

Transcatheter aortic valve-in-ring implantation after aortic valve repair and annuloplasty



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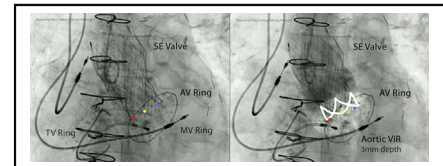
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Deployment of a self-expandable transcatheter valve within an aortic annuloplasty ring.

CENTRAL MESSAGE

Valve-in-ring implantation may be a safe, feasible option to consider for recurrent aortic insufficiency following previous internal annuloplasty ring placement.

▶ Video clip is available online.

Aortic annuloplasty to stabilize the annulus from late failure is an integral part of aortic valve repair. Although conventional annuloplasty methods demonstrate suboptimal leaflet coaptation with subsequent aortic regurgitation (AR) recurrence, the use of an internal geometric annuloplasty ring placed a few millimeters below the aortic annulus may preserve the natural elliptical shape of the annulus and stabilize the ventricular–aortic junction.^{1,2} Late failure of repair with annuloplasty rings may be attributed to residual cusp prolapse, leaflet retraction, or poor commissural orientation. We report a case of late failure of aortic valve repair with an annuloplasty ring and successful use of transcatheter valve-in-ring implantation for recurrent AR. The Northwestern University Institutional Review Board has determined that case reports are not research. Institutional patient consent for use of deidentified information was obtained.

CLINICAL SUMMARY

A 75-year-old woman with history of coronary artery bypass grafting, mitral valve repair with placement of a 32-mm flexible annuloplasty ring (Genesee Biomedical), tricuspid repair with a 28-mm rigid annuloplasty ring (Medtronic Contour 3D), aortic valve repair with a 19-mm internal annuloplasty ring (Corcym [previously BioStable] HAART 300), and Cox-maze III procedure was referred to our clinic. The patient returned 4 and a half years after

her initial procedure with 1 year of progressive dyspnea and exercise intolerance attributed to recurrent AR. Transthoracic echocardiography findings demonstrated decreased left ventricular systolic function with ejection fraction of 38% and moderate-to-severe AR. Aortic valve peak/mean gradients were 18/7 mm Hg, peak velocity of 2.1 m/s, and AR effective regurgitant orifice area of 35 mm². A valve-in-ring transcatheter approach was favored due to the patient's age, comorbidities, and risk of redo sternotomy.

Valve size was determined based on aortic annulus measurements from preoperative computed tomographic angiography (Figure 1). A 23-mm self-expanding valve (Medtronic Evolut FX) was delivered via a transfemoral approach, under monitored anesthesia care. Correct positioning, 3 mm below the ring, was confirmed in the right and left cusp overlap view and coplanar view (Figure 2). Final aortogram confirmed proper position (Video 1). On-table transthoracic echocardiography depicted a peak gradient of 24 mm Hg and a mean gradient of 9 mm Hg with no valvular regurgitation and trivial paravalvular leak.

Dismissal transthoracic echocardiography delineated improved left ventricular ejection fraction from 38% pre-transcatheter aortic valve implantation to 57% post-transcatheter aortic valve implantation and trivial AR. The estimated right ventricular systolic pressure was 26 mm

