

Case Report

Simultaneous Hybrid Transcatheter Aortic Valve Implantation and Endoscopic Mitral Valve Repair

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Multivalvular disease is frequently seen in elderly, high-risk patients, particularly aortic stenosis (AS) with concomitant mitral regurgitation (MR), and can be challenging to treat. The optimal approach is evolving with a spectrum of conventional surgery, transcatheter approaches, and hybrid options available. We report the case of an elderly patient with multiple comorbidities who was treated with simultaneous hybrid transcatheter aortic valve implantation (TAVI) and minimally invasive, endoscopic mitral valve repair.

Case Presentation

A 94-year-old man presented with a 6-month history of rapidly progressive and debilitating dyspnea, in keeping with New York Heart Association class III-IV symptoms. His past medical history was significant for atrial fibrillation, previous pacemaker insertion for complete heart block, hypertension, hyperlipidemia, coronary artery disease, previous percutaneous coronary intervention to the left anterior descending artery and right coronary artery, and deep vein thrombosis with an inferior vena cava filter in situ. Subsequent transthoracic echocardiography (TTE) demonstrated left ventricular dysfunction (ejection fraction: 45%-50%), a calcified aortic valve with mean/peak gradients of 28/50 mm Hg, respectively, with an aortic valve area of 0.96 cm² and severe MR with an eccentric posterolaterally directed jet from medial commissural prolapse (Fig. 1A). Medical optimization was attempted, and based on the patient's advanced age, multiple

comorbidities, and frailty, we felt that a simultaneous, less-invasive single-stage procedure would be best for him.

Under general anaesthesia, the patient was intubated with double-lumen endotracheal tube, positioned in a slight left lateral decubitus position, and had a 16-F percutaneous superior vena cava cannula inserted. A 3-cm right anterolateral mini thoracotomy port was made (Fig. 1B), and simultaneous right common femoral access was achieved through an 8-mm Dacron side graft (Fig. 1C). The patient was fully heparinized, the ARTIS Pheno C-arm (Siemens, Munich, Germany) was brought into position, and a right femoral graft was accessed using a 14-F e-Sheath (Edwards Lifesciences, Irvine, CA). The aortic valve was crossed, and a 26-mm SAPIEN 3 Ultra bioprosthesis (Edwards Lifesciences) was deployed under rapid pacing (Fig. 1D). The final root shot showed widely patent coronary arteries, with no aortic insufficiency, and the valve in a good position (Fig. 1D).

The robotic fluoroscopy C-arm was retracted, the femoral graft was hooked up to the arterial pump head, the right common femoral vein was cannulated, and cardiopulmonary bypass was initiated. The transthoracic aortic cross-clamp was applied, and Del Nido cardioplegia was delivered antegrade to achieve arrest. A 5-mm endoscope was used to visualize the mitral valve through the atriotomy. We performed a commissuroplasty of the medial commissure with a 4-0 Gore-Tex suture and closed the cleft between P2 and P3. We then completed the repair with a 34-mm band annuloplasty (Fig. 1E).

Postoperative TEE demonstrated excellent function of the bioprosthetic aortic valve with mean and peak gradients of 5 and 12 mm Hg, respectively, across the valve, with no aortic insufficiency. The mitral valve repair appeared to be in good shape, with mean and peak gradients of 3 and 6 mm Hg, respectively, across the valve, with no mitral insufficiency, and had a coaptation of 14 mm with reasonable biventricular function. The total cardiopulmonary bypass time and the cross-clamp time were 94 and 66 minutes, respectively. The patient did not receive any blood transfusions or require any inotropic support.

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Ethics Statement: This research has adhered to the relevant ethical guidelines.

[†]Junichi Shimamura and Christina Oatway contributed equally to this work and are co-first authors.

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See page 232 for disclosure information.

Novel Teaching Points

- Innovative, hybrid surgical and transcatheter procedures can be feasible to provide complete valve correction in selected patients.
- Novel hybrid procedures are most successful when performed in a hybrid operating room by a well-functioning heart team with experience, expertise, and an innovative spirit.

The patient was extubated in the operating room and recovered well, without complications, allowing discharge home on the sixth postoperative day. At 1 year postoperatively, he was active and well and was in New York Heart Association class I (Fig. 1F). TTE showed improved

biventricular function and a well-seated bioprosthetic aortic valve with mean and peak gradients of 8 and 16 mm Hg, respectively, with no aortic insufficiency, and mean and peak gradients of 4 and 14 mm Hg, respectively, across the mitral valve with no MR.

Discussion

Approximately one third of elderly patients with severe AS have significant MR,¹ creating a conundrum as to the optimal treatment strategy in elderly, high-risk patients.^{2,3} Our patient was previously very active and highly motivated, despite his advanced age and comorbidities. Thus, we believed that a hybrid transcatheter and surgery would provide the most complete valve correction with the least amount of risk.

