# Transapical aortic valve implantation: a reasonable therapeutic option, but not the only alternative to transfemoral approach

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**KEY WORDS** Transcatheter aortic valve implantation (TAVI); transapical approach; transfemoral approach; non-transfemoral approach

*J Thorac Dis 2013;5(3):360-361. doi: 10.3978/j.issn.2072-1439.2013.06.13*

Since the first human transcatheter aortic valve implantation (TAVI) performed in April 2002 by Alain Cribier in Rouen, France (1), more than 60,000 procedures have been performed worldwide using the Edwards Lifesciences transcatheter heart valves (THV) or the Medtronic CoreValve. Before the TAVI era approximately 30-40% of patients with a class I indication for an aortic valve replacement were left untreated (2). Therefore the combination of this unmet clinical need with the desire to find a less invasive treatment than conventional surgery has driven the development of TAVI. As a result of the important effort of the engineers and medical community and following the results of the prospective multicenter randomized PARTNER trials (3,4) in a decade TAVI has become standard treatment for patients who are unsuitable (cohort B) or seen as high-risk for surgical aortic valve replacement (cohort A).

The retrograde transfemoral approach is the default approach and is performed in approximately 70% to 80% of cases. Given the size of early available devices and the number of patients with significant peripheral vascular disease and challenging vascular anatomy, it is not surprising that alternative approaches, ideally independent of vascular access were developed. The transapical approach—in which the device is inserted through the left ventricular apex exposed through a 3 to 5 cm anterior mini-thoracotomy—and the subclavian access were developed in the early years of TAVI (5-8). More recently, the direct aortic approach has been reported (9,10) and a marginal number of interventions have also been performed through carotid access (11).

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Submitted Jun 10, 2013. Accepted for publication Jun 10, 2013.
Available at www.jthoracdis.com

ISSN: 2072-1439


Transapical approach has the advantage of being independent of vascular access. Furthermore the antegrade passage of the device through the native valve is generally technically easier than the retrograde access used with the other routes, while the short distance between the access point and the native aortic valve improves direct control of THV positioning during deployment. It has also been suggested that transapical TAVI might be associated with a lower rate of cerebral embolism since this approach avoids both the retrograde crossing of the native aortic leaflets and the advancement of large catheters in the ascending aorta with the risk of aortic plaque disruption and embolization. However, a multicenter Canadian study assessing new cerebral lesions by MRI pre- and post-TAVI among 60 patients undergoing transfemoral versus transapical approach found no difference between the two groups (66% *vs.* 71%, P=0.78) as well as no predicting factors such as calcium burden of the native valve or presence of severe aortic atherosclerotic plaques (≥4 mm) (12).

After having significantly contributed to the real launch of the transfemoral retrograde approach with the development of deflectable catheters (13), John Webb and the Vancouver Heart Team were the first to perform a transapical beating heart aortic implant in November 2005 (6). In the July 2012 issue of *Annals of Cardiothoracic Surgery*, Higgins *et al.* report the results of one of the largest series of transapical-TAVI using the Valve Academic Research Consortium definitions to describe the standard endpoints. They reported an in-hospital mortality rate of 12.1%, which is indeed higher than the predicted 30-day mortality using the Society of Thoracic Surgeons (STS) score (10.3%±6.6%). Conversely, in the PARTNER A trial involving 244 transfemoral and 104 transapical TAVI the observed 30-day mortality (global TAVI cohort 3.4%, transapical cohort in the as-treated analysis 8.7%) was lower than the mean STS score (11.8%±3.3%). The higher intra-hospital mortality rate observed in the Vancouver experience despite a lower mean STS score might be explained by the fact that they were pioneers in the field and they started with the initial devices (e.g., the Cribier-Edwards THV, the transfemoral Retroflex 1 catheter used off-

label for transapical access, the 33-French Ascendra catheter, which is now 22-French compatible). Indeed when Higgins *et al.* (14) compared the first 89 patients from their series with the next 89 patients, they observed a trend (not statistically significant) towards a decreased intra-hospital mortality rate (16.9% *vs.* 7.1%), decreased risk of stroke (4.5% *vs.* 2.3%), decreased risk of prolonged ventilation and shorter hospital stay (13.7 *vs.* 10.6 days). Since there were few differences among the 2 cohorts (more congestive heart failure and renal failure in the late cohort, whereas previous acute myocardial infarction was more frequent in the early cohort), the better outcomes, as stated by the authors, are likely related to improvements in patients screening and selection, intra-operative technique and imaging, and peri-operative management.

Compared to transfemoral TAVI, transapical TAVI is often performed in patients with higher risk scores due to comorbidities such as peripheral vascular disease, carotid disease, renovascular disease and previous coronary artery bypass grafting. Interestingly, when Higgins *et al.* divided their series into 2 equal-sized groups based on the STS score (low-risk group: 5.6%±2.0%, high-risk group: 15.0%±6.3%), survival was significantly improved in the lower-risk cohort.

Despite these encouraging data, the penetration of the transapical approach will certainly decline in most countries due to the decrease in size of the Edwards transfemoral delivery catheters, the advent of the new direct aortic approach, and the comparable 2-year results obtained after transfemoral and subclavian procedures (15). Indeed, the largest national registry, FRANCE-2, reported a significant reduction of the use of the transapical route between 2010 and 2011 (19.5% in 2010, and 16.2% in 2011, P<0.001) (16).

Indeed, potential weaknesses of transapical access include the need for a small left lateral thoracotomy with its potential for associated postoperative pain and the need for general anesthesia. It causes trauma to the left ventricle and decreased left ventricular ejection fraction may be a concern for this approach. The incidence of severe left ventricular bleeding during implantation is low and long-term complications such as left ventricular aneurysm are rarely reported, but when they do occur they are potentially lethal complications. The apex of the left ventricle can be a friable and unforgiving structure in elderly patients.

Patient selection and choice for the best approach are essential in order to perform a safe and effective procedure. The different therapeutic strategies and the various approaches should be tailored to the patient in order to reduce the risks associated with the procedure and improve outcomes as well as quality of life. These decisions should be discussed among members of a Heart Team. Transapical TAVI is a reasonable therapeutic option, but not the only alternative to transfemoral approach.

## Acknowledgements

*Disclosure:* The author received honorarium by Medtronic for new CoreValve center training.

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**Cite this article as:** Noble S. Transapical aortic valve implantation: a reasonable therapeutic option, but not the only alternative to transfemoral approach. J Thorac Dis 2013;5(3):360-361. doi: 10.3978/j.issn.2072-1439.2013.06.13