Journal of Geriatric Cardiology (2016) 13: 511–513

Symposium: Transcatheter aortic valve implantation **· Open Access ·**

Guest Editor: Prof. Khalil Fattouch

Transcatheter aortic valve implantation in 2015

Darren Mylotte[1], Faisal Sharif[1], Nicolo Piazza[2], Marco Moscarelli[3], Khalil Fattouch[4], Thomas Modine[5*]

[1]*University Hospital Galway, Ireland*
[2]*McGill University Health Centre, Montreal, Quebec, Canada*
[3]*GVM Care and Research Unit, Anthea Hospital, Bari, Italy*
[4]*GVM Care and Research Unit, Maria Eleonora Hospital, Palermo, Italy*
[5]*Hôpital Cardiologique, Lille, France*

J Geriatr Cardiol 2016; 13: 511–513. doi:10.11909/j.issn.1671-5411.2016.06.003

Keywords: Aortic valve; Echocardiography; Risk factor; Surgery

The last decade has seen transcatheter aortic valve implantation (TAVI) emerge as the standard of care for patients with severe symptomatic aortic stenosis deemed to be either at excessive- or high-risk for surgical aortic valve replacement (SAVR). This position is supported by three important multicentre randomized trials comparing TAVI to the historical gold standard therapies: (1) The Placement of AoRTic TraNscathetER Valve Trial Edwards SAPIEN Transcatheter Heart Valve (PARTNER) IB Trial compared TAVI (Edwards SAPIEN, Edwards Lifesciences Inc., Irvine, CA) to optimal medical therapy in patients at excessive surgical risk, and demonstrated an absolute mortality reduction of > 20% at 1-year, an effect that was maintained out to 5-year follow-up;[1] (2) The PARTNER 1A Trial compared TAVI (Edwards SAPIEN, Edwards Lifesciences Inc., Irvine, CA) and SAVR in patients at high operative risk, and found no significant differences in either clinical outcomes or valve function at five years;[2] (3) The CoreValve (CoreValve, Medtronic Inc., Minneapolis, MN) U.S. Pivotal Trial compared TAVI and SAVR, and demonstrated significantly reduced mortality among patients treated percutaneously (22.2%), compared to those treated with SAVR (28.6%; log-rank test $P < 0.05$) at two years.[3] These strong data have resulted in TAVI being used in hundreds of thousands of patients worldwide,[4] and incorporated into the guidelines for the management of valvular heart disease from both the European Society of Cardiology and the American Heart Association / American College of Cardiology.[5,6]

The excellent aforementioned clinical results were achieved with first generation TAVI devices, which were far from perfect. Important limitations of first generation transcatheter heart valves (THV) included, the requirement for large bore vascular access sheaths (18–24 Fr), the inability to recapture or reposition the device in case of a suboptimal implant position, a high requirement for permanent pacemaker post-implant, and the relative frequency of moderate aortic paravalvular leak.[7] Thankfully, THV technology has not stood still. Relentless device iteration has yielded impressive reductions in the size of the required delivery system: the Medtronic CoreValve Evolut R in-line sheath (Medtronic Inc., Minneapolis, MN) affords delivery of 23, 26, and 29 mm THVs via a 14 Fr system.[8] Such development has the potential to reduce the incidence of major vascular complications and increase the proportion of patients treated by transfemoral TAVI. Similarly, recapturable, repositionable, and retrievable (R^3) TAVI systems are widely available and add considerably to the safety of the procedure.[9–11] Such systems also allow the operator to attempt more challenging anatomy, safe in the knowledge that the system can be removed in case of a suboptimal result.

Post-implantation paravalvular leak (PVL) of moderate grade has also been identified as a significant predictor of adverse outcome.[12] The aetiology of PVL is multifactorial, and has been attributed to suboptimal positioning (THV too low or high), insufficient oversizing of the valve relative to the surrounding anatomy, and incomplete apposition to the contact surface (annulus and leaflets) due to recalcitrant calcific deposits. First generation TAVI devices reported ≥ moderate PVL in up to 20% of cases.[13] The introduction of multislice computed tomography (MSCT) for THV sizing was the first important step towards reducing PVL.[14] Repositionable TAVI systems and the more recent introduction of sealing skirts/cuffs/membranes have further reduced the incidence of PVL in contemporary practice to approxi-

[*]**Correspondence to:** t1modine@yahoo.fr

mately 3%.[15–18]

The requirement for permanent pacemaker remains an Achilles heel for TAVI. Anchoring the THV and sealing to prevent PVL require radial force to be exerted on the surrounding tissues. Such forces can directly or indirectly injure the atrioventricular node or the left bundle branch, due to their close association with the aortic valve annulus. The rates of new pacemaker and left bundle branch block (LBBB) are prosthesis dependent, and are described in up to 29% of patients.[19] Importantly, the requirement for new pacemaker or the development of LBBB has not been associated with adverse long-term clinical outcomes, and may even provide some protection from sudden death in those with pre-existing right bundle branch block.[20,21] With accumulating experience, there appears to be a less liberal use of adjunct pacing: up to 60% of patients with high-degree AV block in the early post-implant period, recover normal AV conduction within six months.[22] Most importantly, it has been recognized that the depth of the THV implant within the left ventricular outflow tract (LVOT) is a strong independent predictor of disturbance.[23] Hence, clinicians tend to implant the prosthesis higher in the LVOT and there are on the horizon novel imaging platforms that have the potential to reduce implant depth and reduce PPM rates.[24]

