

EDITORIAL COMMENT

The Miraculous Journey of TAVR

Beware of Rare!*

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Transcatheter aortic valve replacement (TAVR) has followed a truly miraculous path since the first procedure in 2002: from a rescue option in inoperable and high-risk patients to a potent alternative to surgery across the full risk spectrum of aortic stenosis (1). The rise in the number of TAVR cases per annum has therefore been exponential.

With increasing exposure to and use of TAVR, procedural complications have been increasingly pertinent, including vascular complications, cerebrovascular events (stroke or transient ischemic attacks), paravalvular aortic regurgitation, and pacemaker implantation.

Along the way, we have learned how to recognize and mitigate these common early complications. The complication rates continue to decrease as the result of multiple factors, including accumulated operator experience, evolution of catheter-based technology, and pre-procedural application of advanced imaging methods for precise valve sizing (2). Improved investment in technology resulted in reduced introducer sheath dimensions, a wider range of valve sizes (allowing for better annular coverage), and different iterations of self-expanding or balloon-expandable and repositionable transcatheter heart valves (2).

Widespread adoption of TAVR has also served as an impetus for the refinement of “heart teams,” which consist of general and interventional cardiologists, surgeons, and imagers who work in concert to come

up with the optimal management plan for a particular patient.

Although the focus stays on common complications of TAVR, one should be aware of uncommon and rare complications requiring a multidisciplinary approach and time-sensitive intervention.

Device landing zone injury is an example of such complications. Device landing zone injury (also known as “annular rupture”) is a broad term describing the injuries in the area of ventriculo-aortic continuation. Based on the location, it has been traditionally divided into intra-annular, subannular, supra-annular, and combined subtypes (3). Detailed understanding of the anatomic relationships is essential for recognizing different injury types in this region. Ventriculo-aortic continuation has a complex anatomy: most proximally in the left ventricular outflow tract, the aortic leaflet forms a virtual “annulus” (which is neither circular nor in 1 plane), and most distally the leaflets ascend to the sinotubular junction. Interposed interleaflet triangles are in direct continuation with the left ventricular outflow and represent important anatomic landmarks. The triangle between left and noncoronary cusps extends to the anterior mitral leaflet forming the aortic-mitral continuity. The triangle between right and noncoronary cusps abuts the membranous septum. Finally, the triangle between right and left cusps is a muscular wall. Left and right sinuses of Valsalva give rise to coronary arteries (Figure 1).

Device landing zone injuries are uncommon but can be disastrous. Known risk factors include circular prosthesis oversizing (>20%) compared with an oval-shaped aortic annulus, native bicuspid aortic valve, significant annular calcification, and aggressive valve post-dilatation (4). Depending on the site and extent of the injury, the following complications can be seen: localized dissection, hematoma, pseudoaneurysm and/or contained rupture with and without

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compression effect (such as coronary compression), pericardial extension with tamponade, and fistulous connections between various chambers (4).

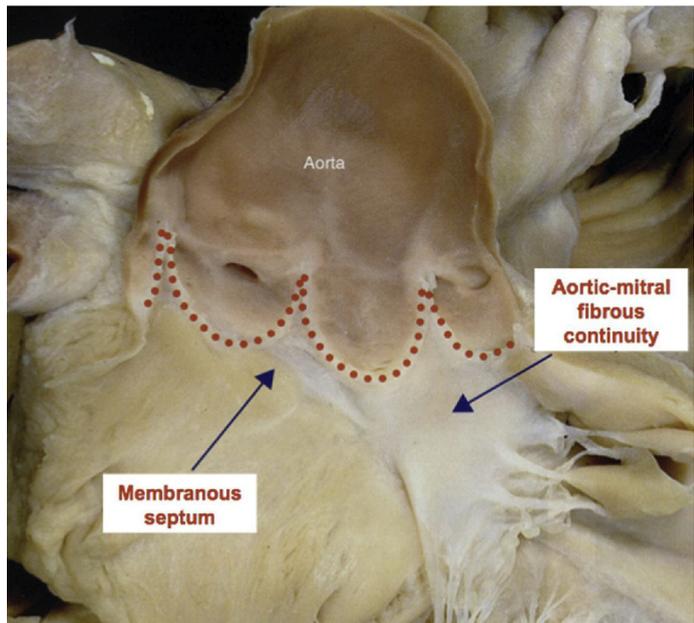
Fistulous connections may result in different abnormal flow patterns depending on the chambers involved. For example, a rupture of the interventricular septum would result in a high velocity left-to-right flow in systole. On the other hand, aortic-atrial or aortic-right ventricular communications would result in a high velocity continuous flow due to significant pressure differences both in systole and diastole. One multicenter registry described the incidence of intracardiac shunts following TAVR at 1.1% (4), including both infection-related and aseptic shunts. Aseptic shunts most commonly involved the interventricular septum. The presence of intracardiac shunt was associated with heart failure in the majority of patients with a high rate of in-hospital and 1-year mortality (4).

In this issue of *JACC: Case Reports*, Iesu et al. (5) present an uncommon case of aortic-left atrial fistulous connection following TAVR. The patient developed shortness of breath and hypotension 2 days after the procedure, prompting immediate transthoracic echocardiogram that showed an abnormal flow in the left atrium. Transesophageal echocardiography was diagnostic in identifying the fistulous connection. The patient underwent successful surgical repair requiring transcatheter valve removal, annular reconstruction, and a bioprosthetic valve implantation. This case highlights the importance of the multidisciplinary team in patient management not only before the procedure but also after the procedure, when certain complications require specific expertise and team collaboration.

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In conclusion, fistulous connections resulting in intracardiac shunts are uncommon but serious complications of TAVR. The multidisciplinary team framework allows early identification of this potential complication and discussion of different therapeutic strategies, from transcatheter closure

FIGURE 1 Anatomy of the Ventriculo-Aortic Continuation



Device landing zone injuries affecting this region are uncommon but can be disastrous. Modified with permission from Leon MB, Piazza N, Nikolsky E, et al. Standardized endpoint definitions for transcatheter aortic valve implantation clinical trials: a consensus report from the Valve Academic Research Consortium, *J Am Coll Cardiol* 2011;57:253-69.

to open surgical repair. With an exponential rise in the number of TAVR cases being performed annually and with a shift to a lower surgical-risk cohorts of patients, it is ever important to diagnose and potentially treat any unexpected complications.

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