Editorial

Delayed Coronary Obstruction After Transcatheter Aortic Valve Implantation is not the Structural Equivalent of Late Stent Thrombosis After Percutaneous Coronary Intervention

Simon Kennon

*Barts Heart Centre, St Bartholomew's Hospital, London, UK; Editor-in-Chief, Interventional Cardiology Review***Citation:** *Interventional Cardiology Review* 2018;13(2):60–1. DOI: <https://doi.org/10.15420/icr.2018.12:1>**Correspondence:** Simon Kennon, Barts Heart Centre, St Bartholomew's Hospital, West Smithfield, London, EC1A 7BE, UK. E: simon.kennon@bartshealth.nhs.uk

Reports of late stent thrombosis following percutaneous coronary intervention (PCI) with drug-eluting stents started to emerge in 2005 and 2006, causing widespread alarm and a substantial reduction in their use.^{1,2} Research-led advances in pharmacology and stent design have done much to allay this alarm, but nevertheless late stent thrombosis (LST) remains a concern for coronary interventionists and a focus for ongoing research.

Until recently, delayed coronary obstruction (DCO) following transcatheter aortic valve implantation (TAVI) was the subject of occasional case reports,^{3–8} but following publication of data from a large registry,⁹ there are now concerns that DCO may be the structural equivalent of late stent thrombosis.

Are these concerns justified? Certainly DCO, like late stent thrombosis, has a high mortality. In 2005, Iakovou et al. documented an incidence of LST of 1.3 % at 9 months with a mortality of 45 %.¹ The recently published paper by Jabbour et al. documents 38 patients presenting with DCO out of a total of 17,092 TAVI procedures, an incidence of 0.22 %, with a mortality of 50 %.⁹ This though, by and large, is where the similarities end.

The British Cardiovascular Intervention Society annual audit (www.bcis.org.uk) documented 70,142 PCI procedures undertaken in the UK in 2005, in the absence of any evidence at the time that PCI conferred a mortality benefit. In 2016 (the most recent year for which data are available), 100,483 procedures were undertaken: 26.1 % of which were for STEMI for which there is clear evidence of benefit;¹⁰ 37.8 % for NSTEMI where evidence is more mixed;¹¹ and 32.7 % for stable coronary artery disease for which there is no evidence of mortality benefit.¹²

In 2016, the largest UK centre carried out 3,600 PCI procedures; in contrast, in the same year, 3,250 TAVI procedures were undertaken across the UK, supported by randomised controlled trial data demonstrating mortality benefit for TAVI compared with conservative and surgical treatment for high- and intermediate-risk patients.^{13–15} TAVI is undertaken less commonly in the UK than other developed countries, but it is clear the number of PCI procedures being

undertaken is an order of magnitude larger than TAVI procedures. Thus, late stent thrombosis is a complication of a commonly undertaken procedure for which, in many cases, there is no evidence of mortality benefit, whereas TAVI is undertaken relatively rarely and in the context of clear evidence of prognostic benefit.

In addition, late stent thrombosis occurs more commonly in patients with diabetes, renal failure and impaired left ventricular function, and is more common following premature discontinuation of antiplatelet therapy and intervention to bifurcation lesions.¹ In the recently published registry by Jabbour et al., however, the 38 cases of DCO occurred more commonly in valve-in-valve procedures (6 out of 9 were Mitroflow prosthetic valves [Sorin Group]) and in those using self-expanding devices. There was <3mm difference between sinus of Valsalva diameter and device diameter in 59.3 % of cases; the left main stem was protected with guide wires in 23.7 % (n=9) of cases; and severe aortic regurgitation necessitated deployment of a second valve in two cases. Thus, predictors of late stent thrombosis are common in patients undergoing PCI, whereas DCO seems to occur in more circumscribed and largely structural or anatomical subgroups.

