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STRUCTURAL INTERVENTIONS

INTERMEDIATE

CASE REPORT: CLINICAL CASE SERIES

Description of the Step-by-Step Technique With Snare Catheter for TAVR in Horizontal Aorta

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ABSTRACT

The presence of a horizontal aorta in patients treated with transcatheter aortic valve replacement increases the difficulty of the procedure. We present 5 cases with aortic stenosis with a horizontal aorta who underwent transcatheter aortic valve replacement using a self-expanding prostheses, with the objective of describing the techniques used and obtaining success with a snare catheter. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2021;3:1811–1815) © 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/).

We present a series of cases with aortic stenosis with a horizontal aorta treated with transcatheter aortic valve replacement (TAVR) using self-expanding prostheses. We describe, in a stepwise fashion, the different techniques used to achieve success using a snare catheter (**Figure 1**).

LEARNING OBJECTIVES

- To demonstrate a step-by-step technique using a catheter snare for TAVR in the horizontal aorta.
- To evaluate the benefit of the snare catheter in patients with a horizontal aorta who underwent TAVR to improve the success of the procedure and to reduce the rate of complications.

HISTORY OF PRESENT ILLNESS

We present 5 patients diagnosed with severe aortic stenosis with complex aortic anatomy caused by a horizontal aorta. Demographic characteristics, medical history, presenting symptoms, imaging findings, and outcomes are presented in **Table 1**. The presenting symptoms were dyspnea, syncope, and angina, with physical examination findings that included systolic crescendo/decrescendo murmur over the right upper sternal border, Gallavardin phenomenon, and pulsus parvus et tardus. All patients presented to our hospital for evaluation because of deterioration in functional class, with worsening dyspnea, angina, or

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ABBREVIATIONS AND ACRONYMS

CT = computed tomography

TAVR = transcatheter aortic valve replacement

TEE = transesophageal echocardiography

syncope, but none presented with congestive heart failure.

PAST MEDICAL HISTORY

All 5 patients had at least 2 concomitant comorbidities. The first patient had ischemic heart disease that was treated with percutaneous coronary intervention. The frailty scores of all 5 patients was elevated.

DIFFERENTIAL DIAGNOSIS

The clinical presentations, including presenting symptoms and physical examination findings were classic for severe aortic stenosis. The findings were less specific for other common differential diagnoses, such as pneumonia, severe mitral regurgitation, or congestive heart failure.

