



Modified mitral valve replacement technique using transcatheter aortic valve for severe mitral annular calcification

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Clinical vignette

An 82-year-old male presented with severe mitral valve stenosis and New York Heart Association class III symptoms. He had a body mass index (BMI) of 23 kg/m² and had a transcatheter aortic valve replacement (TAVR) three years prior to presentation. His history was notable for chronic obstructive pulmonary disease, hypertension, and lung cancer. Echocardiogram showed a left ventricular ejection fraction of 60%, severe calcific mitral stenosis with severe mitral annular calcification (MAC) and a mean gradient of 17 mmHg. His aortic valve bioprosthesis had normal function with a mild paravalvular leak. Cardiac catheterization showed non-obstructive coronary artery disease. Computed tomography (CT) imaging demonstrated severe near-circumferential MAC and an annulus size of 30 mm. He was not considered for a transseptal valve in MAC due to risk of left ventricular outflow tract (LVOT) obstruction. His calculated Society of Thoracic Surgeons (STS) predicted risk of mortality was 8%. He lived independently and desired to proceed. The patient was recommended to undergo transatrial mitral valve replacement with SAPIEN 3 Ultra valve (Edwards Lifesciences, Irvine, CA, USA) via sternotomy approach. Thoracotomy was not utilized, given his chronic obstructive pulmonary disease (COPD).

Surgical technique

Preparation

Preoperative cardiac gated CT imaging was analyzed to

determine risk of LVOT. Intraoperative transesophageal echocardiography (TEE) demonstrated a calcified mitral valve annulus and leaflets with severe mitral valve stenosis. There was mild aortic regurgitation from the previous transcatheter aortic valve.

Exposition

A full median sternotomy was performed. The distal ascending aorta was cannulated. The superior and inferior vena cava were cannulated for venous drainage. The ascending aorta was cross-clamped, and antegrade and retrograde cardioplegia were administered with prompt diastolic arrest.

Operation

Sondergaard's groove was dissected, and an incision was made in the left atrium to visualize the mitral valve. The anterior leaflet was resected to limit the risk of LVOT obstruction, and a limited debridement of the calcified annulus was performed. 2-0 ETHIBOND (J&J MedTech, Ethicon, New Brunswick, New Jersey, USA) sutures were placed around the annulus in a non-everting fashion.

Separately, the SAPIEN 3 Ultra valve was prepared on a back table. The valve size was determined from preoperative cardiac gated CT imaging. A bovine pericardial skirt was sewn with 4-0 PROLENE (J&J MedTech, Ethicon, New Brunswick, New Jersey, USA) to the textured polyethylene terephthalate (PET) skirt of the valve to limit paravalvular leak after implantation. The bovine patch is shaped as a

donut with the inner circle of the patch measured to the outer diameter of the SAPIEN valve and a 2-cm cuff of pericardium. The valve was then crimped over the SAPIEN 3 Ultra delivery device with the skirt towards the handle, opposite to an aortic implant, and brought to the operative field.

A J-wire was placed through the atriotomy into the ventricle and the valve was advanced over the wire into the mitral annulus. The SAPIEN valve is oriented with one of the commissures to P2 and then deployed at the annulus using the balloon provided with the delivery device under direct visualization to 6 mmHg. The previously placed ETHIBOND annular sutures were brought through both the bovine pericardial skirt as well as the PET skirt of the SAPIEN 3 Ultra valve and are subsequently secured with the Cor-Knot device (LSI Solutions, Inc., Victor, NY, USA). The bovine pericardial skirt was then trimmed of excess material and sutured to the atrium using 4-0 PROLENE suture (video). The valve was interrogated in the usual fashion to rule out paravalvular leak.

Completion

The left atriotomy was closed, hemostasis was achieved, and the patient was weaned from cardiopulmonary bypass. Intraoperative TEE demonstrated a well-seated valve with a mean gradient of 3 mmHg and trace paravalvular leak. The patient's postoperative course was uncomplicated, and he was able to resume normal activities upon discharge.

Comments

Clinical results

Patients with severe MAC generally have multiple comorbidities associated with higher all-cause mortality, along with increased operative risk (1). These patients previously only were able to undergo a traditional surgical mitral valve replacement, which is associated with significant risk and high rates of complications (2). Transatrial transcatheter mitral valve replacement provides an opportunity to decrease the operative risk and provide a durable treatment pathway for these patients. The modification of the transcatheter valve to include a larger bovine pericardial skirt allows for implantation at the annulus with a barrier to limit paravalvular leak. We believe this technique provides better sealing and prevents one of the major issues of this procedure.

Advantages

A major advantage of the transatrial transcatheter mitral valve replacement is a limited debridement of the annulus. We generally utilize this approach in patients who are otherwise operative candidates with over 180 degrees of MAC. If the MAC is less than 180 degrees and the thickness is less than a centimeter, we consider the patient for a conventional mitral valve replacement with limited debridement as required. Patients are otherwise considered for transcatheter mitral valve replacement (MVR) trials if they are not suitable operative candidates. The anterior leaflet is resected to limit the development of systolic anterior motion and subsequent LVOT obstruction. Modification of the transcatheter valve with the addition of a more substantial bovine pericardial skirt limits the development of paravalvular leak and permits a more limited debridement of the mitral annulus. Direct visualization of the mitral annulus when implanting the transcatheter valve additionally helps to prevent LVOT obstruction. Early results have demonstrated acceptable short and long-term mortality and morbidity with the use of this technique (3,4).

Caveats

When attaching the bovine pericardial skirt to the SAPIEN valve, care is taken to avoid damaging the valve leaflets. During deployment, the valve is oriented with one of the commissures to P2 to align the leaflet of the valve to the LVOT, thereby allowing future transcatheter mitral valve interventions and leaflet modifications, as well as limiting obstruction risk. Depending on the position of the annulus, the bovine skirt may need to be secured to the orifice of the left atrial appendage if there is extension of calcification into the atrium. If a paravalvular leak is detected on post-implantation valve testing, additional annular sutures are placed.

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Footnote

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Conflicts of Interest: T.K. has been a consultant for Medtronic, Edwards Lifesciences, Abbott Vascular, 4C

Medical, Anteris, and Johnson & Johnson. The other author has no conflicts of interest to declare.

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