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CASE REPORT

ADVANCED

TECHNICAL CORNER: STRUCTURAL HEART DISEASE

Balloon Nudge Technique

A Touch to Nonsteerable Valves

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ABSTRACT

Transfemoral transcatheter aortic valve replacement is an effective treatment for severe aortic stenosis with a high rate of procedural success with the current devices. However, anatomic factors and device limitations may increase technical difficulty. We describe the balloon nudge technique, a novel technique that improves coaxial alignment while crossing the aortic valve. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2022;4:794–798)

CASE REPORT

A 77-year-old symptomatic woman with severe aortic stenosis was referred to our center. She was complaining of shortness of breath. Her comorbidities included central obesity, insulin-dependent type 2 diabetes mellitus, liver cirrhosis secondary to heart failure, Guillain-Barré syndrome with neuromuscular weakness, and speech impairment. She had reduced mobility and used a wheelchair.

LEARNING OBJECTIVES

- To understand the importance of preprocedural planning in TAVR: from basics to relevant anatomic details.
- To learn new techniques to overcome difficult aortic valve crossing caused by adverse anatomy and current technical device limitations.
- To identify reasons for difficulties in valve crossing caused by adverse anatomy and distinguishing the different phenotypes (severely calcified aortic valves, horizontal aorta, dilated ascending aorta, and tortuous descending aorta).
- To highlight the importance of coaxial alignment during valve crossing.

Echocardiogram showed severe aortic stenosis with peak velocity of 4.2 m/s, peak gradient of 70 mm Hg, mean gradient of 37 mm Hg, effective orifice area of 0.8 cm^2, and dimensionless index of 0.25, with good biventricular systolic function. Transcatheter aortic valve replacement (TAVR) computed tomography showed a calcified trileaflet aortic valve (Agatston score: 1,387 AU) with an area of 348 mm^2, perimeter of 70 mm, diameter of 17.5 × 26 mm, and mildly dilated (40-mm) porcelain ascending aorta. The aortic (aorta to left ventricle) angle was 45°. The peripheral vessels were severely calcified, with a minimum diameter of 5 mm bilaterally. There was also calcification of the abdominal aorta with mild tortuosity (**Figure 1**).

Because of her comorbidities and frailty, the patient was believed to be more appropriate for TAVR rather than surgical aortic valve replacement. Because of the small-caliber peripheral vessels, it was decided to use a low-profile TAVR valve, the

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Medtronic Evolut PRO+ 26 mm, using a sheathless approach.

