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CASE REPORT

INTERMEDIATE

TECHNICAL CORNER

Intentional Misalignment of a Transcatheter Aortic Valve to Preserve Reaccess to Coronaries of Anomalous Origin

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ABSTRACT

Achieving patient-specific commissural alignment of transcatheter aortic valves is particularly important to ensure coronary reaccess after transcatheter aortic valve implantation. Nevertheless, in case of uncommon origin of coronary arteries, commissural alignment could be counterproductive. This case shows how alignment techniques could serve to intentionally misalign the neocommissures in this subset of patients. (**Level of Difficulty: Intermediate.**)
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A 82-year-old woman underwent outpatient cardiac examination because of new-onset exertional dyspnea and fatigue (NYHA functional class II) for 6 months. A holosystolic aortic 3/6 murmur was detected. Transthoracic echocardiography showed preserved left ventricular ejection fraction and severe aortic stenosis (mean transvalvular gradient 80 mm Hg, aortic valve area 0.7 cm^2). Mitral and tricuspid valve mild regurgitation was also detected. Therefore, the patient was referred to our center to undergo transcatheter aortic valve implantation (TAVI).

LEARNING OBJECTIVES

- To understand the importance of properly evaluating coronary artery anomalies during TAVI workup.
- To select the most appropriate transcatheter aortic valve in each anatomy, with the aim of guaranteeing uncomplicated coronary reaccess.
- To take advantage of commissural alignment techniques to displace TAV neocommissures according to the origins of the coronary arteries.

MEDICAL HISTORY

The patient was taking a polypill (angiotensin converting enzyme-inhibitor + diuretic + calcium channel blocker) as hypertension treatment. No prior cardiac or cerebrovascular accidents were reported.

DIFFERENTIAL DIAGNOSIS

Pulmonary or neoplastic disorders as alternative diagnoses of dyspnea and fatigue were excluded during the index visit.

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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.

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ABBREVIATIONS AND ACRONYMS

CTA = computed tomography angiography

TAV = transcatheter aortic valve

TAVI = transcatheter aortic valve implantation

INVESTIGATIONS

Preprocedural, electrocardiogram-gated computed tomography angiography (CTA) acquisitions showed vascular anatomy suitable for transfemoral access and aortic root dimensions suitable for transfemoral TAVI with any of the transcatheter aortic valves (TAVs) commercially available (Figure 1).[1] Nevertheless, CTA scans revealed an anomalous origin of the left coronary artery, which arises from the noncoronary cusp, immediately close to the native commissure that separates the left and the noncoronary coronary cusps. Also, a relatively low origin of the coronary (9.5 mm above the virtual basal ring) was detected.

