Right Infraaxillary Thoracotomy for Minimally Invasive Aortic Valve Replacement

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Minimally invasive aortic valve replacement has been performed via partial sternotomy, the parasternal approach, and anterior intercostal approaches. We successfully performed aortic valve replacement through a small right infraaxillary thoracotomy in 25 patients, with the aid of a thoracoscope and a knot-pusher. The patients were 9 men and 16 women with a mean age of 72.6 years. Our approach had better cosmetic results than traditional approaches through the anterior chest wall. This method did not require rib transection or sacrifice of the internal thoracic artery.

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Minimally invasive cardiac surgery (MICS) for aortic valve replacement (AVR) has been performed via partial sternotomy, the parasternal approach, and anterior minithoracotomy [1–3]. Because the annular sutures that fix the prosthetic aortic valve in place are usually tied down using the fingertips, the incision is traditionally made in the anterior chest wall where the aortic valve is within reach of the surgeon’s fingers, which differs from approaches for mitral valve replacement. However, anterior chest wounds may be cosmetically undesirable for patients, even if they are only a few centimeters in length. To improve the cosmetic results of MICS for AVR, we used a small right infraaxillary incision.

Technique

This study was approved by our institutional ethics committee, and written informed consent was obtained from each patient. Between May 2012 and January 2013, 25 patients underwent AVR through a small right infraaxillary thoracotomy (TAX-AVR) at our institution. The patients were 9 men and 16 women with a mean age of 72.6 years (range, 60 to 87 years). Average body surface area of the patients was 1.50 m² (range, 1.14 to 1.77 m²). Patients with aortic calcification, peripheral arterial stenosis, or poor left ventricular function were not included. The preoperative diagnosis was aortic stenosis in 17 patients, aortic regurgitation in 5 patients, and combined stenosis and regurgitation in 3 patients. The valve dysfunction was due to senile aortic stenosis in 14 patients, congenital bicuspid valve in 5 patients, rheumatic valve disease in 2 patients, and degenerative changes in 4 patients. Using general anesthesia with differential lung ventilation, the patients were placed in a partial left lateral position with the right arm flexed to 90 degrees. A 6-cm vertical skin incision was made at the right midaxillary or anterior axillary line. After dissecting a space beneath the pectoralis major muscle anteriorly, a thoracotomy incision was made through the third or fourth intercostal space. A small rib spreader was applied. A videoscope (Endo CAMeleon; Karl Storz, Tuttingen, Germany) was inserted through the sixth intercostal space (Fig 1). Cardiopulmonary bypass was established through the right femoral vein and artery. Vacuum assist was used for venous drainage. A venting tube was inserted through the right upper pulmonary vein. The ascending aorta was cross clamped with a Cosgrove flexible shaft clamp inserted through the main incision. Oblique aortotomy was made slightly more distally than usual, and the aortic valve was exposed with stay sutures (Fig 2). Antegrade cold blood cardioplegia was administered through the aortic root, followed by selective administration into each coronary ostium. The calcified aortic valve was removed using long scissors and an ultrasonic aspirator. A bioprosthesis was used in all patients. Valve sizing was performed as usual. The prosthetic valve was fixed in place using pledgeted 2-0 braided polyester sutures. All sutures were tied down with the aid of a knot pusher (Valve Gate 34-7495; Geister, Tuttingen, Germany). The aortotomy was closed in double layers using 4-0 polypropylene sutures. All procedures were performed under direct or videoscopic vision. Concomitant patch enlargement of the aortic annulus was performed in two patients, and concomitant mitral valve replacement was performed in another. The mean aortic clamp time was 109 min (range, 78 to 171 min), mean cardiopulmonary bypass time was 153 min (range, 107 to 223 min), and mean operative time was 253 min (range, 177 to 392 min). One patient had a 19-mm size valve, 10 patients had 21-mm valves, 12 patients had 23-mm valves, and one patient had a 25-mm valve. The mean blood loss during the first 24 h postoperatively was 194 mL (range, 50 to 440 mL). Thirteen patients did not require blood transfusion. There were no in-hospital deaths, and the mean postoperative hospital
stay was 8.9 days. There were no cases of stroke, wound infection, perivalvular leak, prolonged ventilation, or excessive bleeding. The wounds were seen only from the right lateral view when the right arm was raised (Fig 3).

Comment

MICS for mitral valve replacement is usually performed through a right anterolateral skin incision and intercostal minithoracotomy. The sutures are usually tied down with the aid of a knot pusher. However, MICS for AVR has traditionally been performed through an anterior chest incision near the ascending aorta. AVR via partial sternotomy or the parasternal approach can jeopardize or sacrifice the right internal thoracic artery. In addition, the anterior chest wound required to access the aortic valve directly results in a poorer cosmetic result compared with the anterolateral or lateral chest wound after MICS for mitral valve replacement. Wang and associates [4] used a vertical infraaxillary thoracotomy for mitral valve replacement. We used a similar approach for AVR and limited the skin incision to 6 cm with endoscopic assistance. This approach resulted in an even better cosmetic result than after MICS for mitral valve replacement. In addition, our TAX-AVR procedure did not require transection of the ribs or sacrifice of the right internal thoracic artery.

A possible drawback of our TAX-AVR procedure is the distance between the thoracotomy incision and the ascending aorta. This can be compensated for by using long surgical instruments for MICS and videoscopic assistance. Most of the procedures can be performed under direct vision. Actually, videoscopic assistance was especially useful to observe whether the annular sutures were tied down securely and to confirm hemostasis of the left side of the aortic suture line.

Our aortic clamp time and cardiopulmonary bypass time show that the TAX-AVR procedure was more time consuming than AVR through a median sternotomy. Although opening and closing of the chest were prompt, every step of the AVR procedures took 1.5-fold to twofold the time for median sternotomy because of remoteness and restricted wound. As a result, this procedure might not be appropriate for patients with severely depressed cardiac function. However, learning curve was clearly seen in this procedure. Excluding three patients who needed annular dilatation or mitral valve procedure concomitantly, average aortic clamp time, cardiopulmonary bypass

Fig 1. Right fourth intercostal small thoracotomy was made, and a videoscope was inserted through sixth intercostal space.

Fig 2. Endoscopic view of the aortic valve through oblique aortotomy. The aortic valve can be exposed with several retraction sutures. A similar view can be obtained directly through thoracotomy wound.

Fig 3. Postoperative photograph of a 68-year-old male patient. A small vertical wound is visible in the right midaxillary line when the right arm is raised.
time, and total operative time of the first 11 and later 11 cases were 114 versus 93, 164 versus 129, and 274 versus 221 min, respectively. Those times were significantly shorter in later patients ($p < 0.01$, unpaired t test). In conclusion, TAX-AVR could be a cosmetically superior option for selected patients undergoing AVR.

References