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Snare-Assisted Valve Positioning of Self-Expanding Valves for Transcatheter Aortic Valve Replacement

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ABSTRACT

We describe 4 cases in which technical challenges were anticipated in delivering a self-expanding TAVR valve due to challenging aortic anatomy or a previous placed surgical aortic valve. An upfront snare strategy is described which facilitates valve centralization and atraumatic valve delivery. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:658–62) © 2021 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/).

INTRODUCTION

As the use of transcatheter aortic valve replacement (TAVR) has expanded, the indications and level of anatomic complexity has grown. Delivering a self-expanding valve delivery system without directional flexion control across a surgical bioprosthesis annulus or challenging aortic anatomy presents unique technical considerations. Use of traditional troubleshooting options can be of limited usefulness (1). We discuss 4 cases with high-risk features in whom difficulty advancing the self-expanding Evolut Pro+ TAVR valve (Medtronic, Minneapolis, Minnesota) across aortic bioprostheses and challenging aortic anatomy was overcome with successful use of a snare technique to facilitate valve delivery.

LEARNING OBJECTIVES

- To identify anatomic characteristics associated with high risk for inability to deliver a self-expanding TAVR valve.
- To describe the upfront snare technique to facilitate self-expanding valve delivery in TAVR procedures.

CASE 1

An 81-year-old man with a history of aortic regurgitation status post #21 Carpentier-Edwards (Edwards, Dublin, Ireland) surgical aortic valve replacement (SAVR) presented with New York Heart Association (NYHA) functional class III symptoms and prosthetic valve degeneration with severe stenosis and moderate regurgitation. Following heart team evaluation, the decision was made to proceed with TAVR with an Evolut Pro+ 23 mm valve (**Table 1**). Because of fusiform dilation of the ascending aorta to a maximum of 38 mm (**Figure 1**), the decision was made to proceed with TAVR with snare assistance via the left radial artery.

Via the left radial artery, a 30-mm × 120-cm gooseneck snare was positioned across the aortic arch. Via the right femoral artery, a 0.035-inch J-wire was advanced through an 18-F sheath and captured in

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the gooseneck snare in the aortic arch (Figure 2). The aortic valve was crossed, and the J-wire was exchanged for a Confida wire (Medtronic). The Evolut Pro+ 23 mm valve and delivery system were then advanced into the ascending aorta. Following unsuccessful delivery of the Evolut valve across the surgical valve, the snare was positioned at the base of the Evolut valve, and traction was applied to the snare as the Evolut system was advanced, which facilitated centralization and delivery of the TAVR valve across the surgical annulus (Video 1). After withdrawing the snare, the Evolut valve was deployed uneventfully.

CASE 2

A 63-year-old woman with a history of an ascending aortic aneurysm (4.9 cm) and mixed aortic valve disease secondary to a bicuspid aortopathy previously underwent ascending aortic hemiarch replacement and SAVR with a #23 Trifecta valve (Abbott, Chicago, Illinois) in 2012. The patient presented with NYHA functional class IV heart failure symptoms and severe prosthetic aortic stenosis. Following heart team evaluation, the decision was made to proceed with TAVR with an Evolut Pro+ 26 mm valve (Table 1). Analysis of the ascending aorta showed a kink at the site of the ascending aortic graft anastomosis (Figure 3). Because of anticipated challenges delivering the Evolut valve, TAVR with planned snare assistance via the left common femoral artery was performed.

Via the left common femoral artery, a 30-mm × 120-cm gooseneck snare was positioned in the abdominal aorta. The aortic valve was then crossed, and the Evolut Pro+ valve was delivered to the ascending aorta through the gooseneck snare (Video 2). The snare was positioned at the base of the Evolut valve, and traction was applied to the snare and Confida wire as the Evolut system was advanced. The valve was delivered across the ascending aorta and surgical valve without difficulty (Video 3). After withdrawal of the snare, the Evolut valve was deployed uneventfully.

