Transseptal Implantation of a Transcatheter Heart Valve in a Mitral Annuloplasty Ring to Treat Mitral Repair Failure

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A 56-year-old woman was admitted for recurrent, refractory congestive heart failure. When she was aged 17 years, she had a Hodgkin lymphoma treated by chest radiation. She then developed postradiation heart disease, which required surgery in 2004, combining mitral valve repair using a Physio semirigid ring sized 28 mm (Edwards Lifesciences Inc; Irvine, CA) and tricuspid annuloplasty. In March 2009, the patient experienced recurrent congestive heart failure due to mitral valve stenosis. Percutaneous mitral commissurotomy achieved transient symptom relief, but her clinical status severely worsened in the past year.

On admission, the patient was in New York Heart Association class IV heart failure. Physical examination showed worrying skin sequelae of chest radiation and severe congestive heart failure. Echocardiography demonstrated severe mitral valve stenosis (mean gradient, 11 mm Hg), regurgitation (grade 3+), dilatation of the right atrium and ventricle, moderate tricuspid regurgitation, and estimated systolic pulmonary artery pressure >60 mm Hg (Movie 1). On multislice CT, the anteroposterior diameter of the mitral ring was calculated at 16 mm and the intercommissural diameter at 27 mm.

Because repeated surgery carried a prohibitive risk, a transcatheter option was considered. Because of the cutaneous lesions and postradiation cardiomyopathy, the transapical approach was deemed inadequate; thus, it was decided to intervene through the right femoral vein and a transseptal route. After transseptal catheterization and septal dilation with a 10-mm balloon, crossing the mitral valve with a balloon wedge pressure catheter, a J preshaped 0.035 ExtraStiff wire was placed at the apex of the left ventricle. A 26-mm Edwards Sapien XT transcatheter heart valve was mounted on a NovaFlex catheter (Edwards Lifesciences) and advanced to the mitral ring. The prosthesis was then deployed under rapid pacing (Figure 1, Video 2). Postoperatively, the patient’s functional condition rapidly improved. Echocardiographic examination showed a trivial periprosthetic leak and a mean transmitral gradient of 8 mm Hg, a 13-mm Hg gradient was observed in the left ventricular outflow tract, and systolic pulmonary artery pressure dropped to 45 mm Hg.

Figure 1. A, Positioning of the Edwards Sapien XT transcatheter heart valve within the mitral ring through the transseptal route. B, Transesophageal echocardiographic imaging of the deployment of the prosthesis by balloon inflation within the ring. Arrows indicate the balloon. C, After implantation. The prosthesis is implanted with the skirt covering the surface of the ring to reduce the risk of periprosthetic leak. Arrows indicate the limit between the skirt and the noncovered part of the prosthesis. LA indicates left atrium; LV, left ventricle.
Fluoroscopy, 3D echocardiography, and multislice CT demonstrated deformation of the ring, which tended to become more circular and allowed a good application of the prosthesis except for 1 segment where a gap remained between the ring and the prosthesis (Figure 3). The patient was discharged on day 14. At 30-day follow-up, she reported a stable functional status compatible with maintaining an independent lifestyle and no recurrent acute cardiac failure.

**Discussion**

Mitral valve repair is the treatment of choice for mitral regurgitation, but failure may occur. Repeated mitral surgery may carry prohibitive risks in patients with comorbidities. To date, several cases of transcatheter mitral valve-in-valve implantations have been reported, but only 1 case of transapical valve-in-ring implantation has been reported.1–4

The present report confirms the feasibility and effectiveness of such transcatheter mitral interventions and the ability of the Sapien valve to be sewed in an asymmetrical annuloplasty ring as previously observed1 and demonstrated here. Questions about valve-in-ring implantation concern the size, the deformability, and the asymmetrical geometry of the ring. Although the ring becomes more circular after prosthesis implantation, its application is not circumferential. The presence of mitral tissue filling the gap between the ring and the valve may explain the absence of regurgitation. Two hemodynamic parameters also must be taken into account: (1) the residual 8-mm Hg mean transprosthetic gradient and (2) the 13-mm Hg intraventricular gradient due to the displacement of the subvalvular mitral apparatus and the orientation of the prosthesis toward the outflow tract. In the present case, hemodynamics were sufficient to allow a good clinical outcome.

To our knowledge, the present report is the first to demonstrate the successful use of transseptal access in this setting. Only 1 previous unsuccessful attempt of valve-in-valve implantation through the transseptal route has been reported, complicated by migration of the prosthesis into the left ventricle. Another unsuccessful attempt through a transatrial route was performed, and all other cases were achieved through the transapical route.2,3 The transseptal route has several advantages, including being less invasive, carrying minimal risk of vascular complications, and being compatible with local anesthesia. However, several precautions should be considered: (1) Expertise in transseptal catheterization is required, (2) the distance between the septal puncture site and the mitral valve must be sufficient to allow complete deployment of the balloon in the left atrium (a high and posterior transseptal puncture site may be considered in this particular context), and (3) the positioning may be easier and more stable with the transapical route. In the present case, we optimized positioning of the prosthesis by using a progressive balloon deployment and rapid ventricular pacing. The positioning should aim at placing the prosthesis one third in the left atrium and two thirds in the left ventricle to cover the annuloplasty ring with the basal skirt of the Sapien valve and avoid periprosthetic regurgitation. Finally, the choice between the apical and the transseptal routes should be made according to patient’s clinical and anatomic characteristics and local experience of each approach.

![Figure 2. Echocardiographic examination at baseline and after valve-in-ring implantation. A, Baseline grade 3+ mitral regurgitation. B, Baseline transmitral gradient. C, Trivial periprosthetic regurgitation after implantation. D, Transprosthetic gradient after implantation.](image)

![Figure 3. Postimplantation multimodality imaging. A, Fluoroscopic image showing that the prosthesis is applied onto the ring, except for the segment indicated by the arrow; however, no regurgitation is noted. B, Transesophageal 3D echocardiographic image showing the application of the prosthesis (white arrow) against the ring (black arrow), with circular geometry. C, Multislice CT shows the same findings as in 3A.](image)
The present case shows for the first time that the transseptal approach is feasible and safe to treat failed mitral valve repair with ring annuloplasty. It may represent an attractive option in patients who are not deemed adequate candidates for repeated surgery and warrants further evaluation.

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Disclosures
Dr Himbert is a proctor for Edwards Lifesciences Inc and Medtronic Inc. Dr Lung received speaker’s fees from Edwards Lifesciences and Medtronic. Dr Nataf is a consultant for St Jude and Medtronic and a proctor for Edwards Lifesciences. Dr Vahanian received speaker’s fees from Edwards Lifesciences and Medtronic. Drs Brochet, Radu, Messika-Zeitoun, Enguerrand, and Bougoin have no conflicts to disclose.

References

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SUPPLEMENTAL MATERIAL

Movie Legends

Movie 1. Biplane TEE before implantation. Note the mitral regurgitation.
Movie 2. TEE imaging of prosthesis deployment. Note the intense spontaneous contrast in the left atrium.
Movie 3. Biplane TEE after implantation. Note the correct leaflet motion and the absence of significant regurgitation.
Movie 4. Three-dimensional TEE after implantation. The ring and the prosthesis are visualized, apposition seems correct, leaflet function is normal.