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CASE REPORT

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Novel Techniques to Crossing a Severely Stenotic Aortic Valve

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ABSTRACT

This report presents 2 cases with the use of different techniques to facilitate aortic valve crossing during transcatheter aortic valve replacement with a balloon-expandable system. Case 1 involves a balloon cushion technique with an Edwards Sapien 3 valve (Edwards Lifesciences), and case 2 describes successful crossing and implantation using a buddy balloon technique with an Edwards Sapien Ultra valve. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2019;1:848–52) © 2019 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/).

CASE 1

HISTORY OF PRESENTATION. A 72-year-old man presented with worsening heart failure secondary to severe symptomatic aortic stenosis and severe left ventricular (LV) impairment. A transthoracic echocardiogram revealed low-flow, low-gradient aortic stenosis (aortic valve [AV] area, 0.6 cm^2; AV mean gradient, 29 mm Hg) with a dilated left ventricle, reduced ejection fraction (10% to 15%), and moderate aortic regurgitation. The patient was breathless on minimal exertion (New York Heart Association functional class III to IV). We calculated a predicted surgical mortality of 10.1% (Society of Thoracic Surgeons-Predicted Risk of Mortality) and following heart team discussion, transfemoral transcatheter AV replacement (TAVR) was the preferred option in view of the elevated risk of surgical AV replacement.

LEARNING OBJECTIVES

- Clinicians should be able to understand and use different techniques that can help in cases of difficult AV crossing during TAVR.
- Clinicians should be able to recognize the distinct structural properties of the Edwards Sapien 3 and the Edwards Sapien Ultra valves when attempting rescue maneuvers to cross the AV.

PRE-PROCEDURAL INVESTIGATIONS. Coronary angiogram revealed unobstructed coronary arteries. Multislice computed tomography angiography demonstrated a severely calcified trileaflet AV (**Figure 1A**) with a mean annulus of 25 mm and a perimeter of 86 mm (**Figure 1B**). The aortic angle was favorable, and sinus of Valsalva dimensions were generous at 33 × 32.8 mm (**Figure 1C**), with acceptable coronary heights and good-caliber peripheral access. In view of the severe LV impairment, the plan was to minimize rapid pacing runs and therefore aim for a direct implant with an Edwards 26 mm Sapien 3 valve (Edwards Lifesciences Corporation, Irvine, California).

MANAGEMENT. The procedure was performed with the patient under conscious sedation. A 4-F temporary

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Informed consent was obtained for this case.

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pacing wire was inserted, with right radial access for aortography and pre-closure of the right femoral artery with a Prostar XL (Abbott Vascular, Santa Clara, California) before Edwards E-sheath insertion. The valve was crossed with a Safari wire (Boston Scientific, Miami, Florida) placed in the left ventricle. A 26-mm Edwards Sapien 3 valve was advanced and loaded.

The valve was extremely stenosed and did not allow the Sapien 3 Commander delivery system to cross despite flex adjustments, considerable forward push on the system, and tensioning on the Safari wire (Figure 1D).

For the balloon cushion technique, we inflated 1 to 2 cm^3 of the distal part of the Edwards balloon to cross the valve (Figure 1E). This was akin to coronary balloon tracking techniques and so provided a cushion of contrast at the leading edge of the delivery system and successfully facilitated crossing (Figure 1F). The valve was then implanted in an uncomplicated fashion with a good final result.

CASE 2

HISTORY OF PRESENTATION. An 82-year-old man presented with increasing breathlessness secondary to severe aortic stenosis (New York Heart Association functional class III). Comorbidities included paroxysmal atrial fibrillation, type 2 diabetes mellitus, chronic obstructive pulmonary disease Gold stage 2, and an adverse body mass index. A transthoracic echocardiogram revealed a calcified stenotic trileaflet AV (maximum velocity, 4 m/s; AV mean gradient, 40 mm Hg) with a normal LV ejection fraction (55%) and mild aortic regurgitation. We calculated a predicted surgical mortality of 6.7% (Society of Thoracic Surgeons-Predicted Risk of Mortality), and the heart team decision recommended transfemoral TAVR in view of the significant comorbidities.

