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CASE REPORT

INTERMEDIATE

CLINICAL CASE: EUROPCR

Left Ventricular Outflow Obstruction After Transcatheter Heart Valve Migration and Stent Infolding

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ABSTRACT

Transcatheter aortic valve implantation is a guideline-recommended treatment for elderly patients with symptomatic severe aortic valve stenosis. Procedural safety is high, yet accidental valve malpositioning can occur. We report on a migrated transcatheter heart valve that convoluted on release from its delivery catheter. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2023;16:101893) © 2023 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

An 86-year-old man experiencing progressive dyspnea (NYHA functional class IV), angina (Canadian Cardiovascular Society score for angina 3), and syncope secondary to critical aortic stenosis was referred as an outpatient to our center for consideration of transcatheter aortic valve replacement (TAVR). He was at high operative risk with an STS-PROM (Society of Thoracic Surgeons-Predicted Risk of Operative Mortality) score of 8.16%.

LEARNING OBJECTIVES

- To understand the mechanism of stent frame infolding on THV release.
- To understand bail-out techniques of stent frame infolding.

PAST MEDICAL CARDIAC HISTORY

His cardiac history included a <70% stenotic lesion in the left anterior descending artery and a recent pacemaker insertion for complete heart block.

INVESTIGATIONS

The preprocedural transthoracic echocardiography showed a nondilated left ventricle (LV) with preserved systolic function and critical aortic valve stenosis (Vmax 5.44 m/s, mean gradient 77 mm Hg) (**Figure 1**). Computed tomography revealed an Agatston score of 6,131 HU, annulus area of 545 mm^3, significant calcification of left ventricular outflow tract (LVOT) with membranous septum length of 3.6 mm (**Figure 2**).

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

LV = left ventricle

LVOT = left ventricular outflow tract

TAVR = transcatheter aortic valve replacement

THV = transcatheter heart valve

MANAGEMENT

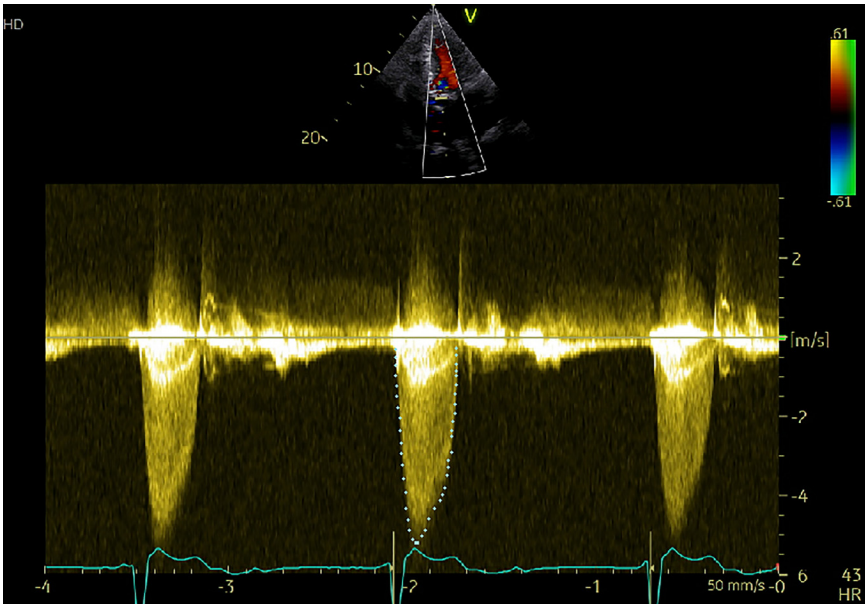
The procedure was performed under local anesthesia, with filter-based cerebral embolic protection. A single access site was chosen using a 14-F sheath in the right common femoral artery and a 6-F sheath for a pigtail in the ipsilateral superficial femoral artery. After balloon dilatation with a 22-mm balloon, an ACURATE neo2 (Boston Scientific) large transcatheter heart valve (THV) (hereafter THV 1) was deployed over a preshaped wire.

