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EDITORIAL

Coronary Angiography Challenges After Transcatheter Aortic Valve Replacement-in-Transcatheter Aortic Valve Replacement

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The recent US Food and Drug Administration approval of several transcatheter heart valves for low surgical risk patients with severe aortic valve stenosis has made transcatheter aortic valve replacement (TAVR) the preferred treatment for most individuals with this condition. There will continue to be some patients with severe aortic stenosis in whom surgical valve replacement is preferred, such as those with multivessel coronary artery disease not amenable to complete revascularization with percutaneous coronary intervention and those with an aortic aneurysm or aortic root anatomy not suitable for TAVR. However, for the vast majority, TAVR is rapidly becoming the preferred procedure. As eligibility for TAVR has expanded, the number of such procedures in the United States has continued to increase from 4666 in 2012 to 63 361 in 2018.[1]

See Article by Nai Fovino et al.

As TAVR indications have expanded into lower-risk younger patients with longer life expectancy, there will be an increasing necessity for coronary angiography and percutaneous coronary intervention in patients after TAVR because of the progression of coronary artery disease and development of acute coronary syndrome.[2] While overall complications with TAVR have significantly decreased over time, challenges with coronary access following "successful" TAVR remain a problem in the contemporary era.[3] Specifically, coronary angiography—and consequently percutaneous coronary intervention—may be hampered by the displaced leaflets of the native aortic valve, the metallic frame or leaflets of the transcatheter heart valve, and the commissural suture posts of the transcatheter heart valve.[4] One real-world study of patients treated with either Evolut R or Evolut PRO valves or with SAPIEN 3 valves reported that coronary intubation may be challenging in a significant proportion (ie, up to 35%) of patients after TAVR using these valves.[5] Another study of 200 subjects with symptomatic severe aortic stenosis who underwent TAVR using commercially available transcatheter heart valves demonstrated challenges to future coronary intubation and aortic valve reintervention in 9% to 13% of low-risk patients.[6] One strategy that has been proposed to prevent coronary obstruction during TAVR is the BASILICA (Bioprosthetic or Native Aortic Scallop Intentional Laceration to Prevent Iatrogenic Coronary Artery Obstruction During TAVR) approach,[7] a transcatheter technique that slices or perforates the target aortic valve leaflet to prevent coronary obstruction. A pilot study reported that BASILICA was feasible in both native and bioprosthetic valves,[7] but additional larger prospective studies are needed to further assess its safety and efficacy.

If coronary access is made difficult or challenging after initial TAVR, the problem is compounded in patients

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undergoing redo TAVR. While TAVR-in-TAVR was initially performed mostly for acute management of suboptimal function of the bioprosthesis during the procedure, it is now increasingly being used electively for transcatheter prosthesis dysfunction months or years after valve implant.[8,9] The characteristics and the anatomical dimensions (inner diameter, height of leaflets, etc) of the pre-existing valve are of supreme importance for selecting the appropriate transcatheter heart valve and to safely perform a redo TAVR procedure. When the second transcatheter heart valve is implanted, the leaflets of the first prosthesis are typically displaced vertically, creating a cylindrical cage that may impair coronary cannulation and possibly coronary flow. One strategy that has been suggested to prevent blockage of the coronary artery is the insertion—but not deployment unless required—of a stent into the coronary artery at risk[10] that can then be deployed for abrupt ostial obstruction.

In this issue of the *Journal of the American Heart Association* (*JAHA*), Nai Fovino et al evaluated the potential risk of coronary access challenges after redo TAVR in 137 consecutive patients who underwent initial TAVR with various transcatheter heart valves.[11] The authors report that coronary angiography after redo TAVR may not be feasible in ≈30% of patients currently treated with TAVR. Furthermore, implantation of a supra-annular transcatheter heart valve initially, female sex, and small sinotubular junction dimensions were independent predictors of impaired coronary access after TAVR-in-TAVR. Inability to perform diagnostic angiography and percutaneous coronary intervention has significant implications in the future care of these individuals, and prospective strategies need to be developed to mitigate this problem. A key consideration is the type of valve implanted at the initial TAVR procedure. If the transcatheter heart valve's metallic frame is positioned above the sinotubular junction during the initial procedure, future TAVR-in-TAVR may be inadvisable, because the displaced leaflets of the original transcatheter heart valve may obstruct the coronary ostium, affecting flow to the coronary artery that arises from that sinus.[12] While a strategy of lower initial transcatheter heart valve implantation would increase feasibility of coronary angiography after redo-TAVR, this would likely result in higher rates of pacemaker implantation during initial valve placement.[13,14] Accordingly, a thoughtful careful risk–benefit analysis is indicated. At this time, implantation of an intra-annular (rather than supra-annular) transcatheter heart valve with a lower frame, low skirt or commissure height, and large open cells that are designed to align the transcatheter heart valves commissures with the native aortic valve commissures is preferable to accommodate future coronary access. Given the increasing use of TAVR in younger patients, new transcatheter heart valves should be designed to facilitate future coronary access in patients who may require redo TAVR.