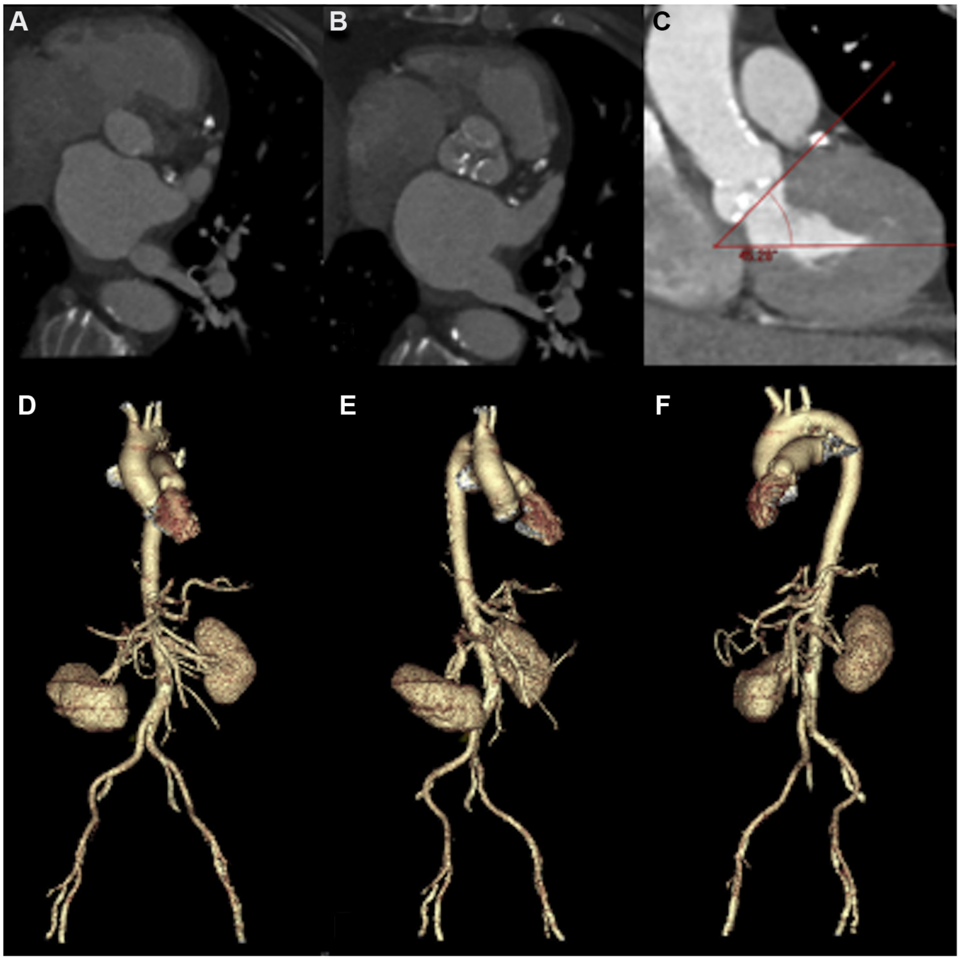
The main access was the right femoral artery, and secondary access was the left femoral artery. The aortic valve was easily crossed with an Amplatz left 2 catheter and a straight-tipped 0.035 inches wire. A precurved Safari2 extra-small wire (Boston Scientific) was positioned in the left ventricle, and the valve was advanced to the aortic root. However, despite several attempts, we were unable to cross the aortic valve with the TAVR valve. Different angulations and wire techniques previously reported[1] were attempted unsuccessfully. To improve support, an extra-stiff Lunderquist wire (Cook Medical) was positioned as a buddy wire via a pigtail catheter in the noncoronary cusp from the contralateral femoral access to straighten the tortuosity in the descending aorta and create a more favorable angle to approach the aortic valve, as previously described.[2] Despite several attempts, the valve still could not be crossed.

It was believed that the issue was caused by the unfavorable angle of approach to the aortic valve rather than caused by the valve stenosis. Therefore, it was decided not to perform a balloon aortic valvuloplasty. An aortic valvuloplasty balloon was used to redirect the valve by correcting the approach angle. Because of the difficult arterial access and sheathless

ABBREVIATIONS AND ACRONYMS

TAVR = transcatheter aortic valve replacement

FIGURE 1 **Computed Tomography: Transcatheter Aortic Valve Replacement, Preprocedural Assessment**



(A) Aortic valve annulus plane for measurements (area: 348 mm^2; perimeter: 70 mm; diameter: 17.5 × 26 mm), no left ventricular outflow tract calcifications. **(B)** Calcified trileaflet aortic valve (Agatston score: 1,387 AU). **(C)** Mild ascending aorta dilatation (40 mm) with significant wall calcifications and horizontal aortic angle (45°). **(D to F)** Three-dimensional reconstruction of the aorta showing mild tortuosity of the abdominal aorta in different views.

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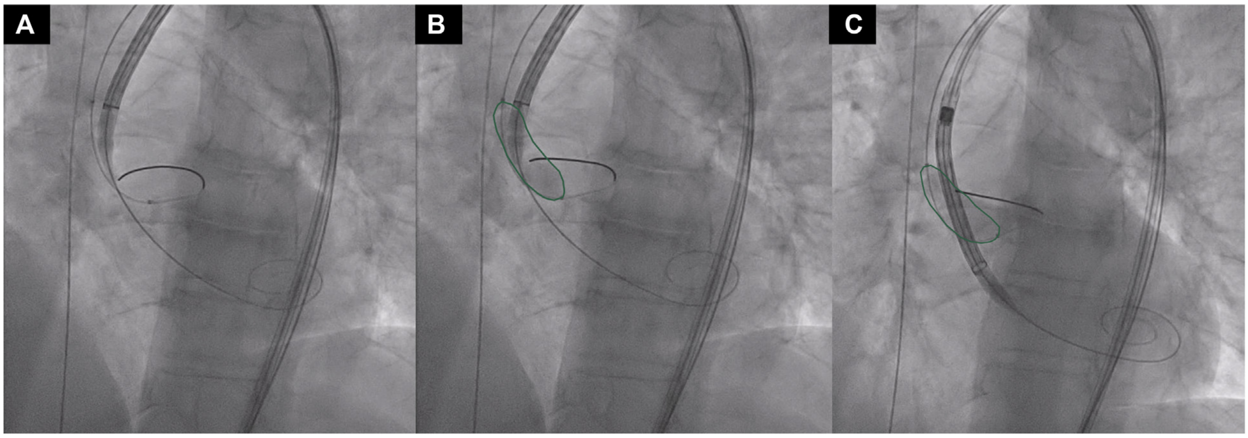
FIGURE 2 **Sequence of the Balloon Nudge Technique**



