Transcatheter Aortic Valve Implantation by the Left Axillary Approach: A Single-Center Experience

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Background. **Transcatheter aortic valve implantation (TAVI) is an accepted alternative treatment for severe symptomatic aortic stenosis in high-risk and inoperable patients. Femoral or transapical accesses are commonly used. We report our initial clinical experience with TAVI using the left-axillary artery approach.**

Methods. **A single-center, retrospective study of patients undergoing transaxillary TAVI between January 2010 and December 2012 was performed. Procedural success was defined as successful device implantation with reduction in the mean aortic gradient and without need for conversion to open-heart surgery. Short-term echocardiographic follow-up was obtained in all patients.**

Results. **A total of 18 consecutive patients with severe aortic stenosis who were not candidates for surgical replacement underwent transaxillary TAVI. Mean age was 81.1 ± 7.3 years and 14 patients (78%) were male. Median logistic European System for Cardiac Operative Risk Evaluation was 8.5% (range, 1.5% to 54.1%). Procedural success was obtained in 17 out of 18 patients (94%). There was no in-hospital or 30-day mortality. One major bleeding complication in the form of an upper gastrointestinal bleeding was observed. No stroke or major vascular complication was reported. Postoperative implantation of a permanent pacemaker was performed in 7 patients (39%). At a mean follow-up of 326 ± 213 days, mean aortic gradient was 10.8 ± 4.8 mm Hg. Mean aortic valve area was 1.7 ± 0.4 cm^2 and aortic insufficiency grade was mild or less in all but 1 patient, who showed moderate regurgitation.**

Conclusions. **The transaxillary approach for TAVI is associated with high procedural success and low rates of stroke, vascular, or bleeding complications. This approach is an appealing alternative to the commonly used transfemoral and transapical TAVI.**

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Transcatheter aortic valve implantation (TAVI) has emerged as a promising alternative to standard surgical aortic valve replacement (AVR) in patients with severe symptomatic aortic stenosis (AS) who are deemed inoperable or who present a high surgical risk [1, 2].

The presence of a safe remote access route to the heart is a critical determinant of success with catheter-based treatment of valvular heart disease. Several approaches have been described for TAVI. The 2 most commonly used are the transfemoral [3] and transapical [4] techniques. However, the former is associated with high rates of vascular complications in patients with severe peripheral vascular disease (PVD) [5–7] while the latter involves a minithoracotomy that may complicate the postoperative course in patients with severe associated lung disease. These limitations have led to the development of alternative routes for TAVI. In recent years, the axillary artery has gained popularity as a safe alternative vascular access site in patients for whom both the transfemoral and transapical routes are contraindicated [8]. However, despite several potential advantages over the other approaches, the transaxillary (TAx) route for TAVI has yet to gain widespread acceptance in the medical community.

There are currently 2 commercially available devices for TAVI, the Edwards-SAPIEN valve (Edwards Lifesciences, Irvine, CA) and the CoreValve Revalving System (Medtronic CV, Santa Rosa, CA), both of which have been successfully implanted through the axillary artery. However, only the CoreValve has received the CE mark certification for this approach [8].

The purpose of this study is to report our initial clinical experience with the transcatheter implantation of the CoreValve prosthesis using the left axillary artery approach.

Material and Methods

This retrospective single-center study examined TAVI procedures carried out between January 2010 and December 2012 at the Montreal Heart Institute, focusing

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Abbreviations and Acronyms

AF = atrial fibrillation
AI = aortic insufficiency
AKI = acute kidney injury
AS = aortic stenosis
AVA = aortic valve area
AVB = atrioventricular block
AVR = aortic valve replacement
COPD = chronic obstructive pulmonary disease
CPB = cardiopulmonary bypass
LIMA = left internal mammary artery
LVEF = left ventricular ejection fraction
MI = myocardial infarctions
PAVR = percutaneous aortic valve replacement
PCI = percutaneous coronary intervention
PPM = permanent pacemaker
PVD = peripheral vascular disease
RBBB = right bundle branch block
TAVI = transcatheter aortic valve implantation
TAx = transaxillary
TEE = transesophageal echocardiography
TIA = transient ischemic attacks
TTE = transthoracic echocardiography
VARC = Valve Academic Research Consortium

on cases performed using the left axillary artery access route.