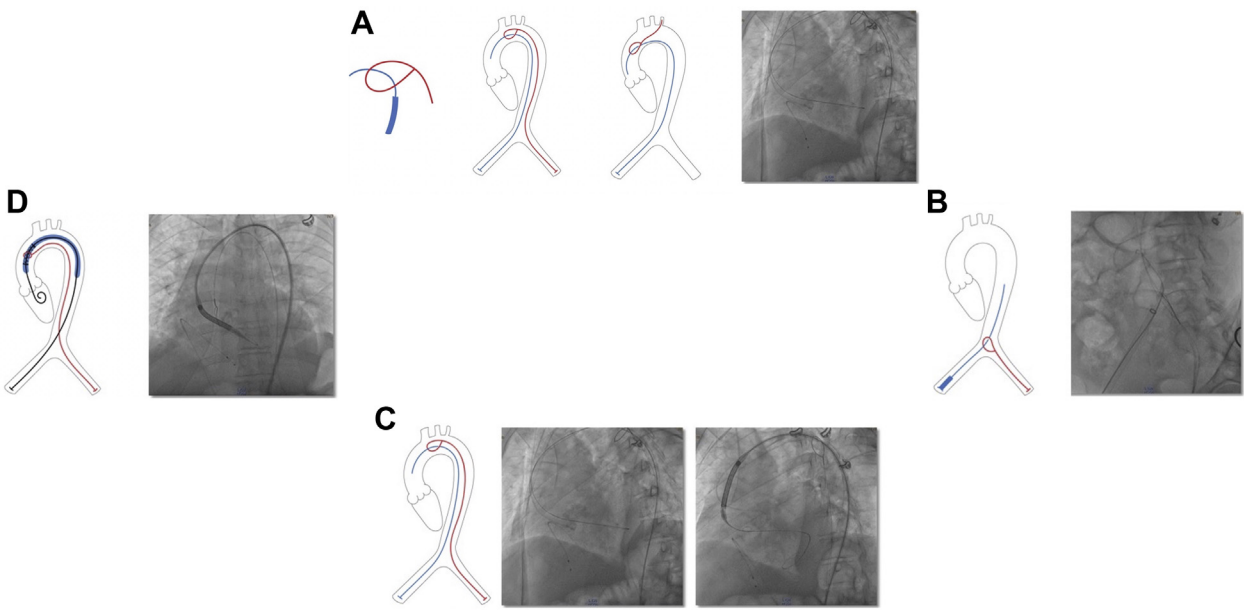
WORKUP

In the second patient, laboratory studies showed elevated serum creatinine of 2.1 mg/dL, urea of 82 mg/dL, and a glomerular filtration rate of 46 mL/min/1.73 m^2. In patients 1, 3, 4, and 5, the diagnosis of severe aortic stenosis was confirmed with transthoracic echocardiography. In all patients, except for the second one, TAVR was deemed feasible with the aid of a cardiac computed tomography (CT) scan (**Figure 2**). TAVR was deemed feasible in the second patient by transesophageal echocardiography (TEE) because this patient had chronic kidney disease. Imaging studies showed that 4 of 5 patients had a bicuspid aortic valve, with Sievers 1 classification, except for 1 patient (the fourth patient), who had a bicuspid aortic valve, with Sievers 0 classification. All patients had aortic root angulation of >48 and <70 degrees.

MANAGEMENT

The 5 patients received conscious sedation; vascular access was obtained via the right femoral artery. Self-expanding transcatheter valves included the CoreValve Evolut R (Medtronic) and 1 Portico transcatheter valve (Abbott). In patients 2, 3, and 5, attempts to cross the stenotic aortic valve were unsuccessful, despite using highly supportive guidewires (Confida Brecker, Medtronic; Amplatz Super Stiff, Boston Scientific; and Lunderquist, Cook Medical, respectively) (Video 1, **Figure 3**). In patients 1 and 4, the Buddy balloon technique and buddy

FIGURE 1 Description of the Step-by-Step Technique With Snare Catheter for Transcatheter Aortic Valve Replacement in a Horizontal Aorta



(A) A snare system can be introduced by contralateral femoral artery or radial artery access. **(B and C)** Capture of the prosthesis advancement system guide can be performed before the aortoiliac bifurcation and in the aortic arch. **(D)** Subsequently, the prosthesis is captured in the middle third with the snare catheter; tension must be applied on the snare with the necessary force to advance the prosthesis through the aortic ring and to position it properly, offering coaxiality of the system with the aorta.

TABLE 1 Presenting Clinical Characteristics, Imaging, and Outcomes of Patients With Severe Aortic Stenosis Treated With TAVR

Patient #	Age (y)/Sex	Medical History	Presentation and Initial Symptoms	Initial Echocardiogram	Cardiac Computed Tomography	Angiography Coronary/PCI	Self-Expanding Prosthesis Used	Outcomes
1	82/M	Hypertension, type 2 diabetes mellitus, ischemic heart disease with PCI to LAD 3 y ago	Dyspnea and syncope in NYHA functional class II, 1 y ago; STS score: 4.5%	TTE: LVEF 45%, aortic valve: bicuspid aorta, Vmax 5.3 m/s, mean PG 53 mm Hg, AVA 0.5 cm^2	Aortic valve: type 1 bicuspid, annulus perimeter 80.7 mm, annular area 5.0 cm^2, 55° aortic angulation	No significant lesions	Portico 29 mm	Successful valve implant, mild paravalvular leak
2	70/M	COPD, stage 3a chronic kidney disease	Dyspnea and fatigue in NYHA functional class II, 2 y ago; STS score: 2.1%.	TTE: LVEF 20%, aortic valve: bicuspid aorta, Vmax 4.6 m/s, mean PG 54 mm Hg, AVA 0.37 cm^2. TEE "Easy Valve": perimeter: 85.2 mm	Not performed, because of his nephropathy, was planned with TEE	No significant lesions. 60° aortic angulation measured with fluoroscopy	Evolut R 34 mm	Successful valve implant, mild paravalvular leak
3	86/M	Hypertension, dyslipidemia, sedentary lifestyle	Angina in NYHA functional class II, 1 y ago; STS score: 4.0%.	TTE: LVEF 40%, aortic valve: bicuspid aorta, Vmax 4.9 m/s, mean PG 54 mm Hg, AVA 0.6 cm^2	Aortic valve: type 1 bicuspid, annulus perimeter 82.2 mm, annular area 4.9 cm^2, 69° aortic angulation	LAD with significant stenosis, PCI was performed with DES implant: 3.0 × 18 mm	Evolut R 34 mm	Successful valve implant, transient cerebral ischemia with resolution in 30 min. Third-degree atrioventricular block with permanent pacemaker implantation
4	71/M	Type 2 diabetes mellitus, gout, chronic liver failure of cryptogenic origin, Child-Pugh "B" with Soehendra grade II esophageal varices	Dyspnea and syncope in NYHA functional class II, 4 mo ago. STS score: 1.9%.	TTE: LVEF 56%, aortic valve: bicuspid aorta, Vmax 4.7 m/s, mean PG 60 mm Hg, AVA 0.5 cm^2 plus mild aortic regurgitation	Aortic valve: type 0 bicuspid, annulus perimeter 80.3 mm, annular area 5.0 cm^2, 53.4° aortic angulation	No significant lesions	Evolut R 34 mm	Successful valve implant, Third-degree atrioventricular block with permanent pacemaker implantation
5	68/M	Type 2 diabetes mellitus, obesity, dyslipidemia	Dyspnea and angina in NYHA functional class III, 4 mo ago. STS score: 0.7%.	TTE: LVEF 41%, aortic valve: bicuspid aorta, Vmax 4.12 m/s, mean PG 44 mm Hg, AVA 0.6 cm^2 plus mild aortic regurgitation, grade III diastolic dysfunction	Aortic valve: type 1 bicuspid, annulus perimeter 90 mm, annular area 6.54 cm^2, 52° aortic angulation	No significant lesions	Evolut R 34 mm	Successful valve implant, mild paravalvular leak