(A) A balloon aortic valvuloplasty balloon is advanced over an extra-stiff wire previously positioned in the noncoronary cusp. **(B)** The balloon is partially inflated in the aortic root. **(C)** Keeping the balloon inflated, the transcatheter aortic valve replacement valve is simultaneously advanced. The balloon gives a gentle nudge to the delivery system, reaching an optimal coaxial alignment.

approach, a decision was made not to use a gooseneck snare to avoid further vascular manipulation.

The contralateral access was upgraded to a 10-F sheath, and an over-the-wire 18 × 50-mm noncompliant balloon (VACS II, OSYPKA Medtec) was advanced over the extra-stiff wire to the noncoronary cusp (**Figure 2A**). A slow partial inflation of the balloon (6 mL) gave the TAVR valve a gentle nudge, which brought the TAVR valve toward a more coaxial position (**Figure 2B**). This allowed advancement of the prosthetic valve across the native aortic valve (**Figure 2C**). The balloon was deflated and retrieved. The extra-stiff wire was retrieved, and a pigtail catheter was repositioned to the noncoronary cusp. With controlled pacing, the valve was successfully deployed.

The patient had an excellent final angiographic result. Periprocedural echocardiogram was also satisfactory. The patient required a permanent pacemaker for conduction disease and was discharged with no complications.

DISCUSSION

This case uses a novel "balloon nudge technique." This technique involves the partial inflation of an aortic valvuloplasty balloon in the aortic root to nudge the TAVR valve into a coaxial position, allowing crossing of the native aortic valve, particularly in angulated aortas.

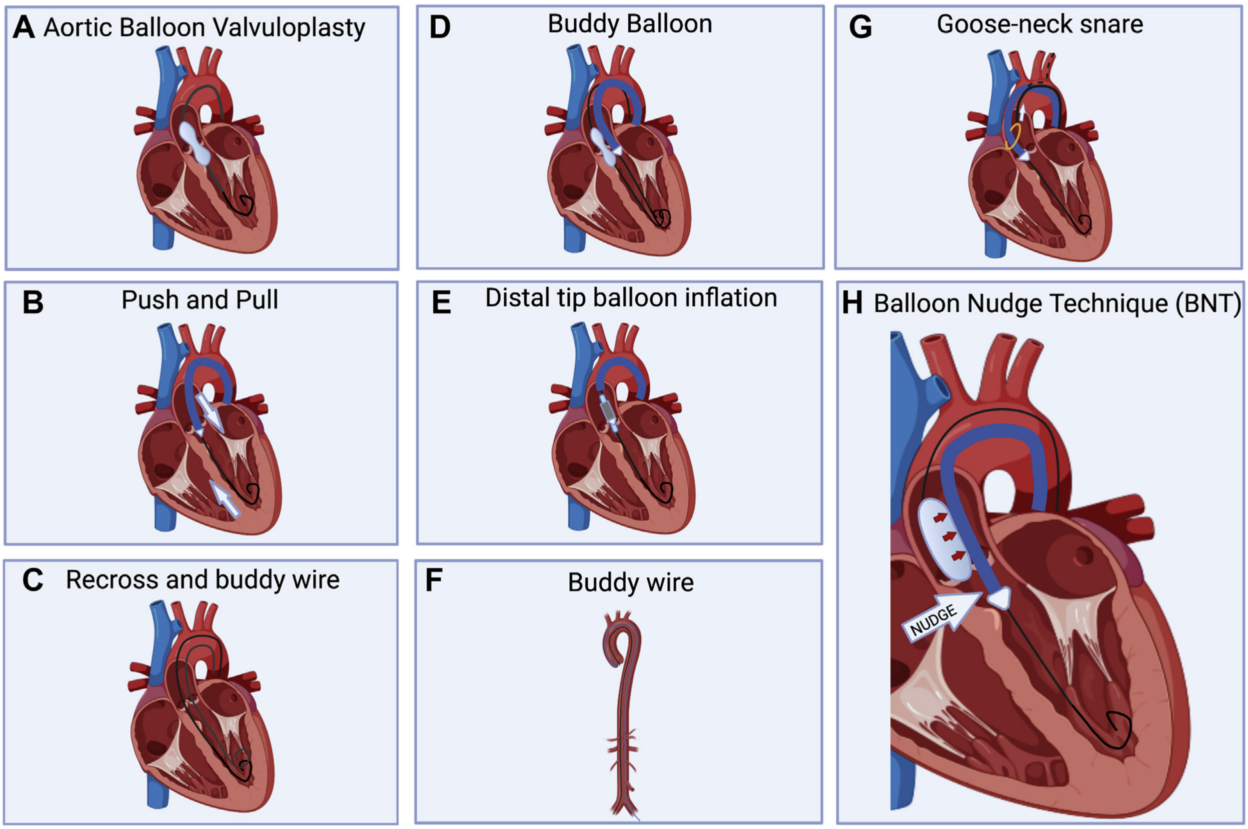
A similar technique, the "buddy balloon technique" for TAVR, was first described by Sheiban et al[3] as a percutaneous shoehorn for difficult-to-cross aortic valves (**Figure 3**), and its use has been extensively reported.[1,7,8]