Patients considered for TAVI were evaluated by a multidisciplinary team composed of cardiac surgeons, interventional cardiologists, and an echocardiologist. In accordance with the position statement of the European Association for Cardio-Thoracic Surgery and the European Society of Cardiology, all patients who underwent transcatheter AVR had severe symptomatic AS, an aortic valve annulus diameter from 18 mm to 27 mm, and contraindication to conventional surgery because of significant comorbidities or high estimated surgical risk [9]. In addition to clinical evaluation, all patients underwent echocardiographic assessment using transthoracic echocardiography or transesophageal echocardiography and coronary angiography. Whenever feasible, the transfemoral access route was the approach of choice. For patients in whom the transfemoral approach was contraindicated, due to either bad vascular access or bulky atherosclerosis of the ascending aorta and aortic arch, the transapical technique with the SAPIEN valve and the TAx technique with CoreValve system were considered. The latter was preferred in patients who showed evidence of septal hypertrophy (septal thickness $>$ 5 mm) or severe associated pulmonary disease confirmed by pulmonary function testing. Contraindications to the TAx approach included a left axillary artery diameter less than 6 mm or a patent left internal mammary artery graft, especially in the setting of proximal occlusion of the left anterior descending artery.

All patients provided written informed consent for the procedure and the retrospective analysis was approved by the institution's ethics committee.

Procedural and clinical outcomes are reported according to the updated Valve Academic Research Consortium (VARC-2) definitions [10]. Procedural success was defined as successful device implantation with reduction in the mean aortic gradient without need for conversion to open heart surgery. Unless otherwise specified, continuous variables are presented as mean $\pm$ standard deviation. Improvements of mean aortic valve gradient and aortic valve area were assessed using the Wilcoxon signed rank test.

Surgical Technique

The Medtronic CoreValve prosthesis was used in all patients. The CoreValve Revalving System includes 3 components; a self-expanding nitinol support frame with a trileaflet porcine pericardial tissue valve, an 18F catheter delivery system, and a disposable loading system [5, 11]. Each procedure was performed by a multidisciplinary team composed of interventional cardiologists, cardiac anesthesiologists, and a cardiac surgeon. Valve implantation was carried out under general anesthesia. A 5F pigtail is first inserted percutaneously into the femoral artery and advanced to the level of the noncoronary sinus for aortic angiography. The left axillary artery is then exposed through a small infraclavicular incision and secured with nylon tapes.

After systemic heparinization, the axillary artery is retracted with vessel loops, punctured and dilated. After direct insertion of a 6F sheath, a stiff wire is positioned in the ascending aorta and an 18F sheath is then inserted through the left axillary artery. The rest of the procedure is carried out in a standard fashion [7, 12]. Briefly, the native valve is crossed retrogradely and dilated using balloon valvuloplasty. The loaded prosthesis is then introduced through the 18F sheath and positioned across the aortic valve using angiographic and fluoroscopic guidance. When correct placement has been confirmed, the valve is deployed. At this point, the patency of the coronary arteries and degree of aortic insufficiency are assessed using aortic angiography. The valve is also examined for the presence of any paravalvular leak. The axillary artery is closed with paradoxal interrupted 5/0 polypropylene sutures to avoid any stenosis and a wound suction device (HemoVac) is left in place to avoid compression of the brachial plexus by an eventual hematoma. An angiogram of the left axillary artery is performed at the end of each procedure.

Results

Between January 2010 and December 2012, 174 TAVI procedures were performed at our institution. Of these, 100 (57%) were performed through a transfemoral approach, 55 (32%) through a transapical approach, 18 (10%) through a TAx approach, and 2 (1%) through a direct transarterial approach. This report focuses on the TAx implantations.