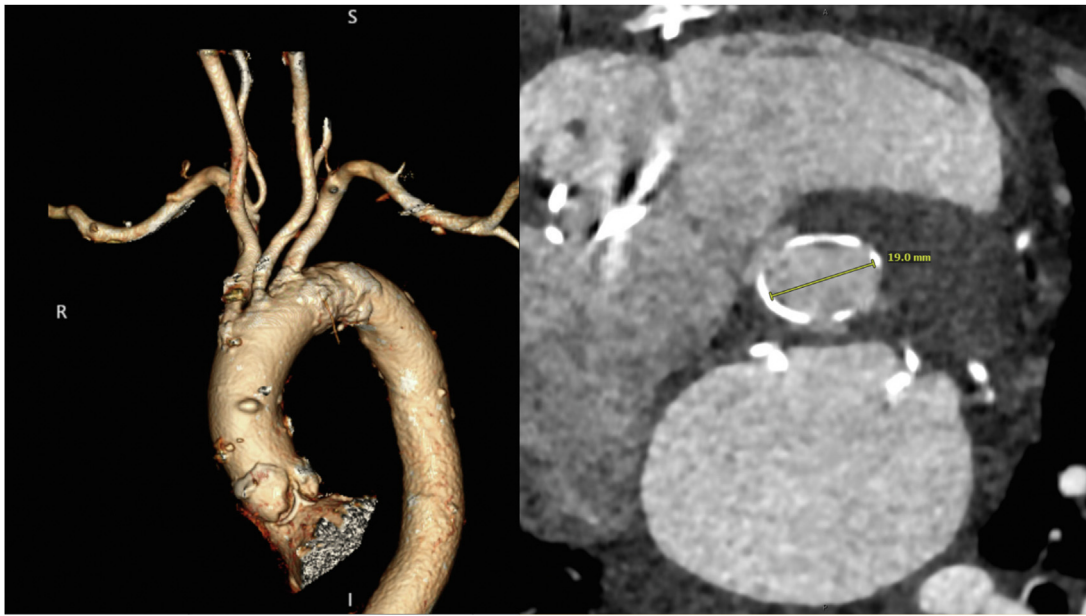


FIGURE 1. Preoperative CT angiography images. The preoperative CT images show the HAART 19-mm internal aortic annuloplasty sitting in a subannular plane, below where annulus/sinus measurements would be taken for transcatheter valve sizing. *CT*, Computed tomography.

Hg, and the right atrial pressure was 3 mm Hg. The aortic valve peak/mean gradients were 25/12 mm Hg, and the peak velocity was 2.4 m/s. Electrocardiogram demonstrated sinus rhythm with no new conduction disturbance or heart block.

The patient was discharged the following day with no complications. The patient was seen in the clinic 1 month after the procedure and is doing well with no symptoms and no limitations in ordinary physical activity. Thirty-day echo results demonstrated continued favorable outcomes with aortic valve peak/mean gradients of 29/13 mm Hg with trivial AR.

DISCUSSION

Experience with transcatheter aortic valve-in-ring implantation following aortic valve repair with annuloplasty ring for AR is limited but may be a reasonable option for patients who are high risk for reoperative AVR. To date, 2 groups—at Duke University and Sana-Herzzentrum in Cottbus, Germany—have successfully performed valve-in-ring placement of a self-expanding 26-mm Medtronic Evolut R valve into a 21-mm HAART ring with acceptable postprocedure gradients.^{3,4} Only one group has reported successful implant of a balloon-expandable Edwards Lifesciences SAPIEN 3 valve within a 21-mm ring.⁵ We report the successful valve-in-ring

