

TAVR - HOW, WHEN AND WHY?

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Transcatheter Aortic Valve Replacement (TAVR) took the world of cardiology like a storm and with the provision of solid evidence based data, it is being accepted in all corners of the world. Very rarely a new technique has been embraced so enthusiastically in spite of the high cost and high technical demand. The technology has found inroads in Pakistan and after the pioneering work at NICVD Karachi, other centres are trying it out. This editorial is an attempt to provide evidence that has been accumulated so far to help us offer this expensive technology to the patients, who have been shown to benefit from it. TAVR has been widely accepted as an intervention of choice in elderly patients with severe aortic stenosis (AS) who are either inoperable or have high-surgical risk. It is has been evaluated and recommended for elderly symptomatic intermediate-risk patients. In asymptomatic, lower-risk patient it is still not being recommended. Undoubtedly, TAVR has emerged as a transformational procedure, which has already improved and saved thousands of precious lives. And the future, indeed, appears more promising.¹

Overall the field of aortic valve replacement has witnessed new advances and transformation. Aortic valve replacement - surgical or transcatheter is the commonest valvular intervention in the developed world due to the ageing population.^{2,3} After the ground breaking ESC guidelines of 2012, a lot of new data in the form of trials and registries has accumulated to enhance the indications and expand the scope of TAVR.⁴ The new data provide evidence for exponential growth of the procedures in USA and Europe and now more TAVRs are being performed than Surgical Aortic Valve Replacement (SAVR) in many countries in Europe.^{5,6}

While evaluating a patient with AS the clinician has to assess severity of stenosis, presence of symptoms, life expectancy, benefits of intervention, local resources and expertise and patient preference. Echocardiography being the key diagnostic tool can reliably document severity of the lesion, calcification of valve, associated valvular involvement, left ventricular function, LV wall thickness and pulmonary hypertension.⁷

The evidence generated from well conducted clinical trials Partner 1A and 1B and 2012 ESC/EACTS guidelines, recommends TAVR in patients with severe symptomatic AS who are not fit for SAVR as assessed by a heart team, in patients who are likely to improve quality of life and have life expectancy of more than 1 year considering the co-morbidities.^{4,8} TAVR should be considered in high-risk

patients with severe symptomatic AS who may be suitable for SAVR but in who TAVR may be considered based on individual risk profile and anatomic considerations.⁹ Based on subsequent PARTNER-II, SURTAVI AND NOTION trials' robust randomized data supports superiority of TAVR on SAVR in intermediate and low risk patients when the procedure is performed transfemoral.¹⁰⁻¹² This allowed for further expansion of indications for TAVR to include lower-risk patients in the updated 2017 ESC/EACTS guidelines on the management of valvular heart disease.¹³

The choice between SAVR and TAVR is made on the basis of cardiac factors like anatomical, vascular and technical and extra cardiac factors like frailty, choice of patient and life expectancy. Considering clinical characteristics, factors like age more than 75 years, STS/Euroscore II score more than 4%, presence of severe comorbidity, previous CABG/cardiac surgery, frailty and restricted mobility should tilt the balance towards TAVR. Presence or history of endocarditis should favor SAVR. Considering anatomical and technical aspects, favorable access for trans-femoral TAVR, history of recurrent chest radiation, porcelain aorta, severe bodily deformities like scoliosis, intact grafts post CABG should favor TAVR. Factors like short distance between valve and coronary ostia, unfavorable valve morphology, non-availability of the size, presence of thrombi in aorta and presence of other condition that require surgery should favor SAVR.⁷ It must be appreciated that in the two groups in the intermediate risk, for which TAVR was recommended, mean ages were 82 and 80 years and STS score was 5.8% and 4.5%; hence the results are applicable to similar cohort.^{11,12} Recently, besides the comorbid conditions there has been more interest in frailty a marker of functional, cognitive and nutritional status. Frailty is a predictor of higher morbidity and mortality after AVR. The assessment should not be based on subjective approach rather it should be estimated objectively.¹⁴⁻¹⁶

There are a few grey areas that need more research. Certain groups of patients have been traditionally excluded from the studies. Patient with low flow and low gradient AS, those with significant CAD, concomitant valvular problem, previous cardiac surgery and patients with severe LV outflow calcification - all these groups need more studies. Recent registry data showed encouraging results of TAVR for bicuspid AS, but unique challenges remain unconquered relating to orifice size and leaflet calcification.⁷ There is little data on TAVR in patients below 75 years of age and for surgical low-risk patients. In such patients SAVR remains the modality of choice. Younger patients differ in terms of anatomy many being bicuspid and yet not available long term data as regards long-term durability data for TAVR prosthetic valves.