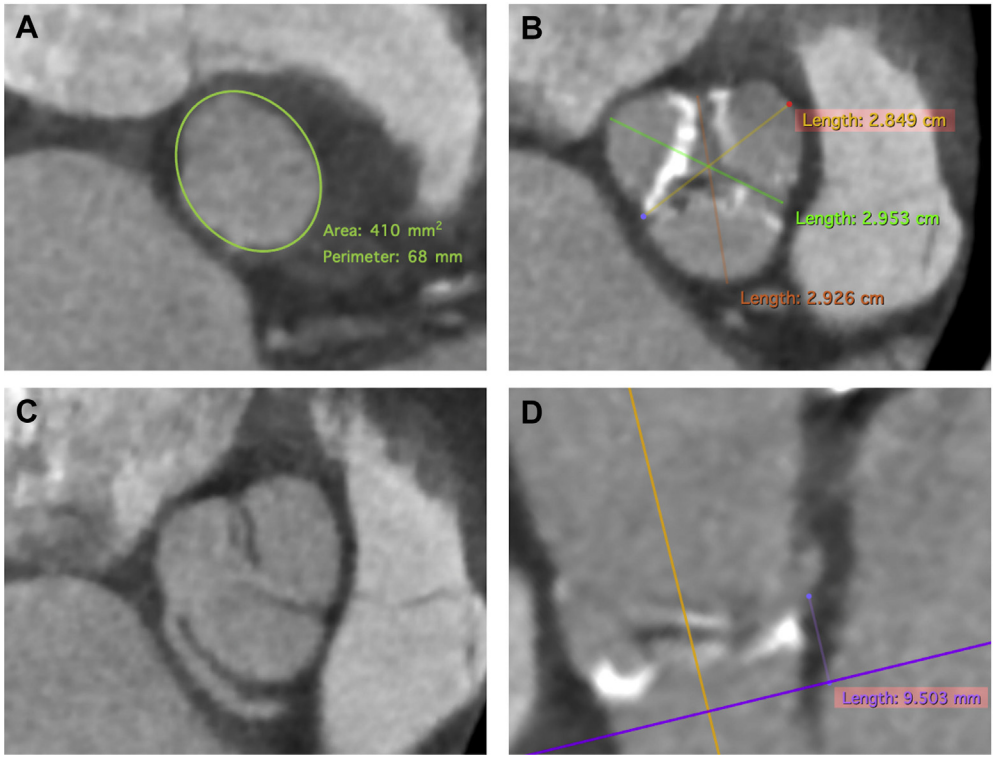
MANAGEMENT

The Acurate NEO2 TAV (Boston Scientific) has a design that allows easy identification of the prosthetic commissures, which match the bases of the 3 stabilization arches of the upper part of the TAV frame. The possibility to visualize the 3 commissural posts by fluoroscopy allows them to be aligned or not aligned to the native commissures.

Therefore, we decided to implant a size S TAV and to intentionally misalign the prosthetic commissures so as to preserve future access to the coronaries. We anticipated that a severe commissural misalignment would have placed a neocommissure in front of the right coronary artery ostium. However, that latter structure was widened, and its sinus of Valsalva was large enough to accomplish complete engagement of a catheter from laterally or above.

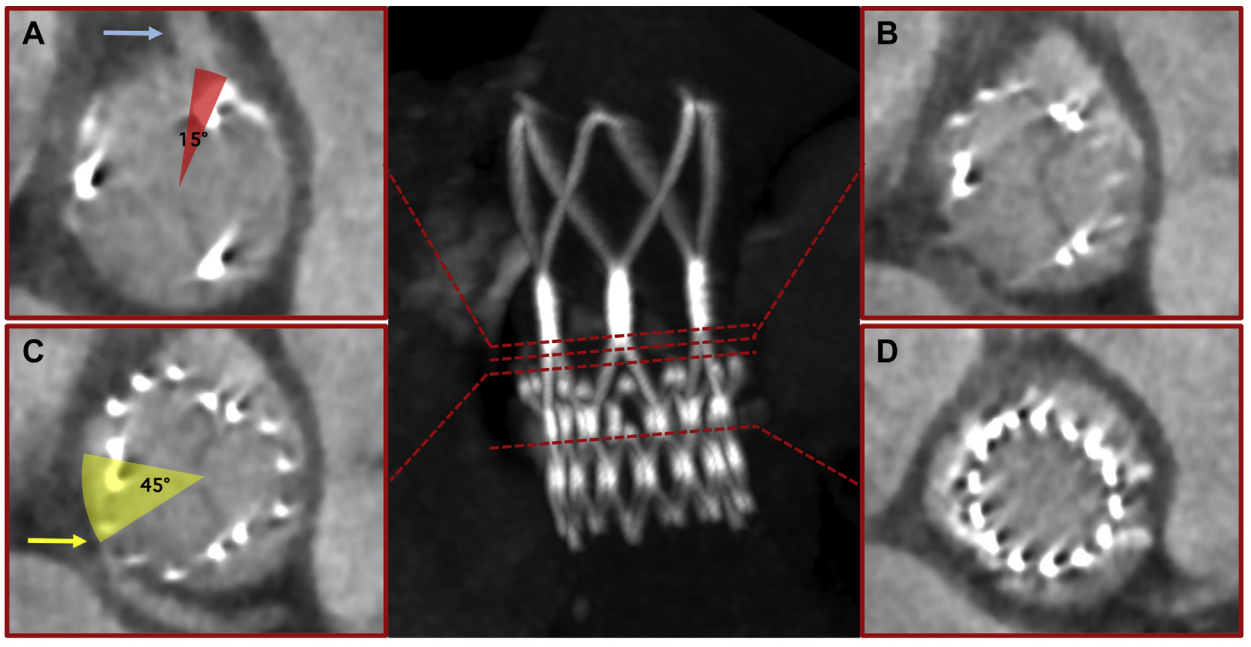
This challenging anatomy raised concerns about the patency of the left coronary after deployment of a TAV because of the limited space for the tilting of the native leaflet in proximity to the commissure. Therefore, it was decided to place a guidewire and a coronary stent down to the left coronary as a backup for treating an eventual coronary occlusion after TAVI.

