Masters of Cardiothoracic Surgery

Open transcatheter valve replacement for prosthesis-patient mismatch at redo surgical aortic valve replacement

Davut Cekmecelioglu[1,2], Subhasis Chatterjee[1,2,3], Joseph S. Coselli[1,2], Ourania Preventza[1,2]

[1]Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College Medicine, Houston, TX, USA; [2]Department of Cardiovascular Surgery, Texas Heart Institute and CHI St Luke's Health—Baylor St Luke's Medical Center, Houston, TX, USA; [3]Department of Surgery, Division of General Surgery, Baylor College Medicine, Houston, TX, USA

Correspondence to: Ourania Preventza, MD. Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, One Baylor Plaza, BCM 390, Houston, TX 77030, USA. Email: preventz@bcm.edu.

Submitted Apr 08, 2021. Accepted for publication Jul 14, 2021.
doi: 10.21037/acs-2021-tviv-58
View this article at: https://dx.doi.org/10.21037/acs-2021-tviv-58

Clinical vignette

A sixty-four-year-old woman (body mass index, 20.34 kg/m^2) underwent aortic root enlargement and placement of a 21-mm Regent mechanical aortic valve (St. Jude Medical, Saint Paul, MN) twelve years ago in an outside institution. She presented to our center with lightheadedness and fatigue after minimal exertion. A transesophageal echocardiogram (TEE) showed severe aortic stenosis with mean 43 mmHg and peak 79 mmHg transvalvular gradients. Peak aortic valve jet velocity measured 5 m/s. The mechanical valve's posterior disc appeared immobile. Left ventricular ejection fraction was 55%, with no other valvular lesions. Preoperative heart catheterization showed normal coronary arteries. Her Society of Thoracic Surgeons Predicted Risk of Operative Mortality score was 4.7% for a planned redo aortic valve replacement. The patient opted for a bioprosthetic aortic valve. The patient also had a moderately enlarged mid-ascending aorta (~4.0–4.3 cm) and elected to have it replaced concurrently, rather than face the prospect of a potential third open-heart operation.

Surgical techniques

Preparation and exposition

The patient underwent full resternotomy and cardiopulmonary bypass with axillary artery cannulation (*Video 1*). During her previous surgery, her aortic annulus had been too small to accommodate the 21-mm mechanical aortic valve; thus, the neo-noncoronary sinus had been reconstructed with a Dacron patch down to the anterior leaflet of the mitral valve, as part of a Nicks technique for aortic root enlargement. The existing mechanical prosthesis was excised after extensive pannus removal, and 4-0 polypropylene pledgetted sutures were placed to approximate tissue planes adjacent to the annulus.

Operation

The annulus was unable to accommodate the sizers for several commercially available 21-mm bioprosthetic valves, yet a 19-mm valve would create a patient-prosthesis mismatch. We therefore elected to place a balloon-expandable transcatheter aortic replacement (TAVR) valve as a bailout option. A 23-mm Sapien 3 valve (Edwards Lifesciences, Irvine, CA, USA) was deployed under direct vision with careful balloon inflation and was determined to be positioned satisfactorily (*Video 1*).

The ascending aorta and the proximal transverse arch were replaced with a 26-mm Dacron graft during a short period of moderate hypothermic (25 ℃) circulatory arrest. The proximal anastomosis was performed by using a running 4-0 polypropylene suture between the Dacron graft and the aorta distal to the new TAVR valve.

Completion and clinical course

The immediate postoperative TEE revealed a well-positioned aortic valve, no paravalvular leak, and a mean transvalvular gradient of 4 mmHg. The postoperative

course was notable for complete atrioventricular block—unsurprising, given the extensive-but-necessary debridement of the aortic annulus—that necessitated dual-chamber permanent pacemaker implantation (PPI). The patient was discharged on postoperative day twelve.

The patient was symptom free at the three-month postoperative follow up. Her echocardiogram showed a dimensionless valve index of 0.5, consistent with normal prosthetic aortic valve function without stenosis.

Comments

We present a bailout direct-vision, open transcatheter valve replacement for patient-prosthesis mismatch in a woman with a previous mechanical aortic valve replacement and aortic root enlargement. When we encountered a small aortic annulus during surgery, we used a hybrid approach in which we surgically deployed a TAVR valve under direct vision.

Although conventional aortic valve replacement is standard treatment for patients with prosthetic aortic valve stenosis (1,2), reoperation for failure of the prosthetic valve with previous aortic root enlargement remains challenging (3). Increasingly, valve-in-valve TAVR is an option for patients needing bioprosthetic valve replacement (4). Both TAVR valve insertion under direct vision during open-heart surgery when a hostile aortic root is present (5) and transcatheter mitral valve replacement for extensive mitral annular calcification (6) have been documented, but not for prosthetic mechanical aortic valve replacement in the presence of previous aortic root enlargement.