During deployment, the self-expanding THV 1 migrated toward the LVOT. On complete deployment, the delivery system could not be detached from the valve frame. A sequence of maneuvers including push-pull manipulation of the SAFARI^2 wire (Boston Scientific) and gentle rotation and pull on the delivery catheter eventually resulted in a brisk release of the delivery catheter and wire into the aortic arch. This coincided with an invagination of the valve frame that now partially obstructed the LVOT (Video 1, **Figure 3C**). The patient became hemodynamically unstable and required intermittent vasopressor support. The infolded frame was successfully recrossed with a 0.035-inch straight wire, confirmed fluoroscopically, which was then exchanged for a preshaped wire. The frame could be re-expanded with a 22-mm balloon and remained stable in the LVOT with its stabilizing arches protruding across the aortic valve into the sinuses of Valsalva (**Figure 4**). A 26-mm SAPIEN 3 Ultra (Edwards) THV (hereafter THV 2) was then deployed at the level of the native annulus locking the migrated THV 1 in place. The residual mean gradient across the aortic valve was 10 mm Hg with no aortic regurgitation (**Figure 5**). Multiple calcific debris particles were collected in the cerebral protection filters (**Figure 6**). Large bore arteriotomy closure was achieved with an 18-F system.

FOLLOW-UP

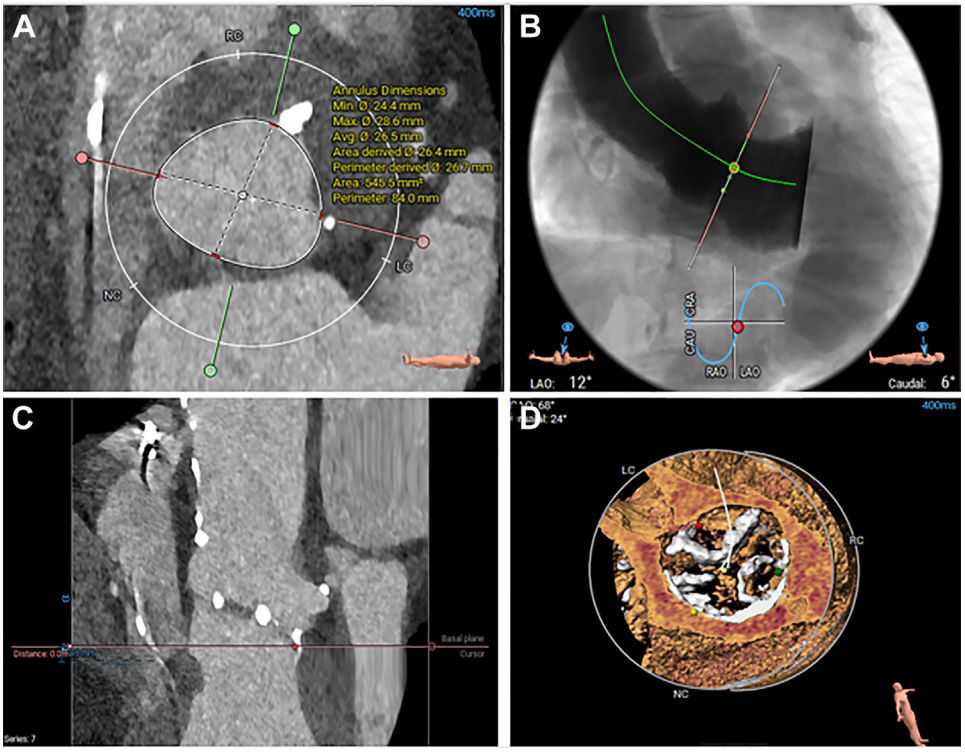
Transthoracic echocardiography confirmed an overall good bioprosthetic valve performance predischarge on day 3 (**Figure 7**). Furthermore, echocardiography showed trace mitral regurgitation, which indicates

FIGURE 1 Continuous Doppler on Native Aortic Valve



Continuous Doppler shows an aortic valve max of 5.44 m/s.

FIGURE 2 **Multidetector Computed Tomography Images of the Native Aortic Valve**



(A) Measurement of aortic annulus for cross-sectional area and perimeter in end systole. **(B)** Three-cusp coplanar view. **(C)** Stretched vessel image, infra-annular membranous septum length 3.6 mm. **(D)** 3-dimensional reconstructions of valve.

there was no iatrogenic injury to the mitral valve apparatus.