CASE 3

A 76-year-old woman with a history of rheumatic fever complicated by aortic and mitral stenosis presented with fatigue and dyspnea. Workup was notable for mild mitral stenosis and severe aortic stenosis. Following heart team evaluation, the decision was made to proceed with TAVR. Computed tomography (CT) analysis was notable for severe calcification at the sinotubular junction (STJ) and a protruding calcified nodule extending from the base of the left coronary cusp into the left ventricular outflow tract (LVOT) (Figure 4). The remainder of the patient's anatomic measurements were appropriate for an Evolut Pro+ 26 mm valve (Table 1).

TAVR was attempted using an Evolut Pro+ 26 mm valve. Due to valve delivery system interaction with protruding calcification at the STJ, the valve was unable to be advanced. Because of bias of the valve along the outer curvature of the aorta, as well as the large, nodular calcium in the LVOT, the decision was made to avoid traditional troubleshooting techniques (e.g., wire escalation or a buddy balloon) and to abort the procedure. A staged attempt with a planned snare from the left common femoral artery was then performed. Using the previously described technique, the Evolut valve was delivered to the ascending aorta through a 30-mm gooseneck snare. As the valve was advanced toward the aortic annulus, countertraction was applied to the snare, centralizing the valve and allowing rapid, safe entry of the self-expanding TAVR nose cone and valve into the ventricle. The valve was deployed uneventfully, and the patient was discharged on post-operative day 2.

CASE 4

A 72-year-old woman with a history of Ebstein anomaly and aortic regurgitation status post #23 Edwards Perimount bioprosthetic aortic valve replacement (2003) presented with acute

ABBREVIATIONS AND ACRONYMS

CT = computed tomography

LVOT = left ventricular outflow tract

NYHA = New York Heart Association

SAVR = surgical aortic valve replacement

STJ = sinotubular junction

STS = Society for Thoracic Surgery

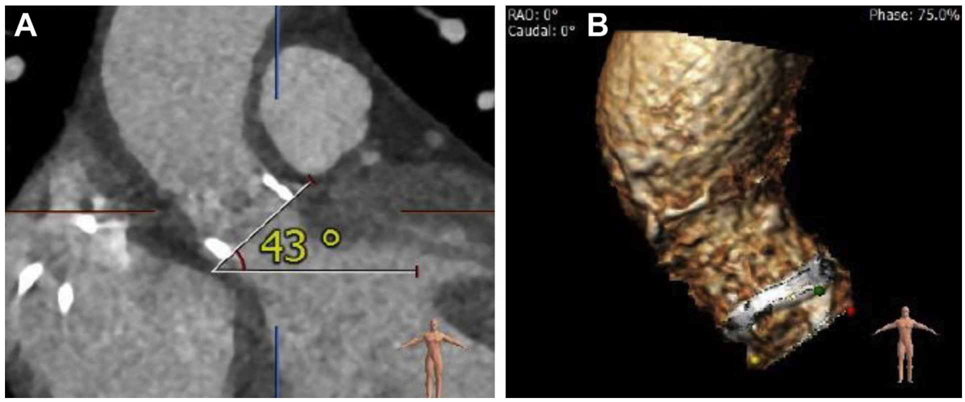
TAVR = transcatheter aortic valve replacement

TABLE 1 Summary of CT Sizing for TAVR Planning

	Annular Area (mm^2)	Perimeter (mm)	Root Angle	Sinuses (Left, Right, Non) (mm)	Left Coronary Height (mm)	Right Coronary Height (mm)	STJ Height (mm)	STJ Average Diameter (mm)	LVOT Area (mm^2)
Case 1	283	59.8	43	26.2, 25.7, 24.3	8.4	15.6	21.3	23.3	261
Case 2	344	65.9	43	38.2, 29.7, 34.6	10.3	11.2	32.0	29.9	461
Case 3	336	65.7	46	27.3, 25.4, 26.8	13	10.4	23.6	17.7	366
Case 4	344	66.0	48	38.1, 36.3, 37.4	21.7	17.2	30.9	34.9	401

CT = computed tomography; LVOT = left ventricular outflow tract; STJ = sinotubular junction; TAVR = transcatheter aortic valve replacement.

FIGURE 1 Computed Tomography of the Ascending Aorta Demonstrating Fusiform Dilation



Computed tomography of the ascending aorta demonstrating fusiform dilation of the ascending aorta rendered in **(A)** 2 dimensions and **(B)** 3 dimensions. RAO = right anterior oblique.