Given the rapid evolution of THV technology, it is not surprising that clinicians have continued to apply the technology to younger and lower-risk patients. The Nordic Aortic Valve Intervention (NOTION) Trial randomized 280 all-comer patients > 70 years old to TAVI or SAVR, and found no difference in the composite primary endpoint of death from any cause, stroke, or myocardial infarction at one year.[25] Two further randomized trials are comparing TAVI to SAVR in intermediate-risk patients (SURTAVI: NCT01586910; PARTNER II: NCT01314313). Although there is currently a paucity of randomized data definitively confirming efficacy in these patients, there is an ever-accumulating non-randomized evidence-base for this indication expansion.[26,27] TAVI technology has also been successfully expanded to a variety of other clinical situations, including treatment of degenerative surgical aortic and mitral prostheses,[28] bicuspid aortic valve stenosis,[29] and pure aortic incompetence.[30]

Foremost among the final hurdles for the widespread application to all patients with aortic stenosis, is the demonstration of long-term durability. A variety of THV valve failure modes have been described, including those similar to surgical bioprosthetic failure, and novel failure methods unique to THVs.[31] To date, significant durability concerns have not arisen: in the PARTNER 1 trials, there were no reported cases of THV failure at five years.[2] Indeed, the longest available follow-up of a THV now stands at 10 years, and reveals no evidence of valve dysfunction![31] One subject of considerable interest in the TAVI field is the recent description of bioprosthetic leaflet thrombosis using 4D-MSCT.[32] It appears that leaflet thrombosis occurs in all bioprosthetic valves (surgical and transcatheter), but the incidence may be valve specific. Crucially, the reduced leaflet motion was not associated with thromboembolic events and resolved following a short period of oral anticoagulation.

Ultimately, the further expansion of TAVI technology to lower risk patients and "off-label" indications is inevitable. Accumulating observation evidence supports such expansion, however the continued demonstration of equivalent clinical outcomes to SAVR in younger patients and long-term valve durability in randomized controlled trials is essential.

Acknowledgement

Dr. Mylotte: Proctor and Consultant for Medtronic and Microport; Dr. Sharif: None; Dr. Piazza: Proctor and Consultant for Medtronic and Microport; Dr. Modine: Proctor and Consultant for Medtronic, Boston Scientific and Microport.

References

1 Kapadia SR, Leon MB, Makkar RR, *et al*. 5-year outcomes of transcatheter aortic valve replacement compared with standard treatment for patients with inoperable aortic stenosis (PARTNER 1): a randomised controlled trial. *Lancet* 2015; 385: 2485–2491.

2 Mack MJ, Leon MB, Smith CR, *et al*. 5-year outcomes of transcatheter aortic valve replacement or surgical aortic valve replacement for high surgical risk patients with aortic stenosis (PARTNER 1): a randomised controlled trial. *Lancet* 2015; 385: 2477–2484.

3 Reardon MJ, Adams DH, Kleiman NS, *et al*. 2-Year outcomes in patients undergoing surgical or self-expanding transcatheter aortic valve replacement. *J Am Coll Cardiol* 2015; 66: 113–121.

4 Mylotte D, Osnabrugge RL, Windecker S, *et al*. Transcatheter aortic valve replacement in Europe: adoption trends and factors influencing device utilization. *J Am Coll Cardiol* 2013; 62: 210–219.

5 Nishimura RA, Otto CM, Bonow RO, *et al*. 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Thorac Cardiovasc Surg* 2014; 148: e1–e132.