PRE-PROCEDURAL INVESTIGATIONS. Coronary angiography showed unobstructed coronary arteries. Cardiac computed tomography demonstrated a

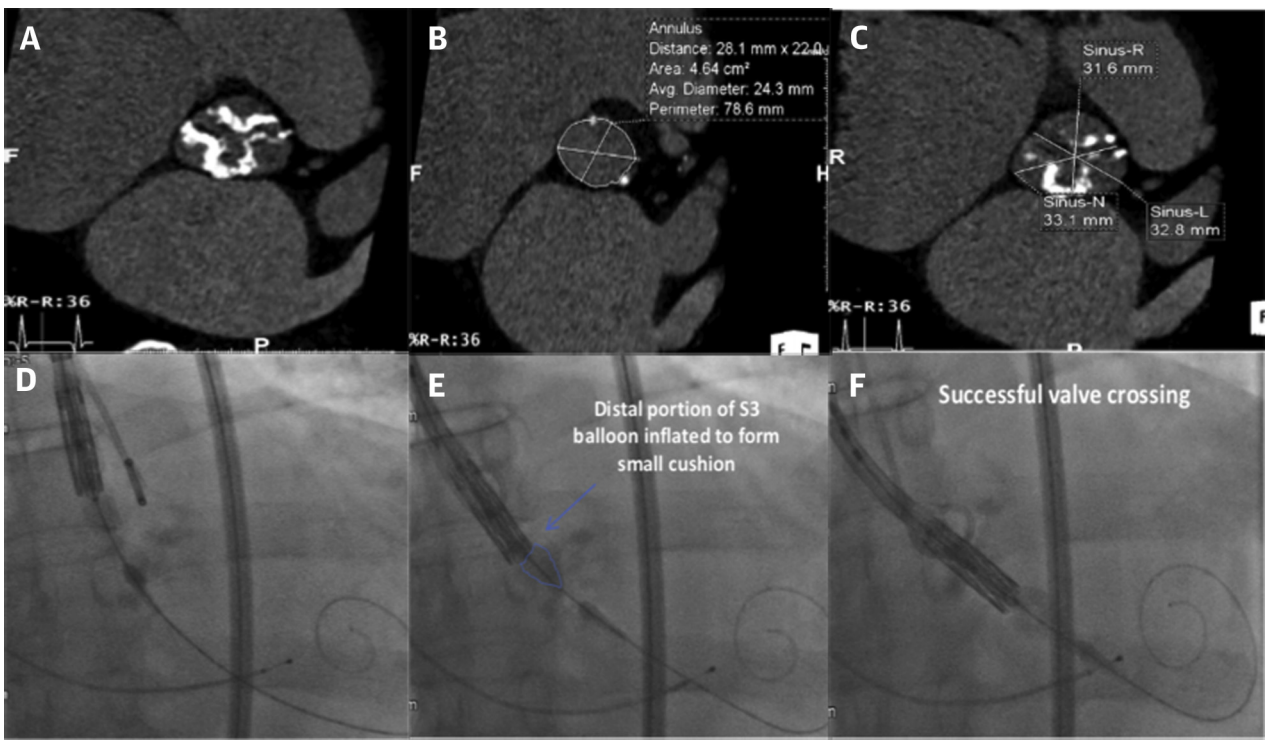
ABBREVIATIONS AND ACRONYMS

AV = aortic valve

LV = left ventricular

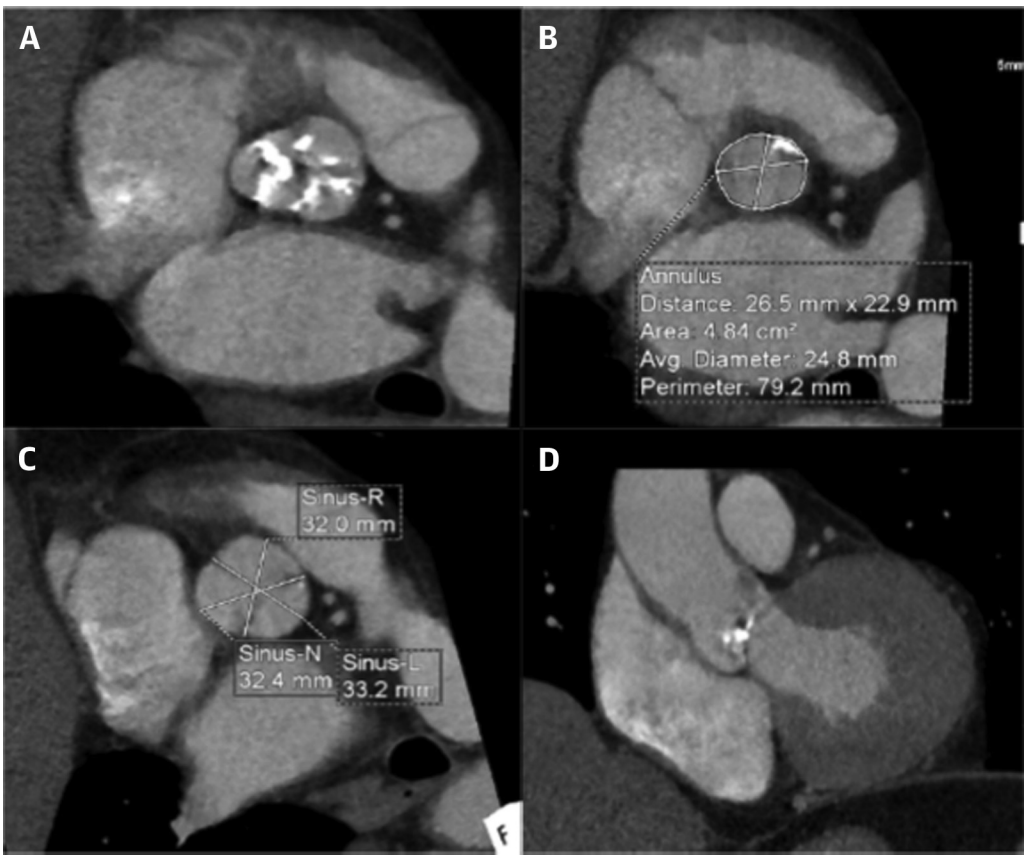
TAVR = transcatheter aortic valve replacement

FIGURE 1 Pre-Procedural MSCT and Angiographic Views of Crossing the Aortic Valve With the Balloon Cushion Technique in Case 1



(A) Heavily calcified trileaflet aortic valve. **(B)** Mean annular measurement (25 mm). **(C)** The sinus of Valsalva measurements (biplane 33× 32.8 mm). **(D)** Failure to cross the aortic valve despite considerable push and manipulation. **(E)** Inflation of 1 to 2 cm^3 of the distal part of the balloon (**blue arrow** highlighting the outline of contrast). **(F)** Successful crossing of the aortic valve following the balloon cushion technique. L = left; MSCT = multislice computed tomography; N = node; R = right.

FIGURE 2 Pre-Procedural MSCT in Case 2



(A) Heavily calcified trileaflet aortic valve. **(B)** Average annular measurements 24.8 mm. **(C)** Sinus of Valsalva measurements (biplane 32 × 33.2 mm). **(D)** Nearly horizontal aorta with an annuloaortic angle of 56°. Avg = average; other abbreviations as in Figure 1.

