Research Highlight

Right infra-axillary mini-thoracotomy for aortic valve replacement

Toshiaki Ito, Atsuo Maekawa, Satoshi Hoshino, Yasunari Hayashi

Department of Cardiovascular Surgery, Japanese Red Cross Nagoya First Hospital, Nagoya, Japan

Correspondence to: Toshiaki Ito, MD, PhD. Department of Cardiovascular Surgery, Japanese Red Cross Nagoya First Hospital, 3-35 Michishita-cho, Nakamura-ku, Nagoya, 453-8511, Japan. Email: cvs1@nagoya-1st.jrc.or.jp.

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Patients and settings

Traditional minimally invasive approaches for aortic valve replacement (AVR) have not necessarily shown cosmetic superiority over standard median sternotomy. We have developed a minimally invasive technique for isolated AVR through a lateral thoracotomy via a small right axillary skin incision, and have evaluated its initial results.

Methodology

Patients

Between May 2012 and April 2014, all patients for whom isolated, first-time AVR was indicated were considered as potential candidates for trans-axillary aortic valve replacement (TAX-AVR). Patients with advanced atherosclerosis or very poor cardiac function were excluded. As a result, 54 patients were enrolled. The mean age was 71.9 (range, 37-88) years, of which 33 (61.1%) were female. Twenty-three patients had senile aortic stenosis as the predominant lesion in this patient group, followed by degeneration in 15, bicuspid valve in 14, and rheumatic lesion in 2.

Surgical technique

The surgical technique has been previously reported in detail (1). In brief, the right thorax was opened via a small, vertical right axillary skin incision and a third or fourth intercostal thoracotomy similarly to that performed in lung surgery. Cardio-pulmonary bypass was established through the right femoral artery and vein. The ascending aorta was clamped with Cosgrove's flex-clamp. A variable angle endoscope (EndoCAMeleon, Karl Storz, Tuttlingen, Germany) was used to observe the aortic valve and suture line. An ultrasonic aspirator was used to remove the calcified aortic valve. All sutures, including those for prosthetic valve seating, were tied down with the aid of a knot pusher (Valve Gate 34-7495, Geister, Germany). Other minimally invasive long shafted instruments were also utilized.

Data collection and statistical analysis

Data were collected prospectively, and all patients were completely followed up. No control group was established, and only descriptive statistical data were presented.

Primary outcomes

Main results

Results are shown in *Table 1*. As concomitant procedures, annular patch enlargement was performed in three patients, mitral valve replacement in one, and mitral valve repair through independent left atriotomy in one. The length of skin incision was 6 cm for isolated AVR, and 8 cm for a double valve procedure. All patients received a bioprosthesis. The average size of the valve implanted was 22 mm, which was sufficient for an average body surface area (BSA) of 1.50 m^2. No case was converted to sternotomy. Forty-nine patients left the intensive care unit (ICU) within 24 hours. Major brain infarction that resulted in left hemiplegia occurred in one 80-year-old male. This patient also needed prolonged mechanical ventilation, and a prolonged stay ICU. There were no cases of in-hospital mortality. As for other morbidities, low output syndrome, re-exploration for bleeding, wound infection, renal insufficiency, leg ischemia, or perivalvular leakage did not occur. Prolonged ventilation was required in one case as mentioned above. Between 1 and 24 months of follow-up

Table 1 Patient demographics and operative data

Variables	Mean	Range
Age (years)	71.9	37-88
BSA (m^2)	1.50	0.96-1.86
EuroSCORE II (%)	1.40	0.56-3.5
Valve size (mm)	22.1	19-25
CPB (min)	144	85-223
ACC (min)	106	62-171
OPT (min)	235	158-392
24 h blood loss (mL)	239	40-1,000
ICU stay (hours)	25.5	20-212
HP stay (days)	10.2	7-60

BSA, body surface area; CPB, cardio-pulmonary bypass time; ACC, aortic cross clamp time; OPT, operation time; 24 h blood loss, refers to post-operative bleeding during first 24 hours; ICU, intensive care unit; HP stay, post-operative hospital stay.

(mean 18.8 months), all patients were alive, and no valve-related complications were observed.

Comment

Axillary incision is a popular technique in thoracic surgery, as this approach offers multiple advantages including cosmetic superiority, and facilitates direct access to the rib-cage by cutting only skin and subcutaneous fat. Some surgeons have adopted this approach for congenital or mitral valve surgery (2,3). In this approach, the ascending aorta is relatively distant compared with fore-chest thoracotomy or partial sternotomy. However, some distance from the access window to the target organ and a wide intra-thoracic space act favorably as a working space when using endoscopic assistance. Leftward deviation of the ascending aorta against the sternum was observed in some patients, but had little effect on the procedure, as opposed to a fore-chest thoracotomy.

All sutures were tied down using a knot pusher, and consequently TAX-AVR was time-consuming. This could be compensated for by using sutureless valves in the future. In addition, a right axillary approach could enable a totally endoscopic AVR, as adequate distance from the access port to the target organ act favorably in endo-surgery.

Study limitation

This is a single center experience with a limited number of patients, and most cases were performed by a single surgeon (T.I.) without a control group. Therefore, comparison with other minimally invasive approaches or with median sternotomy in terms of safety and risk of major complications is necessary.

Generalizability

The largest BSA of the patient in this series was only 1.86 m^2, and as such this procedure may be difficult in extremely large or obese patients. Major stroke occurred in an elderly patient even though the preoperative screening computed tomography (CT) arteriogram showed little atherosclerosis. This procedure may carry a potential risk of stroke associated with retrograde perfusion through the femoral artery. Therefore, selection of elderly patients should be approached with caution. In summary, AVR performed via a cosmetically-advantageous right axillary small thoracotomy was possible with a reasonable technical demand.

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