6 Vahanian A, Alfieri O, Andreotti F, *et al*. Guidelines on the

management of valvular heart disease (version 2012). *Eur Heart J* 2012; 33: 2451–2496.
7 Genereux P, Head SJ, Van Mieghem NM, *et al*. Clinical outcomes after transcatheter aortic valve replacement using valve academic research consortium definitions: a weighted meta-analysis of 3,519 patients from 16 studies. *J Am Coll Cardiol* 2012; 59: 2317–2326.
8 Piazza N, Martucci G, Lachapelle K, *et al*. First-in-human experience with the Medtronic CoreValve Evolut R. *EuroIntervention* 2014; 9: 1260–1263.
9 Manoharan G, Spence MS, Rodes-Cabau J, *et al*. St Jude Medical Portico valve. *EuroIntervention* 2012; 8 Suppl Q: Q97–Q101.
10 Meredith IT, Hood KL, Haratani N, *et al*. Boston scientific lotus valve. *EuroIntervention* 2012; 8 Suppl Q: Q70– Q74.
11 Bijuklic K, Tubler T, Low RI, *et al*. Direct flow medical valve. *EuroIntervention* 2012; 8 Suppl Q: Q75–Q78.
12 Kodali SK, Williams MR, Smith CR, *et al*. Two-year outcomes after transcatheter or surgical aortic-valve replacement. *N Engl J Med* 2012; 366: 1686–1695.
13 Gilard M, Eltchaninoff H, Iung B, *et al*. Registry of transcatheter aortic-valve implantation in high-risk patients. *N Engl J Med* 2012; 366: 1705–1715.
14 Mylotte D, Dorfmeister M, Elhmidi Y, *et al*. Erroneous measurement of the aortic annular diameter using 2-dimensional echocardiography resulting in inappropriate corevalve size selection: a retrospective comparison with multislice computed tomography. *JACC Cardiovasc Interv* 2014; 7: 652–661.
15 Binder RK, Rodes-Cabau J, Wood DA, *et al*. Transcatheter aortic valve replacement with the SAPIEN 3: a new balloon-expandable transcatheter heart valve. *JACC Cardiovasc Interv* 2013; 6: 293–300.
16 Manoharan G, Walton AS, Brecker SJ, *et al*. Treatment of symptomatic severe aortic stenosis with a novel resheathable supra-annular self-expanding transcatheter aortic valve system. *JACC Cardiovasc Interv* 2015; 8: 1359–1367.
17 Meredith Am IT, Walters DL, Dumonteil N, *et al*. Transcatheter aortic valve replacement for severe symptomatic aortic stenosis using a repositionable valve system: 30-day primary endpoint results from the REPRISE II study. *J Am Coll Cardiol* 2014; 64: 1339–1348.
18 Schofer J, Colombo A, Klugmann S, *et al*. Prospective multicenter evaluation of the direct flow medical transcatheter aortic valve. *J Am Coll Cardiol* 2014; 63: 763–768.
19 Siontis GC, Juni P, Pilgrim T, *et al*. Predictors of permanent pacemaker implantation in patients with severe aortic stenosis undergoing TAVR: a meta-analysis. *J Am Coll Cardiol* 2014; 64: 129–140.
20 Nazif TM, Williams MR, Hahn RT, *et al*. Clinical implications of new-onset left bundle branch block after transcatheter aortic valve replacement: analysis of the PARTNER experience. *Eur Heart J* 2014; 35: 1599–1607.
21 Houthuizen P, Van Garsse LA, Poels TT, *et al*. Left bundle-branch block induced by transcatheter aortic valve implantation increases risk of death. *Circulation* 2012; 126: 720–728.
22 Guetta V, Goldenberg G, Segev A, *et al*. Predictors and course of high-degree atrioventricular block after transcatheter aortic valve implantation using the CoreValve Revalving System. *Am J Cardiol* 2011; 108: 1600–1605.
23 Piazza N, Onuma Y, Jesserun E, *et al*. Early and persistent intraventricular conduction abnormalities and requirements for pacemaking after percutaneous replacement of the aortic valve. *JACC Cardiovasc Interv* 2008; 1: 310–316.
24 Piazza N. *Obtaining the correct depth of implant using the FluoroCT Double S curve*. In: PCR London Valves. Berlin, 2015.
25 Thyregod HG, Steinbruchel DA, Ihlemann N, *et al*. Transcatheter versus aurgical 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: 2184–2194.
26 Cribier A, Durand E, Eltchaninoff H. Patient selection for TAVI in 2014: is it justified to treat low- or intermediate-risk patients? The cardiologist's view. *EuroIntervention* 2014; 10 Suppl U: U16–U21.
27 Piazza N, Kalesan B, van Mieghem N, *et al*. A 3-center comparison of 1-year mortality outcomes between transcatheter aortic valve implantation and surgical aortic valve replacement on the basis of propensity score matching among intermediate-risk surgical patients. *JACC Cardiovasc Interv* 2013; 6: 443–451.
28 Dvir D, Webb JG, Bleiziffer S, *et al*. Transcatheter aortic valve implantation in failed bioprosthetic surgical valves. *Jama* 2014; 312: 162–170.
29 Mylotte D, Lefevre T, Sondergaard L, *et al*. Transcatheter aortic valve replacement in bicuspid aortic valve disease. *J Am Coll Cardiol* 2014; 64: 2330–2339.
30 Roy DA, Schaefer U, Guetta V, *et al*. Transcatheter aortic valve implantation for pure severe native aortic valve regurgitation. *J Am Coll Cardiol* 2013; 61: 1577–1584.
31 Mylotte D, Andalib A, Theriault-Lauzier P, *et al*. Transcatheter heart valve failure: a systematic review. *Eur Heart J* 2015; 36: 1306–1327.
32 Makkar RR, Fontana G, Jilaihawi H, *et al*. Possible subclinical leaflet thrombosis in bioprosthetic aortic valves. *N Engl J Med* 2015; 373: 2015–2024.