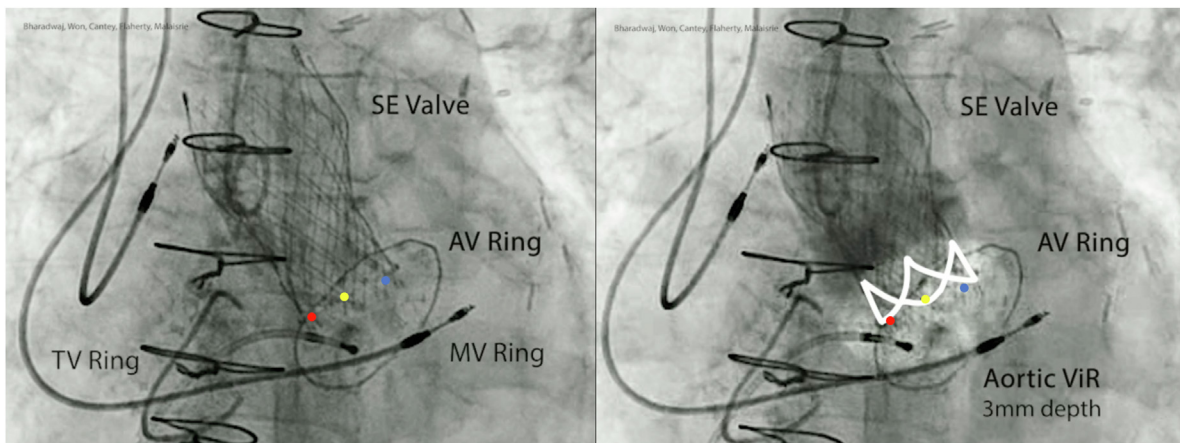
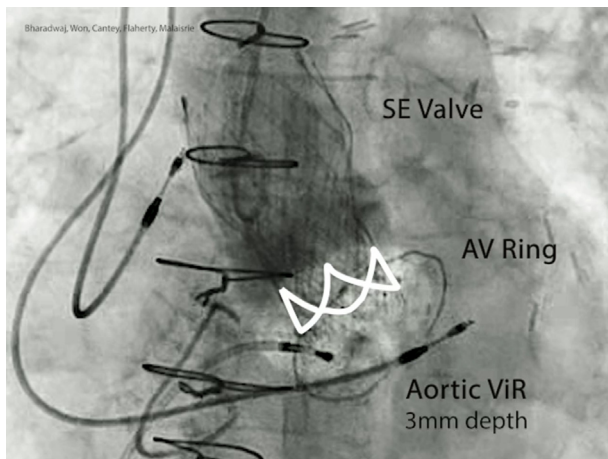


FIGURE 2. Self-expanding valve seated within the aortic annuloplasty ring. In coplanar view, the self-expanding valve commissural markers are placed just below the annular plane to ensure an implantation depth of approximately 3 mm. The *red dot* represents the noncoronary cusp commissural marker, the *yellow dot* represents the right coronary cusp commissural marker, the *blue dot* represents the left coronary cusp commissural marker, and the *white line* in right image represents the enhanced aortic annuloplasty ring. *SE*, Self-expanding; *AV*, aortic valve; *TV*, tricuspid valve; *MV*, mitral valve; *ViR*, valve-in-ring.



VIDEO 1. Aortogram of deployed self-expanding valve within a 19-mm annuloplasty ring. In this coplanar view, the deployed self-expanding valve is well seated and positioned approximately 5 mm below the aortic annuloplasty ring. Video available at: [https://www.jtcvs.org/article/S2666-2507\(24\)00002-6/fulltext](https://www.jtcvs.org/article/S2666-2507(24)00002-6/fulltext).

implantation of the newer Medtronic Evolut FX valve and uniquely demonstrate the feasibility of valve-in-ring procedures several years following index aortic valve repair, at which point one may expect the annuloplasty ring to be endothelialized and fibrosed into the surrounding tissue. We also highlight safe placement of valve sizes larger than the annuloplasty ring; we posit that avoidance of coronary artery obstruction by the larger transcatheter valve is facilitated by the subannular location of annuloplasty ring combined with the use of a self-expanding valve. These early outcomes depict promising results for transcatheter valve-in-ring implantation following internal annuloplasty ring implantation as a feasible approach.

Our group has previously investigated the possibility of ring fracture during valve-in-ring procedures to avoid patient–prosthesis mismatch. In vitro experiments demonstrate internal annuloplasty ring fracture using valvuloplasty balloons 4- to 5-mm larger than the ring size is possible but uncontrollable.^{E1} However, this report demonstrates the need for ring fracture may not be required for even the smallest internal annuloplasty ring when self-expanding valves are used. A larger sample size and further experiments are needed to understand the overall benefits, risks, limitations, and prognosis of aortic valve-in-ring procedures.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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