Masters of Cardiothoracic Surgery

Step-by-step rapid deployment Intuity Elite implantation using a minimally invasive endoscopic approach

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Clinical vignette

A 74-year-old man with a history of arterial hypertension, severe chronic obstructive pulmonary disease and asymptomatic moderate carotid artery disease was admitted to our institution with a diagnosis of a severely stenotic bicuspid aortic valve. He was scheduled for a minimally invasive endoscopic aortic valve replacement (E-AVR) using a mini-right anterior thoracotomy and totally video-thoracoscopic vision.

Surgical technique

Preparation

As previously reported by our group (1,2), our minimally invasive endoscopic technique requires the use of a video column and dedicated long shaft instruments. The patient is placed supine with 30° elevation of the right hemi-thorax. The mechanical ventilation is achieved by a single-lumen endotracheal intubation and a four-lumen central venous catheter is placed. Transcutaneous defibrillator pads for direct current (DC) cardioversion are applied. A transesophageal echocardiography (TEE) probe is placed.

Exposition

We start the operation with surgical exposure of the femoral vessels through a small skin incision. Then, a 3–4 cm right mini-thoracotomy in the 2nd or 3rd intercostal space is done at the midclavicular line, representing the working port. A soft tissue retractor is then placed with no rib-spreading and without sacrificing the internal mammary vessels. Three additional 5 mm mini-ports are needed: in the 4th intercostal space to introduce the vent line; in the 2nd intercostal space to introduce a 5 mm, 30° thoracoscope; in the 1st intercostal space to introduce the aortic cross clamp. A carbon dioxide line is connected to the trocar previously used to introduce the thoracoscope.

Operation

Cardio-pulmonary bypass (CPB) is achieved through femoral vessel cannulation under TEE guidance. The venous cannula is advanced into the superior vena cava to ensure good venous drainage. Vacuum-assisted venous drainage is needed, not exceeding ~60 mmHg in the venous reservoir. Once the patient is under CPB, the pericardium is opened under thoracoscopic vision, paying attention to avoid phrenic nerve injury. Aortic cross clamping is achieved using a trans-thoracic clamp. The cardioplegia is delivered directly into the aortic root and then, after the aortotomy, directly into the coronary ostia if needed. The vent line is placed through the superior right pulmonary vein. We use a 20 Fr. DLP® intracardiac sump with the tip in the left atrium. The vent purse string is made at the end of the operation to avoid further impingement of the working port.

The aortotomy is made minimizing extension of the incision line toward the pulmonary artery, because this is the most difficult area to reach if bleeding occurs. To improve the aortic valve exposure, 3 retraction stitches are placed on the aortic wall and adequately fixed to the pericardium. The aortic valve is then completely excised and the annulus symmetrically decalcified. A proper sizer is used to select the appropriate valve diameter. Although rapid deployment (RD) valves only need 3 guiding sutures at the nadir of Valsalva's sinuses, we place at least 3 additional non-pledgeted stitches at the nadir of the commissures. This maneuver facilitates the orientation of the valve in the native annulus and allows us to be sure that the valve is secured circumferentially at the level of the annulus, reducing the risk of malposition and perivalvular leakage. The Intuity valve is then parachuted into the annulus under careful video control and fixed by securing the guiding sutures on the valve cuff with narrow-diameter snares. To be sure that it is well-positioned, we remove the deflated balloon and insert the thoracoscope directly into the ventricle through the prosthesis so we can confirm correct placement with the skirt above the annulus. We then re-assemble the delivery system and the balloon is inflated and maintained for 10 seconds before deflating.

A second check after ballooning is made. The balloon is removed again, the thoracoscope inserted into the ventricle and the valve position verified. All the native annuli must be above the inlet skirt of the valve. The valve holder is then removed and the guiding sutures are tied serially with a knot-pusher. Proper valve seating is verified again by gently opening the valve leaflets and observing good symmetrical frame expansion below the annulus and good apposition to the left ventricular outflow tract (LVOT). Finally, the aorta is carefully closed using a double 4/0 Prolene running suture.

Completion

The ventricular pacing wire is placed on the inferior wall of the right ventricle after the closure of the aorta and before removing the aortic clamp, with the heart empty. The de-airing of the left heart is performed under TEE control, venting the ascending aorta and the left ventricle without directly manipulating the heart. The aortic cross clamp is removed. Two 24-Fr silastic chest tubes are positioned in the posterior pleural space and in the pericardial space, passed through the mini ports used to place the vent line and aortic clamp. The operation is then concluded in the usual manner.

Comments

Clinical results

Cardiopulmonary by-pass time and aortic cross clamp time were 120 and 75 minutes respectively. The postoperative course was uneventful. The mechanical ventilation time was 3 hours and the ICU and hospital stay times were 18 hours and 4 days respectively.

Advantages

Our endoscopic technique allows for the implantation of a RD valve, minimizing the surgical chest wall trauma, avoiding sternal fracture and any pressure exerted by a costal retractor over ribs. Our technique allows the operator to work with indirect vision and to avoid rib spreading. Moreover, the thoracoscopic vision provides the operator with a direct line of sight into the left ventricle and the ability to assess the correct positioning of the valve, thus minimizing the risk of paravalvular leakage.

Caveats

E-AVR requires development of new surgical skills and it may also be challenging for experienced surgeons. Therefore, the learning curve can be long and consequently, at the beginning, it may be associated with longer operative times compared with standard techniques.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

References

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