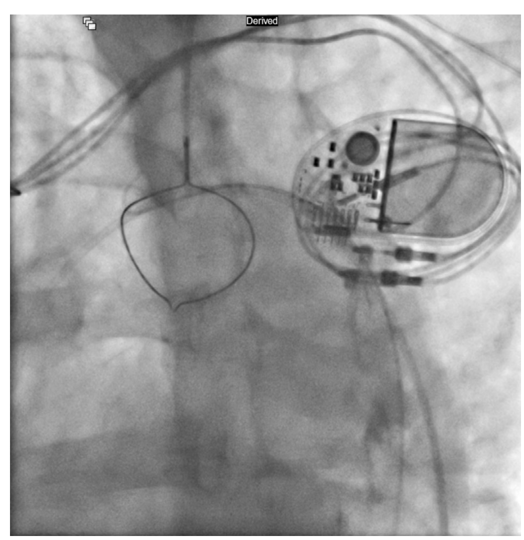
decompensated heart failure and severe prosthetic regurgitation. Following heart team evaluation, the decision was made to proceed with TAVR with an Evolut Pro+ 26 mm valve (Table 1). CT analysis was notable for a root angle of 48° (Figure 5). Because of aortic root angulation, the Evolut valve was delivered across the aortic bioprosthesis with the assistance of an upfront 20-mm gooseneck snare from the left radial artery using the previously described technique. The valve was deployed without incident.

DISCUSSION

Factors associated with difficulty inserting a self-expanding TAVR prosthesis include a markedly reduced valve area, significant calcification of the aorta and valvular apparatus, extreme root angulation, ascending aorta dilation, the presence of a surgical aortic graft, and a previous SAVR. In these situations, rotation of the Evolut Pro+ delivery system may facilitate valve delivery due to the construction of the catheter to facilitate flexion in one primary direction. If catheter rotation is inadequate to facilitate valve delivery, further escalation strategies have been described (2). Several techniques, including pre-dilation and the use of a buddy balloon, may not be feasible or unsuccessful in valve-in-valve procedures. An alternate TAVR valve, such as the Sapien 3 valve with the Commander Flex catheter (Edwards, Irvine, California) or a self-expanding valve platform with a softer and/or shorter valve nose cone could also be considered. In this report, we described an upfront snare technique to facilitate atraumatic valve delivery of the self-expanding Evolut Pro+ prosthesis.

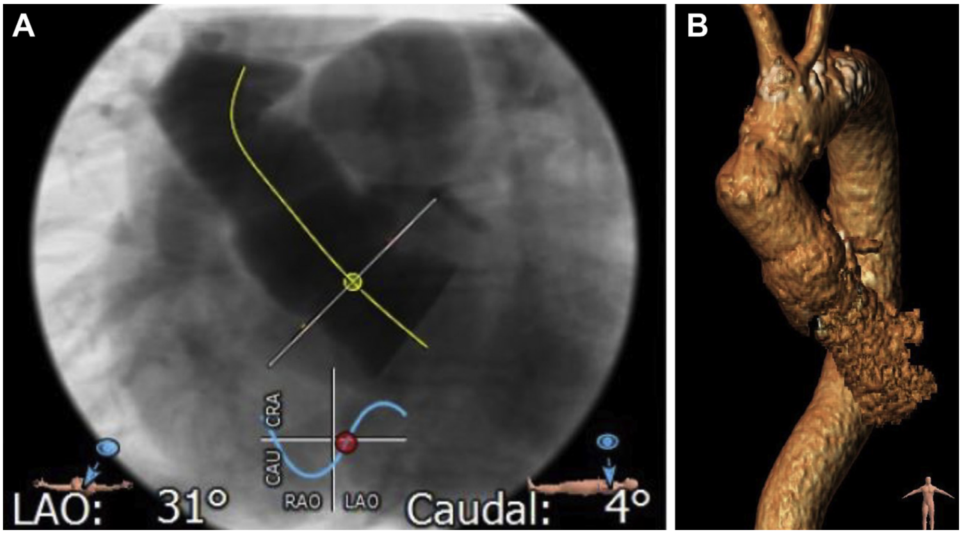
The use of snares as a bailout strategy for nose cone entrapment in native and surgical aortic valves has been previously described (3,4). These techniques are limited by cumbersome methods to snare the TAVR delivery system after gaining wire access to the

FIGURE 2 Fluoroscopic Image of the Gooseneck Snare



Fluoroscopic image of the gooseneck snare positioned across the aortic arch via the left radial artery during capture of the J-wire.