It is clear therefore that DCO does not reflect a fundamental problem with TAVI. It does, however, join a list of adverse events that occur more commonly after TAVI than aortic valve replacement surgery (AVR), the others being paravalvular aortic regurgitation, the need for permanent pacemaker implantation, annular rupture, prosthetic valve thrombosis, and cerebral embolism.^{13–16} These may be partly a reflection of the demographic and clinical profiles of patients who undergo TAVI, and advances in technology – valve design, pharmacology, cerebral protection – are steadily reducing their incidence,^{17,18} but they are nonetheless factors that need to be considered, particularly in intermediate-risk patients.

That said, late stenosis of coronary ostia has been noted following AVR, although its incidence is not well defined.^{19,20} Other disadvantages of AVR compared to TAVI include smaller prosthetic valve areas, the requirement for cardiopulmonary bypass in all patients, for sternotomy in most cases and substantially longer intensive therapy unit stay, in-patient stay and recovery period in almost all cases.^{13–15,17}

In conclusion, the paper by Jabbour et al. confirms the need for vigilance not alarm. Advances in pharmacology and valve design will reduce the incidence of all complications of both TAVI and AVR.

In the meantime, the decision to proceed with transcatheter or surgical aortic valve intervention should take into account the relative merits of both procedures. ■

1. Iakovou I, Schmidt T, Bonizzi E, et al. Incidence, predictors, and outcome of thrombosis after successful implantation of drug-eluting stents. *JAMA* 2005;**293**:2126–30. <https://doi.org/10.1001/jama.293.17.2126>; PMID: 15870416.
2. Pfisterer M, Brunner-La Rocca HP, Buser PT, et al. Late clinical events after clopidogrel discontinuation may limit the benefit of drug-eluting stents: an observational study of drug-eluting versus bare-metal stents. *J Am Coll Cardiol* 2006;**48**:2584–91. <https://doi.org/10.1016/j.jacc.2006.10.026>; PMID: 17174201.
3. Durmaz T, Ayhan H, Keles T, et al. Left main coronary artery obstruction by dislodged native-valve calculus after transcatheter aortic valve replacement. *Tex Heart Inst J* 2014;**41**:414–7. <https://doi.org/10.14503/THIJ-13-3410>; PMID: 25120396.
4. Giustino G, Montorfano M, Chieffo A, et al. Tardive coronary obstruction by a native leaflet after transcatheter aortic valve replacement in a patient with heavily calcified aortic valve stenosis. *J Am Coll Cardiol Interv* 2014;**7**:e105–7. <https://doi.org/10.1016/j.jcin.2014.01.173>; PMID: 25147045.
5. Jategaonkar SR, Dimitriadis Z, Hakim-Meibodi K, et al. Delayed coronary ischemia after transfemoral aortic valve implantation. *J Heart Valve Dis* 2013;**22**:762–6. PMID: 24597395.
6. Freixa X, Bonan R, Asgar AW. Unusual coronary occlusion post transcatheter aortic implantation: the importance of clinical assessment. *Can J Cardiol* 2013;**29**:1014.e5–6. <https://doi.org/10.1016/j.cjca.2012.09.018>; PMID: 23265096.
7. Kukucka M, Pasic M, Dreyse S, Hetzer R. Delayed subtotal coronary obstruction after transapical aortic valve implantation. *Interact Cardiovasc Thorac Surg* 2011;**12**:57–60. <https://doi.org/10.1510/icvts.2010.252866>; PMID: 21098421.