Main complications encountered in TAVR pertain to vascular complications, paravalvular regurgitation (PVR) and requirement for pacemaker. Whereas main complication following SAVR are new onset AF, severe bleeding, kidney injury besides morbidity and mortality associated with valvular surgery.⁷ Refinement of TAVR technology and reduction in the profile of the device has resulted in lesser vascular complications. Recent high-risk registry two studies studying Evolut R implantation using a 14-Fr delivery system, major vascular complication rates reduced to 5.3% and 7.5%.^{17,18} Current equipment in use has wide variation in sheath requirement, from 14 up to 22, and this remains the major source of morbidity in short and long term.⁷ Moderate to severe paravalvular regurgitation was initially reported in 10-15% of patients and was associated with higher morbidity and mortality.¹⁹ Detailed pre procedure work up involving multi slice CT scan (MSCT) and TEE with accurately selecting the right size and appreciation of orifice anatomy has resulted in reduction of complications. Addition of an outer skirt seal or adaptive seal and further refinement in the valve has resulted in reduction of PVR to less than 5%.^{20,21} Further reduction in PVR shall require further research and refinement of technique. Complete heat block and requirement of permanent pacemaker system is seen frequently after TAVR. This is because of the shorter distance between conduction system and the valve extending into LVOT. PPM adds to the cost and morbidity of already sick patients but it saves unexpected deaths in this cohort. Repositionable implants have shown to reduce the PPM requirement rate.²¹

To ensure provision of high quality services and patients safety, the concept of heart valve centre and heart team is being promoted that has a cardiologist, cardiac surgeon, anesthetist, intensivist and geriatric physician. It is believed that techniques with a steep learning curve may have better results in such high volume centres with more experience. They should have active departments of cardiology and cardiac surgery on-site with structured collaboration.²²

Due to the advancement of technology there has been a significant simplification of the technique in the recent times. The new transcatheter heart valve has a reduced insertion profile hence more procedures are being performed using femoral route. This accounts for more than 90% of cases in most busy and leading units. This has resulted in non-requirement of general anaesthesia in most cases, requiring mild sedation and local anesthesia. There is no longer any need for CVP or bladder catheter hence rendering it 'minimalistic TAVR'. These advances have reduced hospital stay with hospital discharges in 24-48 hours. This 'fast track' TAVR has also reduced the total cost.²³⁻²⁵

In the recent times, subclinical leaflet thrombosis has been reported on bioprosthetic aortic valves, both in TAVR and SAVR. But this is more frequent in TAVR. This can be reliably assessed by MSCT and is associated with increase in transvalvular gradients. The clinical significance of this remains unknown. This can be effectively treated with vitamin K anticoagulants and unfractionated heparin as first line treatment.²⁶

To conclude, in general, patients with severe symptomatic AS who are inoperable or offer higher risk profile for SAVR should be considered for TAVR. More so, if the device can be delivered via transfemoral approach. Patients of severe symptomatic AS at younger age and lower risk should be treated with SAVR. With refinement of technology delivery of valve is being simplified and rendered easier. The risk of complications is reducing with shorter hospital stay and more acceptability of the procedure. The choice between SAVR and TAVR should be made after a thorough discussion among the heart team and with the patient considering age, comorbidities, anatomy and local experience of surgery and TAVR of the centre.

REFERENCES

1. Beck DL. TAVR: where do we stand in spring 2017? [Online]. 2017 [cited on 2017 October 25th]. Available from URL: <https://www.acc.org/latest-in-cardiology/articles/2017/06/12/16/29/coverstory>
2. Coffey S, Cox B, Williams A. The prevalence, incidence, progression, and risks of aortic valve sclerosis: a systemic review and meta-analysis. *J Am Coll Cardiol* 2013;63:2852-61.
3. Mylotte D, Osnabrugge RLJ, Windecker S, Lefèvre T, de Jaegere P, Jeger R, et al. Transcatheter aortic valve replacement in Europe: adoption trends and factors influencing device utilization. *J Am Coll Cardiol* 2013;62(3):210-9.
4. Vahanian A, Alfieri O, Andreotti F, Antunes MJ, Barón-Esquivias G, Baumgartner H, et al. Guidelines on the management of valvular heart disease (version 2012). *Eur Heart J* 2012;33(19):2451-96.
5. Eggebrecht H, Mehta RH. Transcatheter aortic valve implantation (TAVI) in Germany 2008-2014: on its way to standard therapy for aortic valve stenosis in the elderly? *EuroIntervention* 2016;11(9):1029-33.
6. Hawkins RB, Downs EA, Johnston LE, Mehaffey JH, Fonner CE, Ghanta RK, et al. Impact of transcatheter technology on surgical aortic valve replacement volume, outcomes, and cost. *Ann Thorac Surg* 2017;103:1815-23.
7. Thonghong T, De Backer O, Søndergaard L. Comprehensive update on the new indications for transcatheter aortic valve replacement in the latest 2017 European guidelines for the management of valvular heart disease. *Open Heart* 2018;5(1):e000753.
8. Leon MB, Smith CR, Mack M. Transcatheter aortic valve implantation for aortic stenosis in patients who cannot undergo surgery. *N Engl J Med* 2010;363:1597-607.
9. Smith CR, Leon MB, Mack MJ, Miller DC, Moses JW, Svensson LG, et al. Transcatheter versus surgical aortic-valve replacement in high-risk patients. *N Engl J Med* 2011;362(23):2187-98.
10. Thyregod HG, Steinbrüchel DA, Ihlemann N, Nissen H4, Kjeldsen BJS, Petursson P, et al. Transcatheter versus surgical aortic valve replacement in patients with severe aortic valve stenosis: 1-year results from the all-comers NOTION randomized clinical trial. *J Am Coll Cardiol* 2015;65(20):2184-94.
11. Leon MB, Smith CR, Mack MJ, Makkar RR, Svensson LG, Kodali SK, et al. Transcatheter or surgical aortic-valve replacement in intermediate-risk patients. *N Engl J Med* 2016;374(17):1609-20.
12. Reardon MJ, Mieghem NM, Popma JJ, Kleiman NS, Søndergaard L, Mumtaz M, et al. Surgical or transcatheter aortic-valve replacement in intermediate-risk patients. *N Engl J Med* 2017;376(14):1321-31.
13. Baumgartner H, Falk V, Bax JJ, De Bonis M, Hamm C, Holm PJ, et al. 2017 ESC/EACTS guidelines for the management of valvular heart disease. *Eur Heart J* 2017;38(36):2739-91.
14. Cockburn J, Singh MS, Rafi NH, Dooley M, Hutchinson N, Hill A, et al. Poor mobility predicts adverse outcome better than other frailty indices in patients undergoing transcatheter aortic valve implantation. *Catheter-Cardiovasc Interv* 2015;86(7):1271-7.
15. Assmann P, Kievit P, van der Wulp K, Verkroost M, Noyez L, Bor H, et al. Frailty is associated with delirium and mortality after transcatheter aortic valve implantation. *Open Heart* 2016;3(2):e000478.
16. Puls M, Sobisiak B, Bleckmann A, Jacobshagen C, Danner BC, Hünlich M, et al. Impact of frailty on short- and long-term morbidity and mortality after transcatheter aortic valve implantation: risk assessment by Katz index of activities of daily living. *EuroIntervention* 2014;10(10):609-19.
17. Kalra SS, Firoozi S, Yeh J, Blackman DJ, Rashid S, Davies S, et al. Initial experience of a second-generation self-expanding

