JACC: CASE REPORTS
PUBLISHED BY ELSEVIER ON BEHALF OF THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION.

VOL. 7, 2023

CASE REPORT

INTERMEDIATE

HEART CARE TEAM/MULTIDISCIPLINARY TEAM LIVE

Innovative Approach to Manage Transcatheter Aortic Valve Embolization

James Z. Keeton, MD,[a] Anand Prasad, MD,[a] Thekla Bacharach, MD,[b] Anand Dayama, MD,[b] Edward Sako, MD, PhD,[c] Ahmed Almomani, MD[a]

ABSTRACT

We describe the case of a patient with an ascending aortic aneurysm who underwent valve-in-valve transcatheter aortic valve implantation, which was complicated by valve embolization. After a multidisciplinary discussion and an innovative approach, the free-floating embolized valve was anchored securely in the aortic arch with an uncovered aortic endovascular stent. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2023;7:101598) 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/).

CLINICAL SUMMARY

This case involved a 64-year-old woman with severe bicuspid aortic valve stenosis and prior history of a 21-mm stented, supra-annular pericardial bioprosthetic surgical aortic valve replacement 8 years before presentation. She presented with severe prosthetic aortic valve stenosis with a peak velocity of 4.1 m/s, mean gradient of 43 mm Hg, effective orifice area of 0.89 cm^2, dimensionless velocity index of 0.2, and trace aortic insufficiency and New York Heart Association functional class III symptoms of exertional dyspnea.

LEARNING OBJECTIVES

- To recognize the potential of an uncovered endovascular stent as a percutaneous bailout strategy to manage valve embolization in inoperable settings.
- To identify the possible factors that may contribute to valve embolization and steps to prevent them.
- To demonstrate the importance of preprocedural planning with computed tomography.
- To recognize the importance of a multidisciplinary team approach to all valve cases, especially in the face of a complex complication, such as valve embolization.

After a multidisciplinary team discussion, she was deemed to have a prohibitive redo surgical risk because of multiple comorbidities, including morbid obesity, nonalcoholic steatohepatitis with cirrhosis, chronic kidney disease, obstructive sleep apnea, and diabetes mellitus; thus, valve-in-valve transcatheter aortic valve replacement (TAVR) was planned via transfemoral approach under general anesthesia. Pertinent measurements on preprocedural computed tomography (CT) were an aortic native annulus area of 400 mm^2 and a perimeter of 71 mm, maximum diameter of 24.7 mm, minimal diameter of 21.6 mm, and perimeter of 72.6 mm. The true internal diameter

From the [a]University of Texas Health at San Antonio, Department of Medicine, Division of Cardiology, San Antonio, Texas, USA; [b]University of Texas Health at San Antonio, Department of Surgery, Division of Vascular Surgery, San Antonio, Texas, USA; and the [c]University of Texas Health at San Antonio, Department of Cardiothoracic Surgery, Division of Adult Cardiac Surgery, San Antonio, Texas, USA.

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.

Manuscript received April 12, 2022; revised manuscript received July 19, 2022, accepted August 12, 2022.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2022.08.015

ABBREVIATIONS AND ACRONYMS

CT = computed tomography

TAVR = transcatheter aortic valve replacement

of the 21-mm stented, supra-annular surgical bioprosthetic aortic valve is only 19 mm. However, a 26-mm self-expanding valve was selected with plans to perform bioprosthetic valve fracture after transcatheter valve implantation.

Initial positioning of the self-expanding valve delivery system was difficult because of aortic root angulation, which required snaring of the distal end to assist with advancement and crossing through the bioprosthetic aortic valve. After confirming appropriate positioning, the self-expanding valve was successfully deployed with rapid ventricular pacing at 120 beats/min. However, after deployment, the valve appeared to be underexpanded, and postdilation was planned. Unfortunately, while positioning the balloon and before inflation, the valve embolized into the ascending aorta (Video 1).

WHAT ARE THE NEXT STEPS IN THE MANAGEMENT OF THIS COMPLICATION?