Multidetector computed tomography images confirmed the deep positioning of THV 1 in the LVOT and the properly positioned THV 2 leaflets at the aortic annular level without coronary impediment (**Figure 8**).

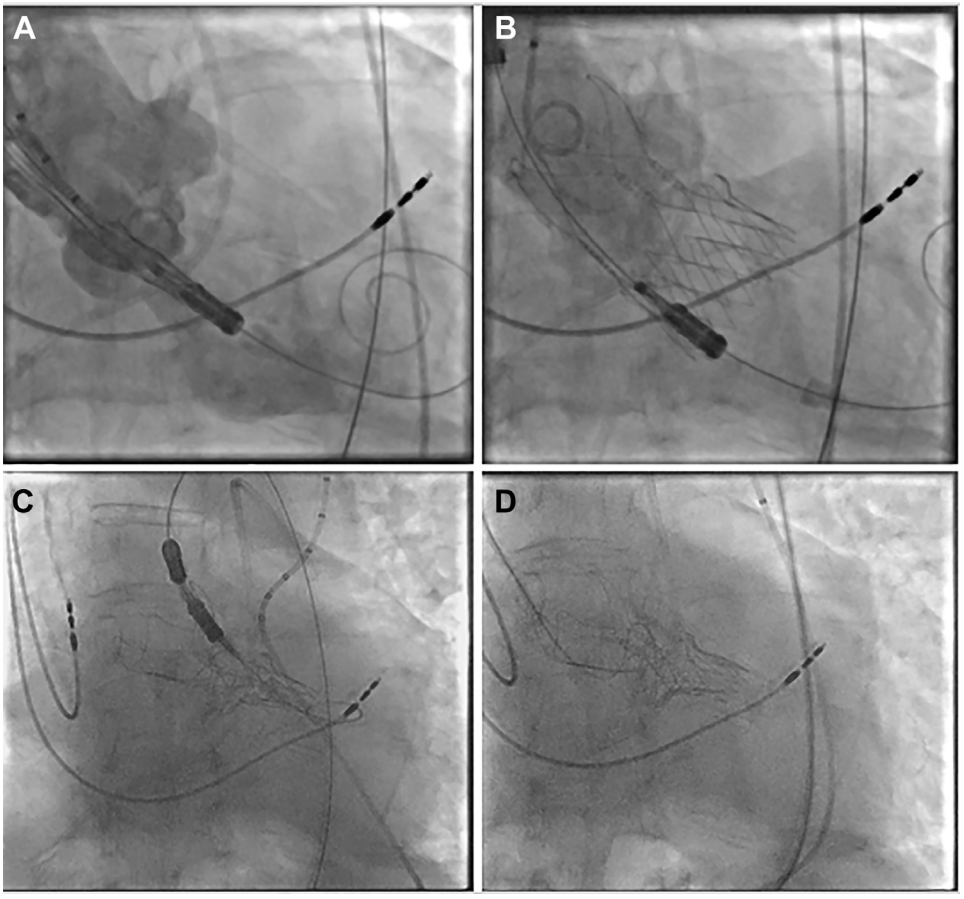
At the 30-day outpatient clinic visit, the patient mentioned marked improvement of his symptoms with increased exercise tolerance and improved quality of life.

DISCUSSION

TAVR has matured into a safe treatment for elderly patients with symptomatic severe aortic valve stenosis.[1] Transcatheter valve migration is a rare event and may require revalving or surgery.[2,3] Inappropriate sizing, lack of calcium, ventricular ectopy, extreme aorta take-off, or inability to visualize the landing zone may predispose to transcatheter migration or embolization. A recent cohort study identified too low positioning as the main reason for revalving.[3]