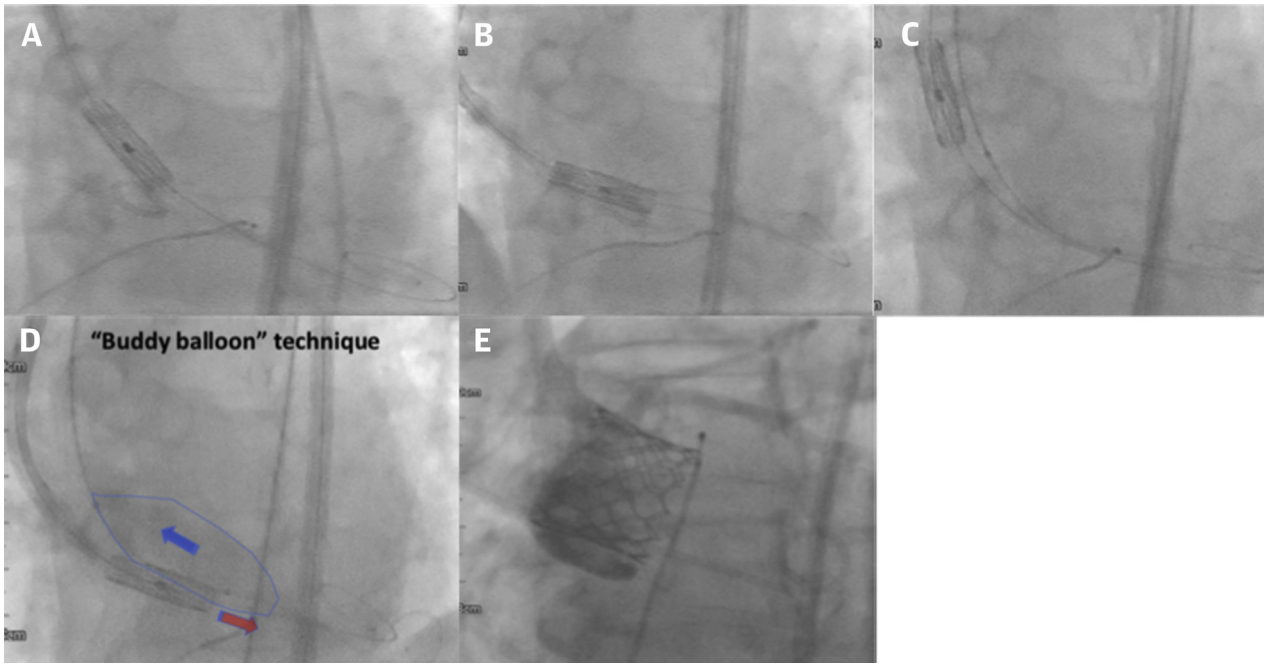
heavily calcified trileaflet AV without commissural fusion (Figure 2A). The annulus was eccentric at 26.5 × 22.9 mm (Figure 2B), with a mean diameter of 24.8 mm and a perimeter of 79.2 mm. The sinus of Valsalva was a good size at 32 × 33.2 mm (Figure 2C), with acceptable coronary heights. The annuloaortic angle was unfavorable at 56° (Figure 2D), and peripheral vessels were of good caliber.

MANAGEMENT. The AV was crossed with difficulty using an Amplatz left 1 (AL1) 5-F catheter and a Terumo 0.035 guidewire (Terumo Medical Corporation, Tokyo, Japan). We then exchanged it for a Safari wire in the left ventricle. Despite flex adjustment, forward push, and wire tension maneuvers, we were unable to cross the AV with the delivery system (Figures 3A and 3B). The balloon cushion technique must never be used with the current Sapien Ultra valve system because the balloon inflation occurs proximally, rather than distally as with the Sapien 3 Commander system. Consequently, we decided to perform balloon pre-dilation with a 20- × 45-mm Cristal balloon (Balt extrusion, Montmorency, France) from the contralateral femoral artery, but we were still unable to cross the AV (Figure 3C). To facilitate crossing we then adopted a modified version of the buddy balloon technique that involved advancing the Sapien Ultra valve while simultaneously withdrawing a deflating 20-mm valvuloplasty balloon (Figure 3D). This was successful and permitted uncomplicated deployment with a good final result.