In this case, the stiffness and small caliber of the sinotubular junction precluded the placement of appropriate bioprosthetic or mechanical aortic replacement valves, given the risk for prosthesis-patient mismatch. We considered aortic root replacement; however, potential distortion of the patch extension into the mitral valve, which could damage its competency, and the desire to limit myocardial ischemia time and avoid coronary artery dissection obliged us to find an alternative approach (7). We also thought that direct insertion of a TAVR valve would reduce the risk for annular disruption and allow slight oversizing of the prosthesis (in this case, a 23-mm Sapien 3). Furthermore, insights from the Placement of Aortic Transcatheter Valve (PARTNER, Edward LifeSciences. Irvine, CA) trial (8) indicate that TAVR procedures have lower mean gradients compared with bioprosthetic surgical aortic valve replacement (SAVR) in women, which made the direct implantation of a TAVR valve an attractive option for this patient. A rapid-deployment, sutureless aortic valve bioprosthesis might also have been considered as an alternative; however, we believed that even the three guiding sutures would be problematic in this case, because of the frail aortic tissue alongside the left ventricle.

Other investigators (9) have shown that adding concomitant aortic replacement to an elective cardiac procedure does not significantly increase the risk for in-hospital mortality or stroke.

Although PPI was almost unavoidable in this case, placing the TAVR valve under direct vision during open surgery may have conferred unique benefits. The membranous septum length anatomically represents the distance between the aortic annulus and the bundle of His and is inversely correlated with the risk for conduction system abnormalities after TAVR (10). Deploying the device with direct visualization of the annulus and membranous septum transition could reduce the risk for needing a pacemaker. Nonetheless, the separation along the tissue planes adjacent to the annulus made our case challenging, and it is likely that any aortic valve replacement in this patient would have necessitated PPI.

In complex aortic valve surgical reoperation, direct insertion of a TAVR valve may be feasible option for avoiding the risks of prosthesis-patient mismatch or complete root replacement by combining the effectiveness of both TAVR and SAVR as a bailout strategy. As surgeons continue to become facile with TAVR and patients with previous TAVR increasingly require surgery, creative hybrid applications of both SAVR and TAVR for complex scenarios will be increasingly necessary in the future.

Acknowledgments

Jeanie F. Woodruff, BS, ELS, contributed to the editing of the manuscript.
Funding: None.

Footnote

Conflicts of Interest: JSC participates in clinical studies with and/or consults for Terumo Aortic, Medtronic, W.L. Gore & Associates, CytoSorbents, and Abbott Laboratories and receives royalties and grant support from Terumo. OP participates in clinical trials with and/or consults for Terumo Aortic and W.L. Gore & Associates None of the other authors has any potential conflict of interest with regard to the work described in this manuscript.

References

1. Davierwala PM, Borger MA, David TE, et al. Reoperation is not an independent predictor of mortality during aortic valve surgery. J Thorac Cardiovasc Surg 2006;131:329-35.
2. Greco R, Muretti M, Djordjevic J, et al. Surgical Complexity and Outcome of Patients Undergoing Re-do Aortic Valve Surgery. Open Heart 2020;7:e001209.
3. Joshi Y, Achouh P, Menasché P, et al. Multiple reoperations on the aortic valve: outcomes and implications for future potential valve-in-valve strategy. Eur J Cardiothorac Surg 2018;53:1251-7.
4. Webb JG, Murdoch DJ, Alu MC, et al. 3-Year Outcomes After Valve-in-Valve Transcatheter Aortic Valve Replacement for Degenerated Bioprostheses: The PARTNER 2 Registry. J Am Coll Cardiol 2019;73:2647-55.
5. Tessari C, D'Onofrio A, Guglielmi C, et al. Sapien XT implantation under direct vision as a bail-out procedure in case of hostile aortic root: a reasonable alternative for stentless bioprosthesis reoperation. J Thorac Cardiovasc Surg 2013;145:e36-8.
6. Lamelas J, Silva GV, Chatterjee S. Minimally Invasive Direct Access Balloon-Expandable Transcatheter Mitral Valve Replacement for Extensive Mitral Annular Calcification after Transcatheter Aortic Valve Replacement. Innovations (Phila) 2018;13:222-5.
7. Iino K, Miyata H, Motomura N, et al. Prolonged Cross-Clamping During Aortic Valve Replacement Is an Independent Predictor of Postoperative Morbidity and Mortality: Analysis of the Japan Cardiovascular Surgery Database. Ann Thorac Surg 2017;103:602-9.
8. Williams M, Kodali SK, Hahn RT, et al. Sex-related differences in outcomes after transcatheter or surgical aortic valve replacement in patients with severe aortic stenosis: Insights from the PARTNER Trial (Placement of Aortic Transcatheter Valve). J Am Coll Cardiol 2014;63:1522-8.
9. Idrees JJ, Roselli EE, Blackstone EH, et al. Risk of adding prophylactic aorta replacement to a cardiac operation. J Thorac Cardiovasc Surg 2020;159:1669-1678.e10.
10. Hamdan A, Guetta V, Klempfner R, et al. Inverse Relationship Between Membranous Septal Length and the Risk of Atrioventricular Block in Patients Undergoing Transcatheter Aortic Valve Implantation. JACC Cardiovasc Interv 2015;8:1218-28.

Cite this article as: Cekmecelioglu D, Chatterjee S, Coselli JS, Preventza O. Open transcatheter valve replacement for prosthesis-patient mismatch at redo surgical aortic valve replacement. Ann Cardiothorac Surg 2021;10(5):711-713. doi: 10.21037/acs-2021-tviv-58