Robotic mitral replacement for a degenerated valve-in-valve transcatheter mitral prosthesis

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Central Message (200 characters):
Robotic approach allowed for optimal visualization with effective manipulation, while minimizing invasiveness by avoiding 4th resternotomy for replacement of valve-in-valve TMVR prosthesis.
We have utilized a lateral endoscopic approach with robotics (LEAR) technique to perform mitral valve surgery in patients with previous sternotomy and demonstrated the safe and effective use of LEAR technique in this high-risk population. For redo patients with isolated mitral and/or tricuspid valve disease, contraindications to this LEAR approach are very few; these include dense right pleural adhesions and severe peripheral atherosclerosis which prohibits peripheral cannulation for cardiopulmonary bypass. Transcatheter mitral valve replacement (TMVR) has been primarily used for valve-in-valve implantation, with two additional uses; valve-in-ring and valve-in-mitral annular calcification. Although the number of TMVR procedures has steadily increased over the last decade, there is a paucity of reports on the explantation of TMVR prostheses. In this report, we describe our clinical experience and technical details of a fourth-time redo mitral valve replacement with LEAR technique, including the explantation of a degenerated valve-in-valve TMVR prosthesis.

CASE PRESENTATION

A 69-year-old gentleman with history of 3-time mitral valve replacement developed severe regurgitation 12 years after the third replacement with a 31mm Mosaic (Medtronic, Minneapolis, MN) valve and had transcatheter mitral valve replacement (TMVR) with a 29mm Sapien 3 (Edwards Lifesciences, Irvine, CA) valve at outside hospital 5 years ago. This time, he developed symptomatic severe prosthetic mitral
stenosis (mean pressure gradient of 16mmHg) with left ventricular outflow tract (LVOT) obstruction
(mean pressure gradient of 16mmHg and peak pressure gradient of 31mmHg) related to the projection of
the prosthetic mitral valve struts (Video) as well as pulmonary hypertension (mean pulmonary pressure
of 39mmHg and pulmonary artery wedge pressure of 33mmHg). Although there was no perivalvular
leakage detected between the two prosthetic valves, there was evidence of paravalvular leakage between
the tissue valve and the native annulus, specifically from the 3 o'clock to 7 o'clock position. The patient
had an ejection fraction of 65% and mild to moderate tricuspid regurgitation. Therefore, the patient was
referred for elective surgical mitral valve treatment. This study was approved by the Institutional
Review Board. (IRB00073906, 4/21/2014). Written informed consent for publication of study data was
obtained from the patient.

SURGICAL TECHNIQUE

We decided to employ a robotic approach (DaVinci Robot Xi, Intuitive Surgical Inc., Sunnyvale, CA).
The patient was positioned in the right hemi-decubitus position, and before obtaining vascular access,
we confirmed that there was no dense adhesion in the right chest wall. We established cardiopulmonary
bypass by cannulating the left femoral vein and anastomosing an 8mm dacron graft to the right axillary
artery. We exposed the left atrium by dissecting adhesions from previous operations with an
electrocautery spatula (Video). Under aortic occlusion using an IntraClude intra-aortic occlusion device
(Edwards Lifesciences, Irvine, CA), we opened the left atrium. The previous tissue valve, along with the
TMVR prosthesis, was separated from the native mitral annulus using curved scissors and removed en
bloc through a right lateral mini-thoracotomy incision in the fourth intercostal space (Video and Figure
1A, 1B, and1C). The TMVR prosthesis was located within the tissue valve and had limited adhesion
with the native mitral annular structure. There were thrombi present under the original Mosaic valve,
adjacent to the TMVR prosthesis (Central Picture, Figure 1C). After meticulously removing old suture material and debris from the intracardiac space using customized suction device\(^1\), we successfully implanted a 31mm Epic tissue valve (St Jude Medical, St Paul, MN) without the need for annular repair (Figure 1D and 1E). The valve was secured in place using pledged-enforced vertical mattress stitches, which were organized with two units of suture guides attached to the right-side drape (Figure 2). The porcine prosthesis was prepared with a custom cinch suture after removing its holder, and passed through the mini-thoracotomy incision without spreading the ribs. The stitches were tied with Cor-knot surgical tying device (LSI Solutions, Victor, NY). Echocardiography showed no paravalvular leakage, no LVOT obstruction and mean mitral pressure gradient of 4mmHg. The patient recovered well, and he was discharged home on the eighth day after surgery.

CONCLUSION

The endoscopic robotic approach allowed for optimal visualization and effective operative manipulation, while also minimizing invasiveness by avoiding a fourth resternotomy. Thrombus formation between two protheses may warrant further investigation into its clinical significance.

Central Picture

Valve-in-valve TMVR prosthesis was removed en bloc.

Figure 1

(Panel A) Intraoperative view showing the TMVR prosthesis inside the previous tissue valve. (Panel B) The previous tissue valve was dissected from the mitral annulus using robotic scissors. (Panel C) The
TMVR prosthesis within the previous tissue valve was removed en bloc. An Arrow points to thrombi present under the original Mosaic valve, adjacent to the TMVR prosthesis. (Panel D) The mitral annulus tissue was preserved after the residual pannus tissue was debrided. (Panel E) A new tissue valve was implanted. (Panel E) The explanted valves. The metal frame of Sapien 3 was deformed when it went through the service port.

**Figure 2**

Our standard port placements in a lateral endoscopic approach with robotics technique. Valve replacement stitches were organized with two units of suture guides attached to the right-side drape.

**Video**

Robotic approach for fourth redo mitral replacement following valve-in-valve transcatheter mitral valve replacement.