DISCUSSION

Consistent with contemporary practice we do not routinely pre-dilate to reduce procedural time and contrast volume and avoid crossing the arch multiple times (1). It is rare to have difficulty crossing the AV with a transcatheter valve delivery system; however, extreme angulation, heavy calcification,

FIGURE 3 Angiographic Views Demonstrating Difficulty in Crossing the Aortic Valve and Rescue Maneuvers With the Buddy Balloon Technique

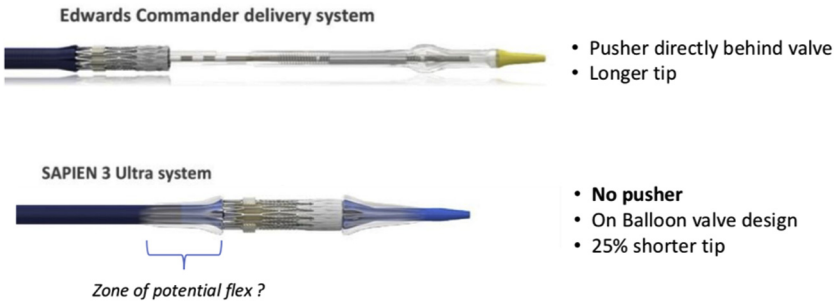


(A) Sapien Ultra valve (Edwards Lifesciences) and delivery system were unable to cross the aortic valve. **(B)** Sapien Ultra valve on the outer curve bias despite delivery system and wire coaxial maneuvers. **(C)** Failure to cross despite use of a Cristal balloon (Balt extrusion; 20- × 45-mm) for valvuloplasty. **(D)** Deflating and withdrawing the buddy balloon across the aortic valve **(blue arrow)** while advancing the Sapien Ultra valve **(red arrow)** to facilitate successful crossing. **(E)** Successful crossing and implantation of the Sapien Ultra valve.

and bicuspid morphology are all recognized risk factors. Different techniques and maneuvers have been described when operators are unable to cross the AV (2).

1. The pull and push technique (2) involves gently pulling on the stiff guidewire to resolve wire entrapment between the valve leaflets and trying to centralize the guidewire. Further wire and delivery system maneuvers to avoid inner-outer curve bias may be effective.
2. If pre-dilation of the native valve has not been performed up front, then it can be performed after the TAVR delivery system has been introduced into the body, but it must be done from the contralateral access site.
3. The recross and buddy wire technique (2) can be considered. This involves recrossing the valve

FIGURE 4 Important Differences Between the Edwards Sapien 3 (Commander) and the Edwards Sapien Ultra Delivery System



through the contralateral access site and using a second stiff wire as a buddy within the left ventricle.

4. The balloon cushion technique, as described earlier, is suitable for use only with the Edwards Sapien 3 valve and not the Sapien Ultra system because of the difference in site where balloon inflation initiates. In addition, structural differences in the 2 delivery systems mean that there is a zone of potential flex within the Ultra system that should be appreciated (**Figure 4**).
5. The buddy balloon technique is occasionally used during percutaneous coronary interventions to facilitate crossing of tortuous or calcified segments (3). The principle is to provide taper to the distal end of the delivery system to facilitate crossing.
6. The snare technique makes use of a snare inserted through the contralateral femoral artery and is used predominantly with self-expanding valves to achieve better alignment of the delivery system tip with the native valve.

We acknowledge that early cerebrovascular events are mainly procedural and related to device manipulation, post-valve deployment balloon dilation, and repeated prosthesis placement. Thus, using more aggressive techniques to help cross the AV would have a theorical increased risk of stroke.

CONCLUSIONS

In patients with challenging anatomy, rescue maneuvers may be needed to facilitate crossing of the transcatheter valve delivery system into the left ventricle. Many techniques can be used with both self-expanding and balloon-expandable systems; however, the Sapien 3 and Sapien Ultra system have distinct structural properties that must be considered when deciding which technique to use.

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REFERENCES

1. Auffret V, Regueiro A, Campelo-Parada F, et al. Feasibility, safety, and efficacy of transcatheter aortic valve replacement without balloon predilation: a systematic review and meta-analysis. Catheter Cardiovasc Interv 2017;90:839–50.

2. Van Mieghem NM, Tzikas A, Nuis RJ, Schultz C, Serruys PW. How should I treat a staggering TAVI procedure? EuroIntervention 2010;6:418–23.

3. Sheiban I, Infantino V, Bollati M. Buddy balloon to deliver a percutaneous aortic valve device: a percutaneous shoehorn? Catheter Cardiovasc Interv 2009;74:805–7.

KEY WORDS aortic valve, imaging, valve replacement