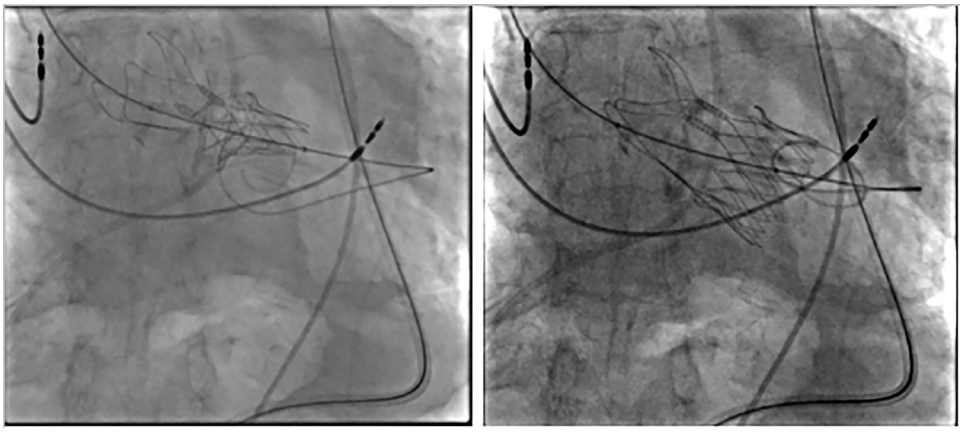
In our case, THV 1 migrated during deployment, which interrupted the forward pressure that is typically recommended during deployment. Because of inadequate forward pressure on the delivery catheter during deployment, the radio-opaque marker on the delivery system did not propel into the LV as it usually should do on final THV release. In fact, this radio-opaque marker moved upward (rather than downward toward the LV), indicating that the capsule was moving toward the ascending aorta (and not into the LV), subsequently wrapping itself around a distal pillar of the frame. The deeply implanted THV did not interact with the mitral valve apparatus. In the matter of mitral valve interference, cardiac surgery would be contingent on clinical picture and operation risk.

FIGURE 3 Aortograms of THV 1 Deployment



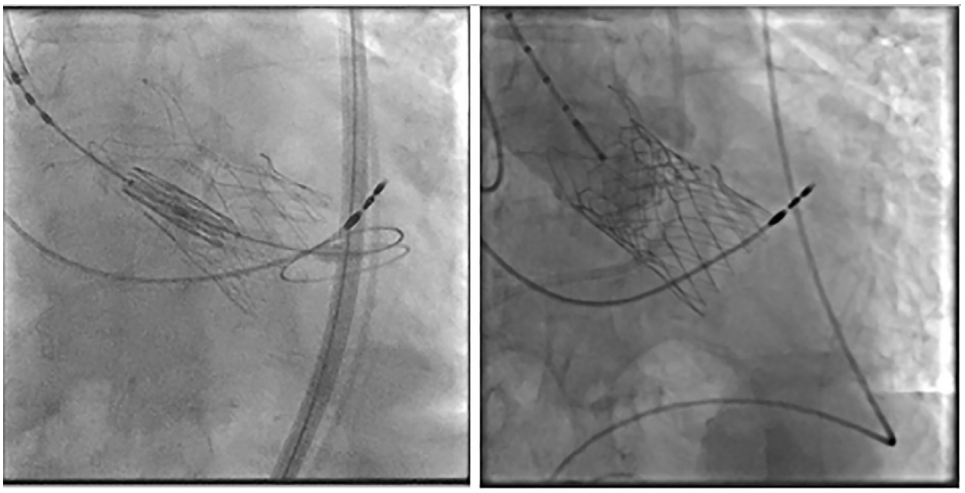
(A) ACURATE neo2 large transcatheter heart valve (THV 1) valve shown not deployed. **(B)** Complete deployment of valve. **(C and D)** Deformed valve on retraction of delivery system.

FIGURE 4 Aortogram of Wire Crossing and Re-expansion



(Left) Wire crossing the deformed valve and **(right)** re-expansion of valve after balloon dilatation.

FIGURE 5 Aortogram of Deployment and Expansion of THV 2



(Left) The 26-mm SAPIEN 3 Ultra THV (THV 2) not deployed and **(right)** fully expanded THV 2 in THV 1. Abbreviation as in Figure 3.