FIGURE 1 Computed Tomography Angiography Assessment of the Aortic Root During Workup for Transcatheter Aortic Valve Implantation



(A) Annulus dimensions. **(B)** Sinuses of Valsalva dimensions. **(C)** Anomalous origin of left main coronary artery. **(D)** Height of left main coronary artery from virtual basal ring.

FIGURE 2 **1-Month Computed Tomography Angiography Assessment of Transcatheter Aortic Valve Commissural Misalignment**



(A) Cross-section at the level of right coronary origin **(light blue arrow)** and overlap degree of coronary ostium with the nearest neocommissure. **(B)** Cross-section at the level of prosthetic leaflets. **(C)** Cross-section at the level of left coronary origin **(yellow arrow)** and overlap degree of coronary ostium with the nearest neocommissure. **(D)** Cross-section at the level of the sinuses of Valsalva.

Predilation with a 20-mm True Dilatation valvuloplasty balloon (Becton Dickinson) was then performed. Afterward, the TAV delivery system was inserted with the flush port at 4 o'clock (away from the operator) and advanced up to the ascending aorta. This resulted in positioning of the 3 tabs at the bases of the stabilization arches facing the 3 native cusps, aiming at a moderate to severe grade of commissural misalignment after valve deployment. The intended orientation was confirmed in both the cusp overlap view (right anterior oblique 12°, caudal 33°) and the 3-cusps view (left anterior oblique 45°, cranial 3°). In the cusp overlap view, used for the commissural alignment technique, the commissural tabs were located equally distant from one another instead of isolating 1 of them at the aortic inner curve (Video 1). In the 3-cusps view, the commissural tabs were visualized with 1 of them at the center and the 2 others equally distant. After valve deployment, the commissural posts were confirmed to be at their intended positions (Video 2).

The angiographic projection used to obtain the best visualization of the left coronary ostium (right anterior oblique 30°, cranial 19°) clearly showed the feasibility of re-engaging the left coronary ostium and of the intended misalignment of the neocommissures (Video 3). The procedure was performed successfully, with no major complications, no aortic regurgitation, and patency of both coronary arteries. The patient was discharged the day after the procedure.

DISCUSSION

Anomalous origin of coronary arteries is a poorly known entity, and its reported incidence ranges from 1% to 6% of the general population.[2] Surgical aortic valve replacement guarantees systematic orientation of the bioprosthesis commissures, avoiding the positioning of a commissural post in front of a coronaria ostium in case of an anomalous origin. Although commissural alignment in TAVI was deemed to be random, recent studies have shown that this can be pursued with most self-expanding TAVs by properly orienting specific radiopaque landmarks of the devices in relationship to the native cusps.[3,4]

Nevertheless, in cases of anomalous origin of coronary arteries, obtaining commissural alignment could be counterproductive.

Although it has been postulated that the commissural alignment might have also an impact on leaflets function and blood flow inside the aortic root,[5] in this case a correct commissural alignment would have resulted in potential impairing of coronary reaccess because of the positioning of a neocommissure in front of the left coronary ostium.

FOLLOW-UP

At 30 days, the patient underwent transthoracic echocardiogram and 4-dimensional CTA assessments to confirm the preserved functioning of the TAV implanted and the absence of subclinical valve thrombosis. An echocardiogram showed optimal performance of the TAV implanted, with an effective orifice area of 1.6 cm^2 and no residual paravalvular leakage. The 4-dimensional CTA acquisitions showed optimal functioning of the valve leaflets and achievement of the neocommissures misalignment without overlapping the left coronary ostium (**Figure 2**).

CONCLUSIONS

Although desirable, TAV commissural alignment should be carefully evaluated during a workup for TAVI, aiming to preserve reaccess to the coronary artery. In a case of anomalous coronary origin, an accurate alignment with native commissures may impair a future cannulation of the coronary. More precise and reproducible techniques to orient the transcatheter valves properly according to the anatomy of each aortic root are awaited to enable movement toward a patient-tailored TAVI.

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Dr. Tamburino is a consultant for Medtronic. Dr. Barbanti is a consultant for Edwards LifeSciences, Medtronic, and Boston Scientific. 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 commissural alignment, commissural misalignment, coronary abnormalities, coronary reaccess, transcatheter aortic valve implantation

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