The embolized self-expanding valve was unstable and spinning in the ascending aorta (Video 2) and was quickly snared using a multipurpose guide catheter and a 15-mm snare while maintaining wire access through the aortic valve (**Figure 1**). Because the embolized self-expanding valve was securely snared and the patient was hemodynamically stable without any evidence of aortic injury on transesophageal echocardiography, we elected to proceed with TAVR with a second transcatheter heart valve. A 23-mm balloon-expandable valve was advanced through the embolized self-expanding valve and positioned for deployment (**Figure 2**). After successful deployment of the balloon-expandable valve, postdilation with a 22-mm balloon to fracture the previous bioprosthetic valve was successfully performed. Subsequent transesophageal echocardiography (Video 3) and aortography (Video 4) confirmed a well-positioned valve without any significant aortic regurgitation. Invasive hemodynamics were measured, showing an improvement in aortic valve mean gradients from 43 mm Hg preprocedurally to 10 mm Hg postprocedurally. A multidisciplinary team approach involving the structural heart team, cardiothoracic surgery, and vascular surgery was held in real time to discuss strategies for management of the embolized valve.

WHAT ARE THE CONSIDERATIONS FOR BAILOUT STRATEGIES IN VALVE EMBOLIZATION?

Valve embolization accounts for most emergent cardiac surgical indications during TAVR.[1] However, as was such in this case, some patients may have a prohibitive operative risk, and percutaneous options are the only choice. The main considerations of percutaneous rescue of an embolized valve include the valve type and size as well as location and potential hemodynamic compromise of aortic blood flow. There was a transcatheter valve that could be fully retrieved and repositioned without any reported malposition events,[2] but it was taken off the market by the U.S. Food and Drug Administration because of safety concerns. However, the self-expanding valve

FIGURE 1 Snaring of the Embolized Self-Expanding Valve

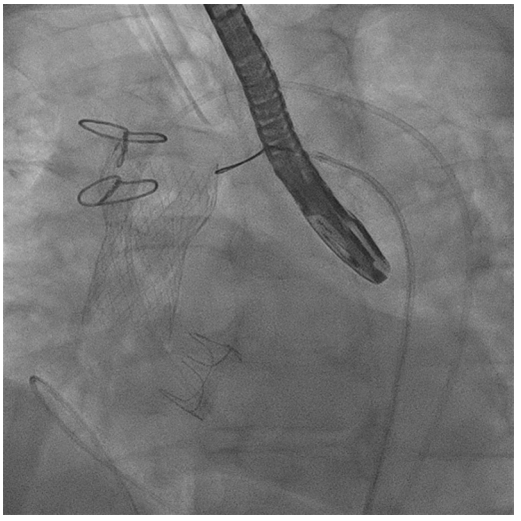
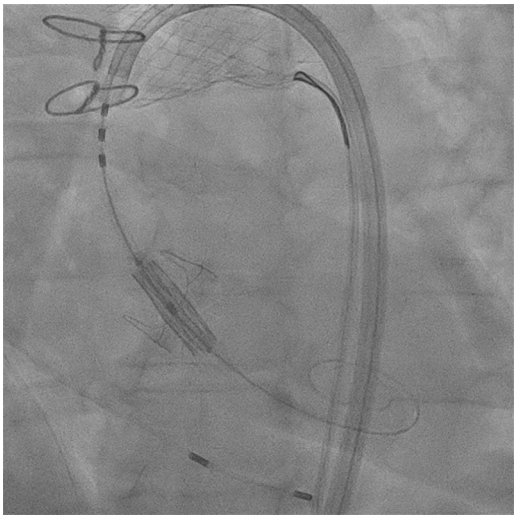


FIGURE 2 Positioning of the Balloon-Expandable Valve Through the Embolized Self-Expanding Valve



can be retrieved only if it is not fully deployed. There have been several proposed algorithms to assist in determining the best approach for percutaneous rescue for valve embolization,[3,4] but robust data are scarce because of the rarity of this complication.