A benchtop simulation of this event is demonstrated in Video 2. By subsequent pulling on the delivery catheter, the nitinol frame convoluted but could be easily redeployed to its spherical format by balloon valvuloplasty. Maintaining forward motion on the delivery catheter during the entire deployment process may have prevented this release malfunctioning. To our knowledge, this is the first report of such phenomenon in vivo. Techniques to consider in this situation are: 1) to attempt to pass a wire through the transcatheter valve as it remains connected to the delivery catheter and perform an undersized valvuloplasty to help it disengage from the delivery catheter; and 2) ensuring knob 2 is fully opened, application of careful forward push with centralization of nose cone by gentle pull on SAFARI[2] wire, and ensuring closure of knob 1 to deflect inner catheter and lift the stent holder off the valve, weighing the risk of further device migration into the LV.

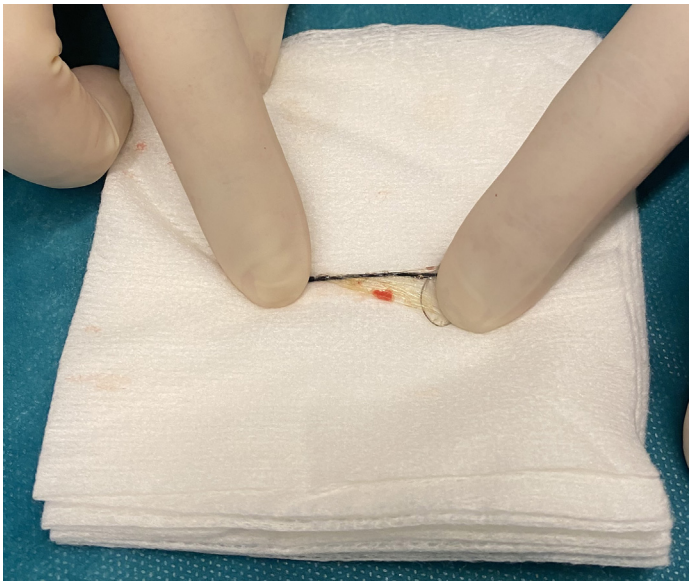
CONCLUSIONS

Transcatheter valve migration and frame infolding is a rare life-threatening complication of TAVR that can be solved by rewiring and revalving.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

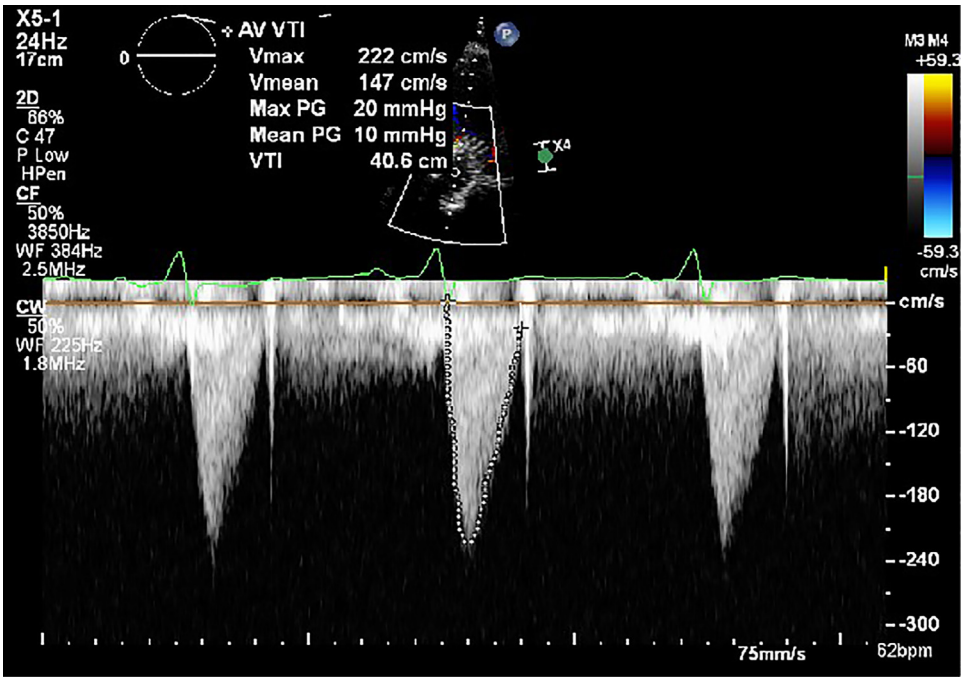
Dr van den Enden has received personal fees from Abiomed and speaker fees from AngioDynamics. Dr Daemen has received institutional grant/research support from AstraZeneca, Abbott Vascular, Boston Scientific, ACIST Medical, Medtronic, Microport, Pie Medical, and ReCor Medical; and consulting and speaker fees from Abbott Vascular, Abiomed, ACIST Medical, Boston Scientific, Cardialysis BV, CardiacBooster, Kaminari Medical, ReCor Medical, PulseCath BV, Pie Medical, Sanofi, Siemens Health Care, and Medtronic. Dr Van Mieghem has received grant funding from or has contracts with Abbott, Boston Scientific, Biotronik, Edwards Lifesciences, Medtronic, PulseCath BV, Abiomed, and Daiichi Sankyo; consulting fees from