- transcatheter aortic valve: the UK & Ireland Evolut R Implanters' Registry. *JACC CardiovascInterv* 2017;10(3):276-82.
18. Popma JJ, Reardon MJ, Khabbaz K, Harrison JK, Hughes GC, Kodali S, et al. Early clinical outcomes after transcatheter aortic valve replacement using a novel self-expanding bioprosthesis in patients with severe aortic stenosis who are suboptimal for surgery: results of the evolut r U.S. study. *JACC CardiovascInterv* 2017;10(3):268-75.
 19. Van Belle E, Juthier F, Susen S, Vincentelli A, Lung B, Dallongeville J, et al. Postprocedural aortic regurgitation in balloon-expandable and self-expandable transcatheter aortic valve replacement procedures: analysis of predictors and impact on long-term mortality: insights from the FRANCE2 Registry. *Circulation* 2014;129(13):1415-27.
 20. Arai T, Lefèvre T, Hovasse T, Morice MC, Garot P, Benamer H, et al. Comparison of Edwards SAPIEN 3 versus SAPIEN XT in transfemoral transcatheter aortic valve implantation: difference of valve selection in the real world. *J Cardiol* 2017;69(3):565-9.
 21. Meredith IT, Walters DL, Dumonteil N, Worthley SG, Tchétché D, Manoharan G, et al. 1-Year outcomes with the fully repositionable and retrievable lotus transcatheter aortic replacement valve in 120 high-risk surgical patients with severe aortic stenosis: results of the REPRISE II study. *JACC CardiovascInterv* 2016;9(4):376-84.
 22. Badheka AO, Patel NJ, Panaich SS, Patel SV, Jhamnani S, Singh V, et al. Effect of hospital volume on outcomes of transcatheter aortic valve implantation. *Am J Cardiol* 2015;116(4):587-94.
 23. Durand E, Borz B, Godin M, Tron C, Litzler PY, Bessou JP, et al. Transfemoral aortic valve replacement with the Edwards SAPIEN and Edwards SAPIEN XT prosthesis using exclusively local anesthesia and fluoroscopic guidance: feasibility and 30-day outcomes. *JACC CardiovascInterv* 2012;5(5):461-7.
 24. Alkhalil A, Lamba H, Deo S, Bezerra HG, Patel SM, Markowitz A, et al. Safety of shorter length of hospital stay for patients undergoing minimalist transcatheter aortic valve replacement. *Cath CardiovascInterv* 2018;91(2):345-53.
 25. Marcantuono R, Gutsche J, Burke-Julien M, Anwaruddin S, Augoustides JG, Jones D, et al. Rationale, development, implementation, and initial results of a fast track protocol for transfemoral transcatheter aortic valve replacement (TAVR). *Catheter CardiovascInterv* 2015;85(4):648-54.
 26. Chakravarty T, Søndergaard L, Friedman J, De Backer, Berman D, Kofoed KF, et al. Subclinical leaflet thrombosis in surgical and transcatheter bioprosthetic aortic valves: an observational study. *Lancet* 2017;389(10087):2383-92.