SAM and mitral regurgitation (Figure 2). Hemodynamically, the patch worked as a spinnaker sail. Figure 2 depicts the surgeon's view. Intraoperative transesophageal echocardiography demonstrated neither SAM nor LVOTO (Figure 1, C). After 13 days, the patient was discharged in sinus rhythm with a right bundle branch block. The 6-month postoperative transthoracic echocardiogram also revealed neither SAM nor LVOTO (Figure 1, D).

DISCUSSION

Left ventricular septal myectomy has been the gold standard for the surgical treatment of LVOTO in patients with

FIGURE 2. Artist's impression of surgeon's view of mitral valve leaflet extension (A). Surgeon's view through oblique incision of ascending aorta on the septal trough (B) and anterior mitral valve leaflet. The autologous pericardial patch was harvested before crossclamping, measured 2.5×3.0 cm, and was tanned with glutaraldehyde. The oval patch was inserted with a 5-0 Prolene (Ethicon, Inc, Somerville, NJ) after a longitudinal split in the midline of the anterior mitral leaflet between the trough rough zone and the aortic mitral continuity. (Adapted with permission from Van Herwerden LA, Ten Cate FJ. Combined anterior mitral leaflet extension and spark erosion myectomy in hypertrophic obstructive cardiomyopathy: echo-enhanced surgery. *Oper Tech Thorac Cardiovasc Surg Comp Atlas*. 2004;9:310-8.)

HOCM. LVOTO and mitral regurgitation may persist after successful surgical myectomy. However, if the mitral valve apparatus abnormalities are left untreated may cause residual SAM. Mitral valve replacement has been performed to abolish any risk of residual SAM; however, this is associated with thromboembolic complications or bleeding events as a result of anticoagulation therapy.⁵ As such, an alternative surgical procedure seems warranted to address the mitral valve apparatus abnormalities present in patients with HOCM, with the aim of reducing the risk of residual LVOTO caused by SAM after a successful septal myectomy. Moreover, LVOTO gradient is an independent predictor of mortality after myectomy.⁶

This case demonstrates the importance of performing a mitral valve leaflet extension in addition to septal myectomy in patients with HOCM and LVOTO. To our knowledge, this case is unique because the patient had undergone a successful myectomy by PTSMA but still had residual LVOTO caused by SAM. This finding supports the notion that an uncorrected enlarged anterior mitral valve leaflet may predispose toward residual SAM after a successful standard myectomy or PTSMA. Moreover, at 1-year follow-up after mitral valve leaflet extension in addition

to septal myectomy, significant decreases in residual SAM and superior hemodynamic results have been observed.⁴

In summary, we report the case of a patient with HOCM previously treated with PTSMA but with residual LVOTO caused by SAM. We successfully performed an isolated mitral valve leaflet extension to address the mitral valve apparatus abnormalities. This case report illustrates the importance of surgically treating the mitral valve apparatus in addition to septal myectomy when treating patients with HOCM for LVOTO caused by SAM.

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Transapical double valve implantation plus percutaneous revascularization as a bailout for a high-risk patient

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Transcatheter aortic valve implantation as a treatment option for severe aortic valve stenosis has become a routine procedure, with encouraging results in a high-risk population.^{1,2} Concomitant treatment of coronary artery disease by percutaneous intervention has been described,³ and single cases and small series of transcatheter mitral valve-in-valve procedures (and even 1 double valve procedure) have been reported.^{4,5} This represents the first description of successful combination of all these procedures.

CLINICAL SUMMARY

A 73-year-old man who had undergone mitral valve reconstruction and bypass surgery 12 years previously was referred to our clinic. He was in New York Heart Association functional class IV.

Echocardiography revealed structural degeneration of the repaired mitral valve with moderate to severe mitral stenosis (pressure gradient maximum/mean ratio, 21/8; effective orifice area, 1.3 cm²) and grade II insufficiency. Additionally, the aortic valve was severely stenosed, with

a gradient of 56/30 mm Hg despite his poor left ventricular function of 18%. There was moderate tricuspid insufficiency, and pulmonary arterial pressure was 66 mm Hg greater than central venous pressure. Coronary angiography showed patent bypass grafts; however, 2 de novo lesions of the proximal right coronary artery needed intervention.

The EuroSCORE was 17 points, with a logistic EuroSCORE of 69.4% (Society of Thoracic Surgeons risk model not available). The heart team chose and the patient agreed to a hybrid approach with percutaneous coronary intervention and transapical aortic and mitral valve implantation.

The aortic annulus was measured at 27 mm with transesophageal echocardiography and computed tomography. Selection of the mitral valve prosthesis was done by precise computed tomographic reconstruction of the I ring, which revealed an inner circumference of 79.5 mm, equaling an inner diameter of 25.3 mm if pressed into a perfectly round shape. Thus 29-mm Edwards Sapien XT valves (Edwards Lifesciences LLC, Irvine, Calif) were selected for both the aortic and mitral positions.

Procedures

Percutaneous coronary intervention with placement of 2 drug-eluting stents in the proximal right coronary artery, was successfully performed 4 days before the transapical procedure (Figure 1).

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