Redo hybrid mitral valve-in-valve for early structural valve degeneration: Pearls and pitfalls of a novel technique

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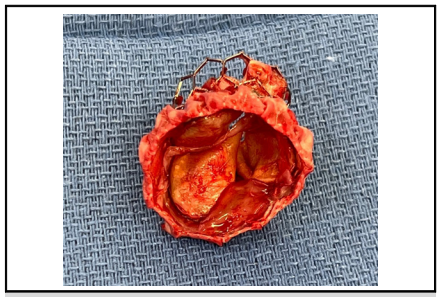

Underexpanded explanted 29-mm Sapien 3 valve with early structural valve degeneration.

CENTRAL MESSAGE

Direct access hybrid valve-in-valve is feasible in select high risk patients. Appropriate valve sizing is mandatory to prevent under-expansion and early structural valve degeneration.

Surgical valve re-replacement remains the standard of care for most patients with bioprosthetic valve degeneration, whereas transcatheter valve-in-valve procedures remain a valid alternative in anatomically feasible high-risk patients.[1]

Here we discuss a case of early failure of a direct access hybrid transcatheter mitral valve (TMV) in a surgical mitral valve (SMV) due to underexpansion of the TMV. Per institutional review board correspondence, institutional review board approval/consent was not required for this retrospective analysis of a de-identified case.

CASE REPORT

We present a 71-year-old man with a past medical history of hypertension, paroxysmal atrial fibrillation, and Streptococcus endocarditis of his native aortic and mitral valves. During January 2012, due to acute endocarditis, he underwent a double valve replacement with septal myectomy (hypertrophy likely incited turbulence for infection nidus). An inflow-outflow enlargement approach was performed to upsize his valves. The aorta was opened in an oblique fashion down to the noncoronary sinus and through the anterior mitral leaflet about an inch into the atrial roof. Both bioprostheses were secured to a folded autologous pericardial patch with continuous 4–0 Prolene to reconstruct the aorto-mitral curtain.

During February 2018, secondary to structural valve degeneration of the bioprosthetic mitral valve, he underwent a re-do sternotomy and direct implantation of a 29-mm Sapien 3 (Edwards Lifesciences) transcatheter valve in his degenerated 31-mm Hancock II (Medtronic) SMV. A 29-mm Sapien 3 was selected based on the ViV Mitral application (Dr Vinayak Bapat) and computed tomography showing an internal diameter of 27 mm. Valve oversizing was recommended to avoid device migration. A hybrid approach was selected to avoid en bloc resection and reconstruction of the inflow-outflow patch and both prosthetic valves to minimize surgical risk. It allowed us to remove the Hancock II leaflets to open the left ventricular outflow tract. This was combined with a tricuspid valve annuloplasty, left atrial appendage closure, and biatrial cryomaze procedure.

In June 2022, he developed New York Heart Association functional class III heart failure. Transesophageal echocardiography showed a degenerated TMV with severe mitral stenosis (mean gradient 19 mmHg), minimal regurgitation, and elevated pulmonary pressures. Aortic bioprosthesis hemodynamics did not warrant re-replacement. After a

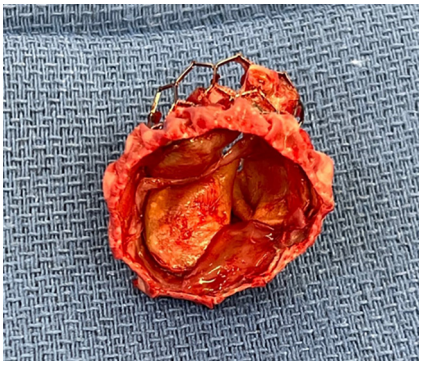

FIGURE 1. Underexpanded explanted 29-mm Sapien 3 valve (Edwards Lifesciences) with early structural valve degeneration.

multidisciplinary heart team discussion, the patient was brought to the operating room for a high-risk reoperation.

Following third-time sternotomy, he was centrally cannulated for cardiopulmonary bypass. The aorta was cross-clamped and antegrade/retrograde cold blood cardioplegia was given. Via a transseptal approach, inspection of the 29-mm Sapien 3 valve in the 31-mm Hancock II bioprosthesis showed evidence of Sapien 3 underexpansion, with leaflet thickening and restricted mobility. The existing mitral bioprosthesis was cemented into the calcified inflow-outflow patch with extensive pannus overgrowth, and there was subvalvular thrombi between the 2 valves.

We therefore elected to perform a repeat TMV-in-valve replacement with a true-sized 26-mm Edwards Sapien 3 Ultra. The original Sapien 3 valve was explanted using blunt dissection (Figure 1). Deployment of the new valve was performed with the Edwards Certitude system, with forceps guiding commissural orientation similar to the SMV, confirmed by marking the inflow cuff. The new valve was slowly inflated with 2 cc added to the nominal volume to ensure the outflow would flare slightly outward. After saline-testing the valve, atrial access was closed and the patient was successfully weaned off bypass.

The postoperative course was uneventful, and the patient was discharged on postoperative day 10 with a mean mitral gradient of 7 mmHg, minimal mitral/tricuspid regurgitation, and no left ventricular outflow tract obstruction (LVOTO). These were the same results seen on echocardiogram 6 and 8 weeks postoperatively.

DISCUSSION

Recent advances in transcatheter valve-in-valve interventions have led to an expansion in the use of bioprosthetic valves in younger patients, with subsequent increase in patients presenting with structural valve degeneration. TMV-in-valve replacement is now approved in high-risk surgical patients, but can be limited by small SMV size and LVOTO. We previously introduced the concept of hybrid direct access TMV-in-valve implantation with leaflet resection, which avoids en bloc explant and annular debridement of SMVs, while significantly reducing bypass time and LVOTO risk and allowing for concomitant procedures.[2,3]

Despite extensive preoperative measurements using computed tomography to analyze this patient's prosthetic valve dimensions and outflow tract anatomy in systolic phase, we hypothesize that the 29-mm Sapien 3 failed because it was underexpanded, leading to an elevated transvalvular gradient, and thereby early structural degeneration.[4] Although we downsized to a 26-mm Sapien 3 valve, we added 2 cc to ensure more frame expansion, flaring the outflow to avoid device migration and minimize pinwheeling.

CONCLUSIONS

Direct access TMV-in-valve replacement is a reasonable alternative to conventional reoperative SMV replacement in select high-risk patients. Valve oversizing/underexpansion, however, may be associated with early valve failure. Longer follow-up is necessary to evaluate durability of hybrid valve-in-valve prostheses.

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