AVA = aortic valve area; COPD = chronic obstructive pulmonary disease; DES = drug eluting stent; LAD = left anterior descending artery; LVEF = left ventricular ejection fraction; NYHA = New York Hear Association; PG = peak gradient; PCI = percutaneous coronary intervention; STS = Society of Thoracic Surgeons; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography; Vmax = maximum velocity.

wire technique were also unsuccessful. Multiple other techniques were also attempted but failed. We were only successful using a snare catheter (Video 2).

DISCUSSION

In a small percentage of patients, severe aortic stenosis co-exists with a bicuspid aortic valve and significant aortic root angulation. Treatment with TAVR in this subset of patients is challenging, with an increasing risk of procedural failure, aortic dissection, perforation, device embolization, transcatheter valve deformation, and moderate and severe paravalvular leak. This case series described techniques with a snare system used to facilitate crossing the aortic valve with non-deflectable, self-expanding valve delivery systems in TAVR in cases with highly angulated aortas, using femoral access while reducing risk of complications. The ONE Snare Endovascular Snare System (Merit Medical) was used with a loop diameter of 20 mm, a length of 120 cm, and a 90-degree angle; sheath size was 7-F, advanced through contralateral femoral artery access and radial artery. TAVR was performed in 5 patients with aortic angulation of >48° and <70°, with self-expanding prostheses (4 cases with Evolut R and 1 case with Portico) using the transfemoral approach for access. Successful result in all 5 cases was achieved without vascular complications. Mild paravalvular leak happened in 4 cases (80%). Permanent pacemakers were required in 2 (40%) cases because of postoperative third-degree atrioventricular block and in 1 patient because of

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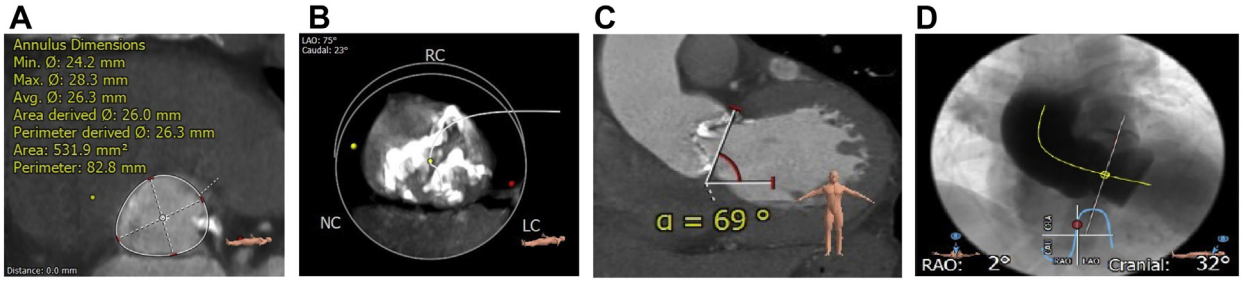
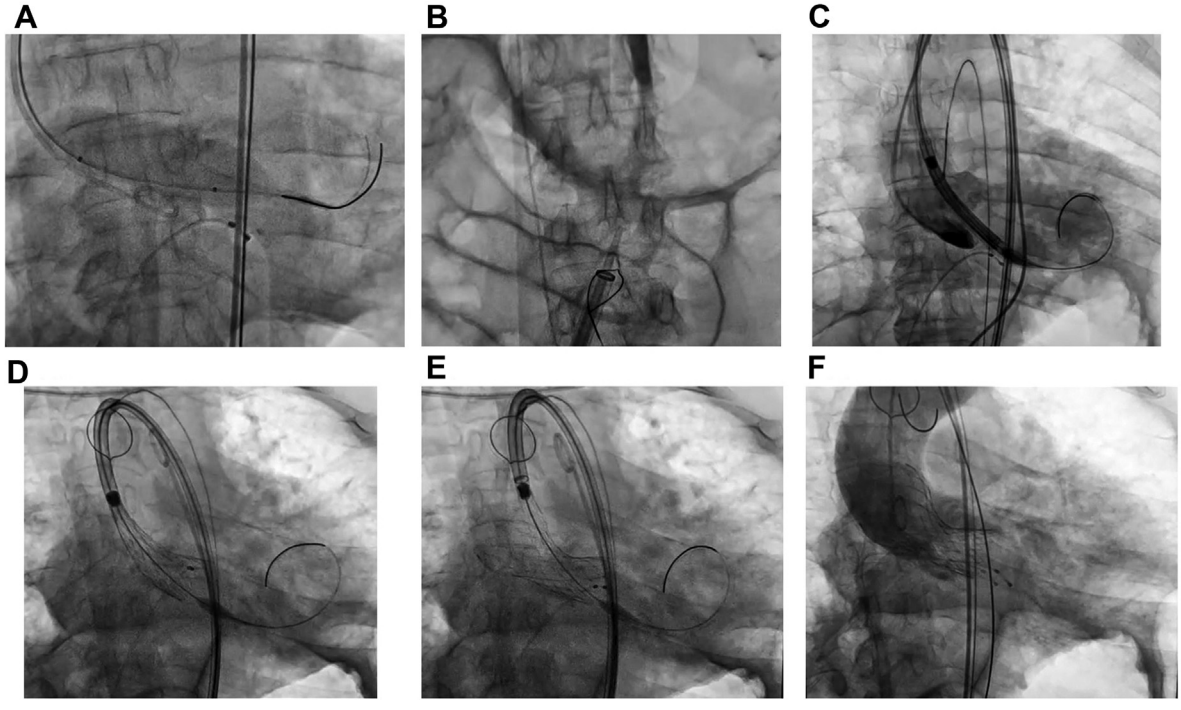
FIGURE 2 Planning With Cardiac Computed Tomography Scan