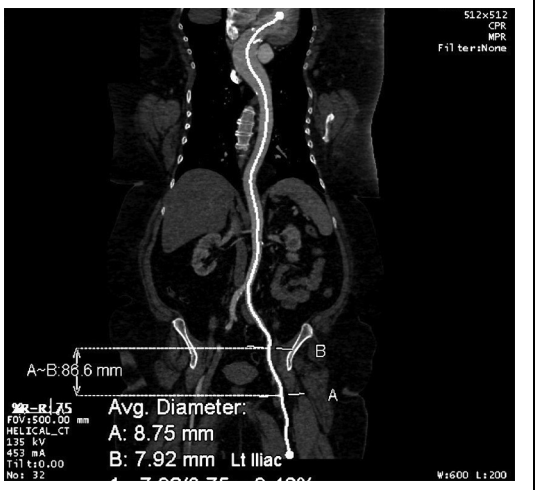
Aortic dimensions on preprocedural CT showed aneurysmal dilation of the ascending aorta up to 42 mm, which tapered down to 34 mm in the aortic arch and 24 mm in the proximal thoracic descending aorta (**Figure 3**). The outflow portion of the 26-mm self-expanding valve is 34 mm. Thus, positioning of the embolized valve using 2 snares into the descending aorta could not be achieved because of rapid tapering of the aortic arch and risk of aortic injury and dissection with the widened upper outflow portion of the self-expanding valve. The decision, made after also discussing with the patient's family, was to secure the embolized valve in the ascending aorta with an uncovered endovascular stent.

The snared embolized valve was secured in the aortic arch proximal to the right innominate artery, and aortography was performed to ensure there was no obstruction of aortic arch branches (Video 5). Next, a 46 × 180-mm open endovascular stent was advanced over a stiff guidewire through the embolized valve. With the embolized valve held in place with countertraction on the snares, the open self-expanding endovascular stent was carefully unsheathed, tacking the embolized valve in place against the walls of the proximal aortic arch (Video 6). The uncovered endovascular stent was deployed close to the prosthesis but did not appear to interfere with prosthetic valve function, so no further intervention was pursued. Final aortography demonstrated normal flow in the coronary arteries and aortic arch branch vessels without evidence of extravasation or dissection (Video 7).

WHAT ARE THE TECHNICAL CONSIDERATIONS WITH DEPLOYMENT OF AN UNCOVERED ENDOVASCULAR STENT?

The open endovascular stent consists of a series of self-expanding nitinol bare stents held together by polyester sutures. It was initially designed to be used as the distal component in combination with a separate endovascular graft to avoid covering spinal and visceral aortic branch vessels during transcatheter endovascular aortic repair. The open endovascular stent is available in 2 diameters (36 and 46 mm), which come in multiple lengths: 80 mm, 120 mm, and 180 mm with the 36-mm-diameter stent and 80 mm, 120 mm, and 185 mm with the 46-mm-diameter stent. Sizing and careful positioning of these self-expanding open stents should be considered before implantation to avoid any potential interference with implanted TAVR leaflets. There are 4 radiopaque markers positioned on each end of the stent to facilitate fluoroscopic visualization of the stent. The open endovascular stent comes preloaded onto a delivery system, which is compatible with either the 14- or 16-F introducer sheaths typically used for TAVR procedures. Additionally, the introduction system is compatible with a 0.035-inch guidewire. All these factors make open endovascular stents an ideal percutaneous bailout strategy for unstable embolized valves if surgical options are of prohibitive risk.

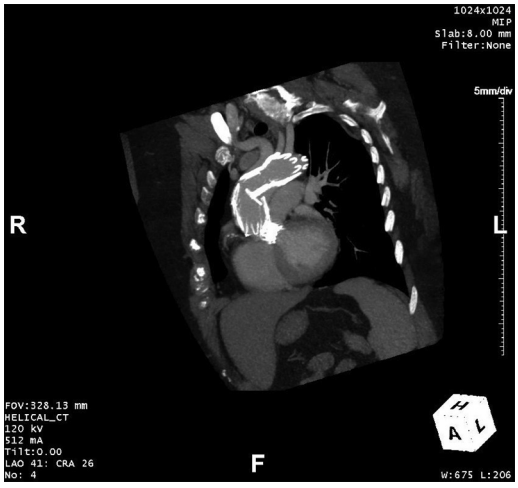
FIGURE 3 Preprocedural Computed Tomography of the Aorta



WHAT FACTORS COULD CONTRIBUTE TO VALVE EMBOLIZATION?