Our "balloon nudge technique" has multiple advantages over the previously described buddy balloon technique: 1) no crossing of the stenotic valve is required, reducing hemodynamic compromise and procedural time; 2) there is no need for a second stiff wire in the left ventricle, reducing the risk of left ventricular perforation; 3) there is no need for rapid pacing, avoiding potential hemodynamic decompensation; and 4) there is no need for balloon aortic valvuloplasty, which might lead to acute aortic regurgitation. The disadvantage is the necessity to upgrade the secondary arterial access to a larger sheath size. This technique can be used primarily in self-expanding valves and potentially also in balloon-expandable valves.

Our technique attempts to overcome challenges in crossing the valve caused by noncoaxial alignment. This may be attributable to anatomic factors or to prosthesis issues such as maneuverability of the delivery system. Anatomic factors may include: 1) a horizontal aorta; 2) a dilated ascending aorta; and 3) a tortuous descending aorta. Other unfavorable anatomic characteristics include severely calcified aortic valves and bicuspid aortic valves (Supplemental Figure 1).

In this case, the angle between the aorta and the horizontal plane was 45°. The presence of a horizontal aorta with the aortic angle >48° has been described as reducing procedural success and

FIGURE 3 Techniques for Difficult-to-Cross Aortic Valves



(A) Balloon aortic valvuloplasty: well recognized for severely calcified aortic valves. **(B)** Push-and-pull technique: used to resolve the tension and centralize the transcatheter aortic valve replacement valve for coaxial crossing. **(C)** Recross and buddy wire: gives extra support to the system.[4] **(D)** Buddy balloon technique: inflating a valvuloplasty balloon across the aortic valve while advancing the valve delivery system. **(E)** Distal tip balloon inflation: in balloon-expandable valves.[1,5] **(F)** Buddy wire without crossing: to straighten the descending aorta and relieve tortuosity. **(G)** Gooseneck snare: can be used via radial or femoral access.[6] **(H)** The balloon nudge technique as described.

increasing the risk of paravalvular leak with the first-generation self-expanding valves.[9] A more recent study on newer-generation TAVR valves demonstrated equal procedural success with both self-expanding and balloon-expanding valves, with an increased radiation dose and tendency to higher fluoroscopic time in patients with horizontal aorta. This was more evident when using self-expanding valves,[10] highlighting the increased procedural challenges in this setting.

CONCLUSIONS

Techniques for difficult-to-cross aortic valves are well known. Here, we describe the balloon nudge technique, a novel method that allows difficult valve crossing using a controlled nudge that redirects the TAVR delivery system to an optimal coaxial alignment.

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KEY WORDS aortic stenosis, difficult to cross, horizontal aorta, TAVR, techniques

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