FIGURE 6 Cerebral Embolic Protection



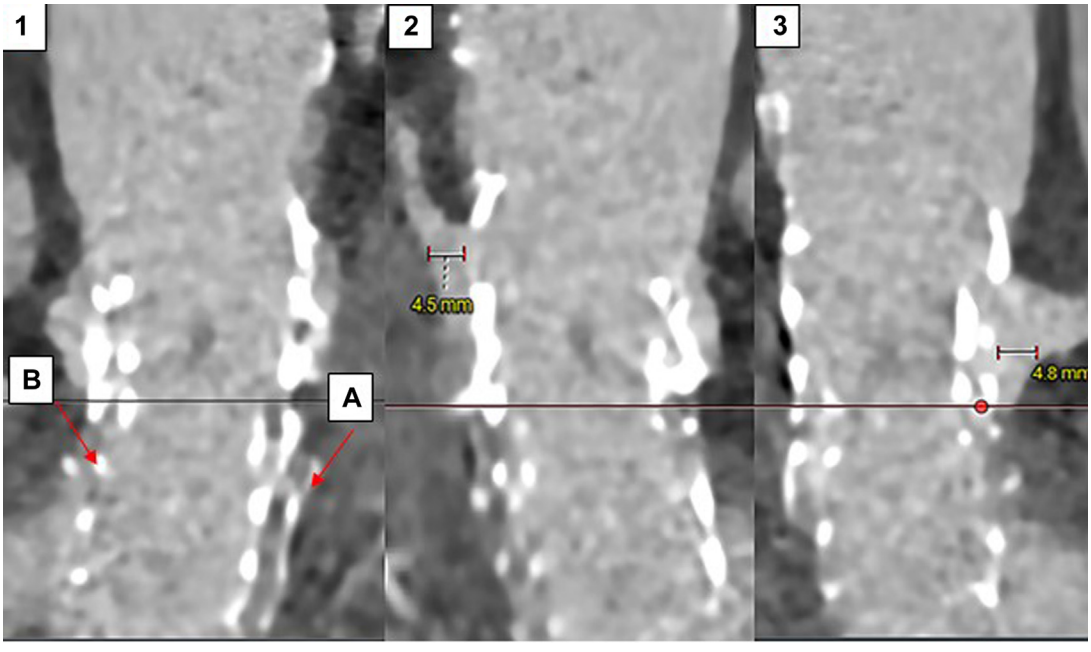
Cerebral embolic protection shown after procedural removal.

FIGURE 7 Postprocedural TTE Measurements



Postprocedural transthoracic echocardiography (TTE) measurements using continuous Doppler on bioprosthetic aortic valve. Continuous Doppler shows an aortic valve max of 2.22 m/s.

FIGURE 8 Multidetector Computed Tomography Images Post TAVR of the Bioprosthetic Valves



(1) Stretched left ventricular outflow tract vessel images of **(A)** THV 1 and **(B)** THV 2 **(2)** Distance of THV 1 to left coronary ostia is 4.5 mm. **(3)** Distance of THV 1 to right coronary ostia is 4.8 mm. TAVR = transcatheter aortic valve replacement; other abbreviations as in Figures 3 and 5.

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KEY WORDS interventional complications, LVOT migration, stent collapse, structural heart disease, TAVR, valve complication, valve-in-valve

APPENDIX For supplemental videos, please see the online version of this paper.