Transcatheter aortic and mitral valve implantation in bioprosthetic valves: When one correction is not enough

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See related commentary on pages e17-8.

Aortic bioprosthesis failure in high-risk patients who are not candidates for operation has been ameliorated with transcatheter aortic valve replacement. As of last year, more than 80,000 patients had undergone TAVR since 2002. Less progress has been made, however, for high-risk patients with mitral stenosis. In patients with previous mitral repair or bioprosthetic replacement, an anchor for a transcatheter valve is already in place. To treat high-risk patients with previous mitral or aortic valvular surgery, we therefore suggest transcatheter aortic and mitral valve implantation (TAMVI).

CLINICAL SUMMARY

Our case is that of an 86-year-old woman with previous implantation of Edwards bovine 23-mm pericardial aortic valve and 27-mm mitral valve replacements (Edwards Lifesciences Corporation, Irvine, Calif) in 2004. She presented with class III congestive heart failure. Transthoracic echocardiography (Philips Healthcare North America, Andover, Mass) revealed severe aortic stenosis (mean gradient of 55 mm Hg) and mitral stenosis (mean gradient of 10 mm Hg; see Figure 1, A and B). Computed tomography revealed a porcelain aorta (Figure 1, C). The patient’s euroSCORE II was 40.11.

She was evaluated by the multidisciplinary valve team and deemed a candidate for valve-in-valve TAMVI. Valve sizing was determined by the internal diameter of the bioprosthetic valves.

In the hybrid operating room, a transvenous right ventricular pacing wire was placed. After CT and transthoracic echocardiographic evaluation for optimal point of entry, a left fourth anterolateral thoracotomy was performed. The apex was confirmed with finger probing and transesophageal echocardiographic guidance (Philips Electronics North America).

Pledgedet purse-string sutures of 2-0 Prolene (Ethicon, Inc, Somerville, NJ) were placed concentrically around the apex. The patient was heparinized. The left ventricle was accessed with a 16-gauge needle. With fluoroscopy, a 0.035 mm wire was passed through the aortic valve. The needle was exchanged for a 6F sheath (Boston Scientific

FIGURE 1. A, Preoperative bioprosthetic mitral stenosis can be seen on 3-dimensional transesophageal echocardiography. B, Preoperative bioprosthetic aortic stenosis can be seen on 2-dimensional transesophageal echocardiography. C, Computed tomographic scan shows evidence of porcelain aorta.
Corporation, Marlborough, Mass). Then a 0.035 exchange-length wire was placed once again through the aortic valve in an antegraded fashion. A 5F shuttle catheter [60 cm; (Cook Medical Inc, Bloomington, Ind)] was brought over the wire and placed in the descending aorta. The wire was then exchanged for an Amplatz (Boston Scientific) extrastiff wire. The sheath was exchanged for the Ascendra transapical introducer (Edwards Lifesciences), and the introducer was passed through the prosthesis for dilation. It was then pulled back into an appropriate position.

Through a right femoral approach, a pigtail catheter was advanced into the noncoronary cusp, and coplanar views of the aortic valve were obtained. The obturator was removed. The 23-mm Edwards Sapien valve was loaded onto the valve catheter in the proper position and advanced over the guidewire. It was deployed under rapid ventricular pacing, seating the valve in the strut of the bioprosthesis. The catheter was withdrawn. Transesophageal echocardiography confirmed normal function without paravalvular leak.

The wire was exchanged for a stiff wire. A 26-mm Sapien valve was loaded onto the valve catheter in an inverted position and advanced over the wire. It was deployed under rapid ventricular pacing, and the catheter and wire were withdrawn (Figure 2, A). Transesophageal echocardiography confirmed normal function with trace paravalvular leak. (Figure 2, B and C).

Hemodynamic stability was ensured. Under rapid pacing, the introducer sheath was withdrawn and the purse-strings were tied. The patient was transferred to the intensive care unit in stable condition. Transthoracic echocardiography at 1 month revealed well-functioning valves (aortic mean gradient of 15 mm Hg and mitral mean gradient of 4 mm Hg).

**DISCUSSION**

Seven years after the first clinical TAVR by Cribier, Cheung and colleagues performed the first human mitral valve-in-valve procedure. The evolution of transcatheter techniques has been rapid, and although there is a paucity of data on long-term outcomes, results so far have been promising. In the not-so-distant past, patients with concomitant mitral stenosis, regurgitation, or both, who might have seen benefit from TAVR, were excluded from trials. TAMVI

![FIGURE 2. A, Balloon expansion of Sapien valve in bioprosthetic mitral valve. B, Well-functioning mitral and aortic valves after valve-in-valve deployment. C, Mitral and aortic valves after deployment in systole with no residual mitral or atrial stenosis and trace paravalvular leak.](image-url)
was beneficial in this patient because her porcelain aorta made crossclamping prohibitive. It could also be less risky in conventional redo cases of patients who have had previous grafting.2

As the popularity of TAVR procedures continues to rise and the established levels of risk that warrant the procedure decrease, there will be an inherent increase in TAMVI. This is particularly fortunate for those who have failure of repairs and bioprosthetic valves. This is the first reported transapical approach for double valve-in-valve TAMVI without bypass. As the scope of transcatheter valve expands, it is without doubt that there will be extension of care to those in all risk strata.

References

EDITORIAL COMMENTARY

Double transcatheter valve-in-valve therapy: A viable alternative for high-risk patients

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See related article on pages e15-7.

Transcatheter valve therapies have revolutionized the way in which structural heart disease is treated in patient populations ineligible for operation or with high surgical risk. Beginning with the results of the Placement of Aortic Transcatheter Valve Trial (PARTNER 1), numerous studies have shown a survival benefit in inoperable and high-risk surgical candidates with aortic stenosis.1 Since those initial reports, this technology has seen tremendous progress, with improvements resulting in smaller catheters and advancements in valve design aimed at decreasing paravalvular leaks. Rapid technologic advancement, coupled with refinement in implantation procedures, has led to expanded use of transcatheter valves in the mitral valve position and for a variety of pathologies.

As a result of early success in patients at high risk, investigators began placing transcatheter valves within previously implanted but deteriorating aortic valve bioprostheses.2 Success with this technique led to the formation of an international registry investigating the outcomes of valve-in-valve implantations.3 In this large, multi-institutional registry, valve-in-valve procedures were associated with a 7.6% mortality and a 1.7% rate of stroke. Subsequent case reports have since appeared in the surgical literature detailing simultaneous valve-in-valve procedures for failing bioprostheses for both the aortic and mitral positions. Case reports have also appeared of simultaneous valve-in-valve procedures performed for failing mitral and aortic bioprostheses. All these procedures have heretofore been performed with the assistance of cardiopulmonary bypass.

Akujuo and colleagues3 have added to the surgical literature by reporting a double valve-in-valve procedure in an 86-year-old woman who was not a candidate for operation, and they are to be congratulated on their clinical decision making and the ultimate outcome. Their article in this issue of the Journal is the first report of such a procedure being done without the use of cardiopulmonary bypass. Because of the patient’s porcelain aorta, she was clearly at high risk and had few other viable options for management. In addition, the postprocedural echocardiographic follow-up demonstrated resolution of her valvular stenoses with