(A) Aortic annulus has a perimeter of 82.8 mm and a diameter derived from a perimeter of 26.3 mm, ideal for implanting a prosthesis number 34 mm. **(B)** Type 1 bivalve aorta, severe calcification. **(C)** Significant aortic angulation of 69°. **(D)** Projection of work used.

transient ischemic attack. There is controversy regarding the success rate of the procedure using self-expandable valves for horizontal aorta TAVR. In a study published by Di Stefano et al (1), patients with severe aortic stenosis and an angled aorta >48° were evaluated; no significant difference was found in the objectives evaluated with TAVR with balloon-expandable prosthesis versus TAVR with self-expanding prosthesis. Another recent study that compared different types of self-expanding valves showed that the 49° greater horizontal aorta was a modifying factor in the association between the type of self-expanding valve and the success of the device (2). There are case reports of valve-in-valve TAVR with complex anatomy, such as a horizontal aorta and an aortic aneurysm, that used a snare catheter to

FIGURE 3 Transcatheter Aortic Valve Replacement Using the Evolut R 34 mm Prosthesis



(A) Aortic valve predilatation due to severe calcification. After 3 unsuccessful attempts with change guides of greater support. **(B)** Advancement of the snare system via the left femoral artery, capturing the prosthesis in aortoiliac bifurcation. **(C)** Allowing the prosthesis to advance through the aortic valve plane, achieving coaxility and adequate position for its implantation. **(D to F)** Successful implantation was obtained with the use of a snare catheter.

obtain satisfactory results (3-5). Therefore, we concluded that the snare catheter technique could be used in cases with complex aortic anatomy with aortic root angulations 48°.

FOLLOW-UP. Patients 1, 2, and 5 were discharged from the hospital after 48 h, and patients 3 and 4 were discharged at 72 h. During outpatient follow-up at 30 days and 3 months, all patients were asymptomatic.

TIPS AND TRICKS ABOUT THE TECHNIQUE. When performing TAVR using a snare catheter, it is necessary to take into account the following tips and tricks for successful implantation and to reduce complications. Vascular access can be used through the contralateral femoral artery or through the radial artery to advance the snare catheter. Capture of the prosthesis is carried out at the level of the aortoiliac bifurcation or aortic arch. The snare must capture the prosthesis in the middle third of the aortic prosthesis to be implanted and provide the necessary tension for advancement through the aortic ring. Once the prosthesis is in the correct position, the snare catheter is withdrawn, and the prosthesis is released.

CONCLUSIONS

In this case series, use of the snare catheter showed more precise positioning and satisfactory hemodynamic performance in TAVR, even in steep aortic root angulation. It also achieved success in complex cases that previously might have been aborted because of an inability to cross the severely stenotic aortic valve.

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KEY WORDS aorta, aortic valve, bicuspid aortic valve, computed tomography, echocardiography, stenosis, valve replacement

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