FIGURE 3 **Computed Tomography of the Ascending Aorta Demonstrating Kinking**

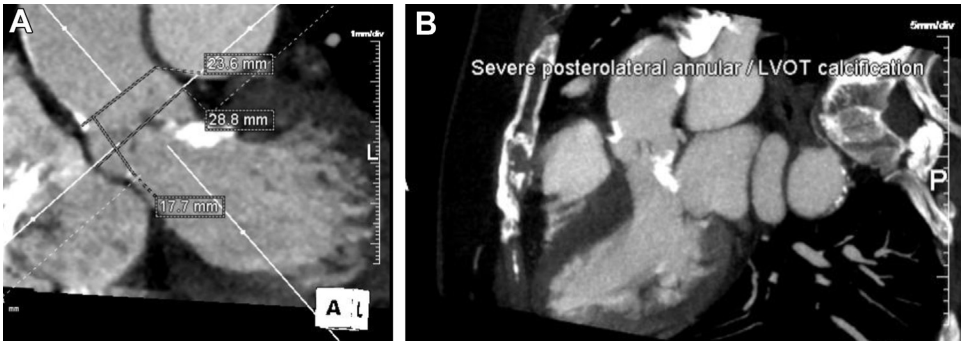


Computed tomography of the ascending aorta demonstrating kinking at the insertion of the hemiarch graft proximal to the aortic arch rendered in **(A)** 2 dimensions and **(B)** 3 dimensions. CAU = caudal; CRA = cranial; LAO = left anterior oblique; RAO = right anterior oblique.

left ventricle. In this report, we described 3 patients who were identified as high risk for difficult surgical valve crossing due to their aortic anatomy and a fourth patient with extensive STJ calcification. Specific anatomy that we believe contributes to crossing difficulty includes a large STJ or enlarged right coronary sinus that biases the device to the greater curvature of the aorta and a non-coaxial angle through the surgical valve. In the third case, a large calcium burden on the greater curvature at the STJ similarly impeded valve advancement.

With the snare in place before valve crossing, the TAVR delivery system can be advanced through a gooseneck snare, facilitating use of the snare to provide countertraction. Countertraction facilitates valve centralization when navigating hostile aortic anatomy and when advancing the TAVR valve through a previously placed bioprosthetic aortic

FIGURE 4 **Computed Tomography Analysis Demonstrating Calcium**



Computed tomography analysis demonstrating **(A)** significant left ventricular outflow tract (LVOT) calcium extending below the left coronary cusp, and **(B)** a large calcific nodule at the sinotubular junction along the greater curvature of the aorta.

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FIGURE 5 **Computed Tomography Analysis Demonstrating Extreme Root Angle**

Computed tomography analysis demonstrating extreme root angle with a previous surgical aortic bioprosthesis.

valve. This technique requires an additional contralateral arterial access point, generally the left radial or femoral artery. Planned snare use is safe and facilitates rapid delivery of a self-expanding valve, reducing the potential risk of injury to the aorta with excessive manipulation of and force on the TAVR delivery system.

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Dr. Anwaruddin is on the advisory board of Medtronic; has received speaker fees from Medtronic and Edwards Lifesciences; has received honoraria from Medtronic and Siemens; and has been a consultant for V wave. Dr. Herrmann has received institutional research funding from Abbott, Boston Scientific, Edwards Lifesciences, and Medtronic; and has received consulting fees from Abbott, Edwards Lifesciences, and Medtronic. Dr. Desai has received institutional research funding from Core, Medtronic, and Cook; and has received consulting fees from Core, Medtronic, Terumo, and Edwards Lifesciences. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS snare, transcatheter aortic valve replacement (TAVR), valve-in-valve

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