Transcatheter valve embolization is rare, occurring in approximately 1% of procedures and associated with an increase in morbidity and mortality.[1,3,5] Based on the international TRAVEL (Transcatheter Heart Valve Embolization and Migration) registry, self-expanding and first-generation valves as well as the presence of a bicuspid aortic valve were independent predictors of valve embolization.[5] There are several different anatomic (eg, inaccurate prosthesis sizing), procedural (eg, poor coplanar angulation or rapid pacing failure), and device-related factors that affect the risk of valve embolization.[3] Most individual causes of

FIGURE 4 Computed Tomography at the 1-Month Follow-Up After Transcatheter Aortic Valve Replacement



valve embolization are mostly procedure related and caused by mispositioning, but sizing errors may also be a major contributor.[5] Thus, accurate measurements by CT for appropriate valve selection and sizing are imperative in preprocedure planning to mitigate the risk of procedural complications. However, despite meticulous planning and technical procedural performance, valve embolization can still occur. In our case, we suspect that lack of contact of the self-expanding valve outflow portion to the walls of the dilated ascending aorta resulted in decreased radial anchoring forces and led to the valve being tilted to the side during balloon repositioning because of wire tension. Subsequently, the self-expanding valve released from the surgical valve ring and embolized to the ascending aorta.

SUBSEQUENT CLINICAL COURSE

The patient recovered from the procedure without any signs of stroke and was discharged home. Transthoracic echocardiography postprocedure and at the 1-month follow-up showed a well-seated valve with stable gradients and no paravalvular regurgitation. Her exertional symptoms improved, and subsequent CT showed the endovascular stent well-opposing the embolized self-expanding valve without any evidence of dissection or aortic branch obstruction (Figure 4).

CLINICAL PERSPECTIVES

This case demonstrates a collaborative and innovative percutaneous approach to managing valve embolization with an uncovered endovascular stent.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

The publishing of this study was supported by the Freeman Heart Association Endowment in Cardiovascular Disease. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr James Keeton, University of Texas Health at San Antonio, Division of Cardiology, MC 7872, 8300 Floyd Curl Drive, San Antonio, Texas 78229-3900, USA. E-mail: keetonj@uthscsa.edu. Twitter: @jzkeeton.

REFERENCES

1. Scarsini R, De Maria GL, Joseph J, et al. Impact of complications during transfemoral transcatheter aortic valve replacement: how can they be avoided and managed? *J Am Heart Assoc*. 2019;8(18):e013801.

2. Van Mieghem NM, Wöhrle J, Hildick-Smith D, et al. Use of a repositionable and fully retrievable aortic valve in routine clinical practice: the RESPOND study and RESPOND extension cohort. *J Am Coll Cardiol Intv*. 2019;12(1):38-49.

3. Alkhouli M, Sievert H, Rihal CS. Device embolization in structural heart interventions: incidence, outcomes, and retrieval techniques. *J Am Coll Cardiol Intv*. 2019;12(2):113-126.

4. Chawla KK, Huang X, Hadro N, Islam AM. A novel technique to manage transcatheter aortic valve embolization. *Catheter Cardiovasc Interv*. 2021;97(5):955-958.

5. Kim WK, Schäfer U, Tchetche D, et al. Incidence and outcome of peri-procedural transcatheter heart valve embolization and migration: the TRAVEL registry (TranscatheteR HeArt Valve EmboLization and Migration). *Eur Heart J*. 2019;40(38):3156-3165.

KEY WORDS aortic stenosis, endovascular stent, transcatheter aortic valve replacement, valve embolization

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