The classic treatment of multivalvular disease is open surgical repair/replacement of both valves via median sternotomy. However, this approach may not be ideal, or

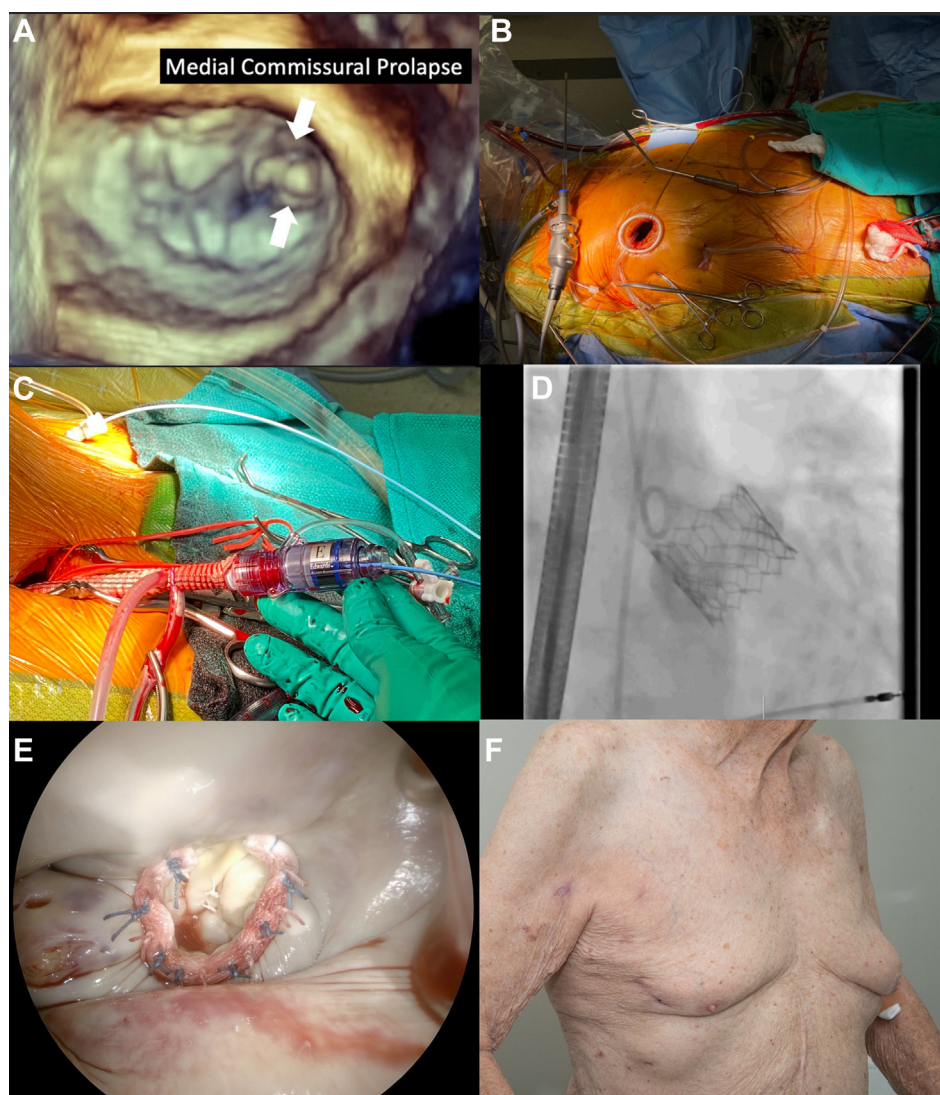


Figure 1. (A) Preoperative transesophageal echocardiogram demonstrated medial commissural prolapse. (B) Patient setup. (C) transcatheter aortic valve replacement valve delivery through an 8-mm right common femoral arterial graft. (D) Final aortogram. (E) Saline test. (F) Postoperative incision.

desirable, in elderly, high-risk patients, owing to their advanced age, comorbidities, limited life expectancy, and frailty. With the emergence of a multitude of contemporary treatment options, transcatheter aortic valve implantation (TAVI) for AS and transcatheter edge-to-edge repair have emerged as the most commonly selected options in elderly patients.

In our case, we had considered a staged approach, but in our experience, MR from mitral prolapse rarely improves with TAVI, and we wanted to provide the most-efficient care for our nonagenarian patient. For the mitral valve, we considered a transcatheter edge-to-edge approach but felt that the commissural prolapse would likely predispose the patient to a poor result and that other transcatheter mitral replacement options were not well suited to his anatomy. We selected a balloon expandable aortic valve prosthesis because of the short stent frame and high freedom from paravalvular leak to enable safe transthoracic cross-clamping and delivery of antegrade cardioplegia. We preferentially selected a partial band annuloplasty to avoid any interference with the TAVI prosthesis. Additionally, we used more superficial left atrial retraction and relied upon endoscopic visualization alone to repair the mitral valve to prevent unintentional TAVI prosthesis distortion or recoil.

Simultaneous TAVI and endoscopic mitral valve repair require some coordination, particularly in the cadence of the operation; however, we feel that expanding hybrid options can

provide the best therapeutic approaches tailored for each valve pathology, but taking advantage of less-invasive options.

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