8. Neuss M, Kaneko H, Tambor G, et al. Fatal thrombotic occlusion of left main trunk due to huge thrombus on prosthetic aortic valve after transcatheter aortic valve replacement. *J Am Coll Cardiol Interv* 2016;**9**:2257–8. <https://doi.org/10.1016/j.jcin.2016.08.027>; PMID: 27744041.
9. Jabbour RJ, Tanaka A, Finkelstein A, et al. Delayed coronary obstruction after transcatheter aortic valve replacement. *J Am Coll Cardiol* 2018;**71**:1513–24. <https://doi.org/10.1016/j.jacc.2018.01.066>; PMID: 29622157.
10. Schömig A, Kastrati A, Dirschinger J, et al. Coronary stenting plus platelet glycoprotein IIb/IIIa blockade compared with tissue plasminogen activator in acute myocardial infarction. Stent versus Thrombolysis for Occluded Coronary Arteries in Patients with Acute Myocardial Infarction Study Investigators. *N Engl J Med* 2000;**343**:385–91. <https://doi.org/10.1056/NEJM200008103430602>; PMID: 10933737.
11. Wallentin L, Lindhagen L, Årnström E, et al. Early invasive versus non-invasive treatment in patients with non-ST-elevation acute coronary syndrome (FRISC-II): 15 year follow-up of a prospective, randomised, multicentre study. *Lancet* 2016;**388**:1903–11. [https://doi.org/10.1016/S0140-6736\(16\)31276-4](https://doi.org/10.1016/S0140-6736(16)31276-4); PMID: 27585757.
12. Boden W, O'Rourke A, Teo K, et al. Optimal medical therapy with or without PCI for stable coronary disease. *N Engl J Med* 2007;**356**:1503–16. <https://doi.org/10.1056/NEJMoa070829>; PMID: 17387127.
13. Leon MB, Smith CR, Mack M, et al. Transcatheter aortic-valve implantation for aortic stenosis in patients who cannot undergo surgery. *N Engl J Med* 2010;**363**:1597–607. <https://doi.org/10.1056/NEJMoa1008232>; PMID: 20961243.
14. Leon MB, Smith CR, Mack MJ, et al. Transcatheter or surgical aortic-valve replacement in intermediate-risk patients. *N Engl J Med* 2016;**374**:1609–20. <https://doi.org/10.1056/NEJMoa1514616>; PMID: 27040324.
15. Adams DH, Popma JJ, Reardon MJ. Transcatheter aortic-valve replacement with a self-expanding prosthesis. *N Engl J Med* 2014;**370**:1790–8. <https://doi.org/10.1056/NEJMoa1400590>; PMID: 24678937.
16. Rodés-Cabau J, Dumont E, Boone RH, et al. Cerebral embolism following transcatheter aortic valve implantation: comparison of transfemoral and transapical approaches. *J Am Coll Cardiol* 2011;**57**:18–28. <https://doi.org/10.1016/j.jacc.2010.07.036>; PMID: 21185496.
17. Thourani VH, Kodali S, Makkar RR, et al. Transcatheter aortic valve replacement versus surgical valve replacement in intermediate-risk patients: a propensity score analysis. *Lancet*. 2016;**387**:2218–25. [https://doi.org/10.1016/S0140-6736\(16\)30073-3](https://doi.org/10.1016/S0140-6736(16)30073-3); PMID: 27053442.
18. Haussig S, Mangner N, Dwyer MG, et al. Effect of a cerebral protection device on brain lesions following transcatheter aortic valve implantation in patients with severe aortic stenosis: the CLEAN-TAVI randomized clinical trial. *JAMA* 2016;**316**:592–601. doi: 10.1001/jama.2016.10302. <https://doi.org/10.1001/jama.2016.10302>; PMID: 27532914.
19. Yates JD, Kirsh MM, Sodeman TM, et al. Coronary ostial stenosis: a complication of aortic valve replacement. *Circulation* 1974;**49**:530–4. <https://doi.org/10.1161/01.CIR.49.3.530>; PMID: 4544298.
20. Pillai JB, Pillay TM, Ahmad J. Coronary ostial stenosis after aortic valve replacement, revisited. *Ann Thorac Surg* 2004;**78**:2169–71. [https://doi.org/10.1016/S0003-4975\(03\)01536-4](https://doi.org/10.1016/S0003-4975(03)01536-4); PMID: 15561065.