Masters of Cardiothoracic Surgery

Robotic endoscopic aortic valve replacement with rapid deployment valve: technique and outcomes

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Clinical vignette

We present a case of a 71-year-old man with aortic valve insufficiency who underwent robotic endoscopic aortic valve replacement (AVR) using a rapid deployment valve. Transesophageal echocardiography showed preserved ejection fraction and severe aortic valve insufficiency. A computed tomography scan was performed, and the aortic valve size was estimated using three-dimensional imaging software.

Surgical technique

Preparation

The patient was placed supine with a vertical roll under the right scapula. General anesthesia was induced with a single-lumen endotracheal tube. External defibrillator pads were placed on the chest and back.

Operation

With the lungs deflated, a Veress needle was inserted in the 3rd intercostal space to insufflate carbon dioxide. An 8-mm camera port was placed in the 3rd intercostal space in the anterior axillary line. An 8-mm port for a dynamic atrial retractor was placed in the 5th intercostal space parasternally. All ports except for the first were placed under direct camera vision. An 8-mm right arm port was placed in the 6th intercostal space in the posterior axillary line, and an 8-mm left arm port in the 2nd intercostal space in the mid-clavicular line. The original camera port was removed, and the incision was extended slightly to accommodate the rapid deployment valve sizer. An XXS-size soft tissue retractor was placed at the site and used as a working port. A new 8-mm camera port was placed anterior to the working port in the 3rd intercostal space. The robot was docked from the patient's left side. Cardiopulmonary bypass was initiated with percutaneous femoral arterial and venous cannulation. The pericardium was opened 2 cm above the phrenic nerve. An epicardial pacemaker lead was placed on the right ventricle. The aorta was gently retracted using the dynamic retractor, and careful dissection was carried out between the aorta and the pulmonary artery. The aorta was completely separated from the pulmonary artery. A trans-thoracic aortic clamp was inserted in the 2nd intercostal space and gently advanced into the space between the aorta and the pulmonary artery. An aortic cross-clamp was applied, and an antegrade needle was inserted in the aorta. Del Nido cardioplegia was delivered. The left atrium was opened using monopolar scissors, and a percutaneous drain was inserted. A transverse aortotomy was made at the antegrade needle site. The aortic valve was exposed using the dynamic retractor. Aortic valve leaflets were sharply excised with monopolar scissors under excellent visualization. The rapid-deployment valve sizer was inserted through the working port, and the annulus was sized. A size 'medium' valve was chosen. Three stay sutures were placed at the nadir of each cusp and brought out through the working port. The sutures were placed in the rapid deployment valve. The valve was introduced through the working port and deployed after its correct position was confirmed. The valve was balloon expanded for 30 seconds. The left atriotomy was closed with a 4-0 Prolene running suture, leaving the drain for deairing. The aortotomy was closed with a 4-0 Prolene double-layer running suture. The aortic cross-clamp was released. After extensive de-airing the drain was removed, and the left atrium was closed. Cardiopulmonary bypass was discontinued. The femoral cannulas were removed using pre-closure devices.

Completion

Postoperative transesophageal echocardiography showed a well-seated rapid deployment valve with no paravalvular leakage. The mean pressure gradient was 6 mmHg. The patient was extubated within 24 hours and discharged home on postoperative day 2.

Comments

Clinical results

We have progressively developed our robotic endoscopic AVR technique, transitioning from a right anterior mini-thoracotomy approach to a robotic totally endoscopic approach (1). Robotic assistance was increasingly utilized for key steps of the procedure, including antegrade needle insertion, aortotomy, valve excision, and valve suture placement. Since transitioning fully to the robotic endoscopic approach, we have performed a total of 61 robotic AVR cases. Our first robotic endoscopic AVR using a rapid deployment valve was performed in 2019 (2). Since then, we have completed 33 cases (20 stenosis, 13 insufficiency). The mean age was 71 years old. The mean STS score was 2.3. Four patients (12%) had previous cardiac surgery. The valve sizes included small [3], medium [9], large [11], and extra-large [10]. Concomitant procedures were performed in 11 patients, including five mitral valve repairs, two totally endoscopic coronary artery bypasses, and four atrial fibrillation ablations. There were no conversions to sternotomy. The mean length of hospital stay was 4.5 days. No perioperative mortality or stroke was observed.

Advantages

Rapid deployment valves have become one of the options in surgical AVR, offering equivalent outcomes to conventional surgical sutured or trans-catheter valves (3). The rapid deployment valve is primarily used in minimally invasive surgeries, benefiting from its small size and ability to reduce operative time compared to conventional sutured valves, especially in cases involving concomitant procedures (4,5). In our cases, the rapid deployment valve enables a truly totally endoscopic approach without mini-thoracotomy, taking full advantage of the benefits of robotic technology which minimizes surgical invasiveness. Moreover, both robotic technology and rapid-deployment valves allow variable concomitant procedures to be performed while maintaining an endoscopic approach, thereby broadening the patient population eligible for minimally invasive AVR options, such as those with aortic valve plus mitral or coronary disease.

Caveats

Several centers have initiated mini-thoracotomy or endoscopic robotic AVR programs (6). We believe that the use of rapid-deployment valves in endoscopic robotic AVR maximizes the advantages of robotic technology facilitating early functional recovery while achieving long-term outcomes comparable to those of the conventional approach.

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Footnote

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