ARTICLE INFORMATION

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Disclosures

None.

REFERENCES

1. Bavaria J. TAVR update: new insights and perspectives from the U.S. National STS/ACC TVT Registry. 2019.
2. Vilalta V, Asmarats L, Ferreira-Neto AN, Maes F, de Freitas Campos Guimaraes L, Couture T, Paradis JM, Mohammadi S, Dumont E, Kalavrouziotis D, et al. Incidence, clinical characteristics, and impact of acute coronary syndrome following transcatheter aortic valve replacement. *JACC Cardiovasc Interv*. 2018;11:2523–2533.
3. Panchal HB, Barry N, Bhatheja S, Albalbissi K, Mukherjee D, Paul T. Mortality and major adverse cardiovascular events after transcatheter aortic valve replacement using Edwards valve versus CoreValve: a meta-analysis. *Cardiovasc Revasc Med*. 2016;17:24–33.
4. Tang GHL, Zaid S, Ahmad H, Undemir C, Lansman SL. Transcatheter valve neo-commissural overlap with coronary orifices after transcatheter aortic valve replacement. *Circ Cardiovasc Interv*. 2018;11: e007263. DOI: 10.1161/CIRCINTERVENTIONS.118.007263.
5. Ochiai T, Chakravarty T, Yoon SH, Kaewkes D, Flint N, Patel V, Mahani S, Tiwana R, Sekhon N, Nakamura M, et al. Coronary access after tavr. *JACC Cardiovasc Interv*. 2020;13:693–705.
6. Rogers T, Greenspun BC, Weissman G, Torguson R, Craig P, Shults C, Gordon P, Ehsan A, Wilson SR, Goncalves J, et al. Feasibility of coronary access and aortic valve reintervention in low-risk TAVR patients. *JACC Cardiovasc Interv*. 2020;13:726–735.
7. Khan JM, Greenbaum AB, Babaliaros VC, Rogers T, Eng MH, Paone G, Leshnower BG, Reisman M, Satler L, Waksman R, et al. The BASILICA trial: prospective multicenter investigation of intentional leaflet laceration to prevent TAVR coronary obstruction. *JACC Cardiovasc Interv*. 2019;12:1240–1252.
8. Vrachatis DA, Vavuranakis M, Tsoukala S, Giotaki S, Papaioannou TG, Siasos G, Deftereos G, Giannopoulos G, Raisakis K, Tousoulis D, et al. TAVI: valve in valve. A new field for structuralists? Literature review. *Hellenic J Cardiol*. 2019;S1109–9666:30294–30295.
9. Landes U, Webb JG, De Backer O, Sondergaard L, Abdel-Wahab M, Crusius L, Kim WK, Hamm C, Buzzatti N, Montorfano M, et al. Repeat transcatheter aortic valve replacement for transcatheter prosthesis dysfunction. *J Am Coll Cardiol*. 2020;75:1882–1893.
10. Maggio S, Gambaro A, Scarsini R, Ribichini F. Preventive left main and right coronary artery stenting to avoid coronary ostia occlusion in high-risk stentless valve-in-valve transcatheter aortic valve implantation. *Interact Cardiovasc Thorac Surg*. 2017;25:147–149.
11. Nai Fovino L, Scotti A, Massussi M, Cardaioli F, Rodinò G, Matsuda Y, Pavei A, Masiero G, Napodano M, Fraccaro C, et al. Coronary angiography after transcatheter aortic valve replacement (TAVR) to evaluate the risk of coronary access impairment after TAVR-in-TAVR. *J Am Heart Assoc*. 2020;9:e016446. DOI: 10.1161/JAHA.120.016446.
12. Tang GHL, Zaid S, Gupta E, Ahmad H, Khan A, Kovacic JC, Lansman SL, Dangas GD, Sharma SK, Kini A. Feasibility of repeat TAVR after SAPIEN 3 TAVR: a novel classification scheme and pilot angiographic study. *JACC Cardiovasc Interv*. 2019;12:1290–1292.
13. Jilaihawi H, Zhao Z, Du R, Staniloae C, Saric M, Neuburger PJ, Querijero M, Vainrib A, Hisamoto K, Ibrahim H, et al. Minimizing permanent pacemaker following repositionable self-expanding transcatheter aortic valve replacement. *JACC Cardiovasc Interv*. 2019;12: 1796–1807.
14. Tarantini G, Mojoli M, Purita P, Napodano M, D'Onofrio A, Frigo A, Covolo E, Facchin M, Isabella G, Gerosa G, et al. Unravelling the (arte) fact of increased pacemaker rate with the Edwards SAPIEN 3 valve. *EuroIntervention*. 2015;11:343–350.