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VALVULAR DISEASE

CASE REPORT: CLINICAL CASE

Late Third Transcatheter Aortic Valve Replacement for Treatment of Persistent Paravalvular Regurgitation

Valentina Frittitta, MD,[a] Giuliano Costa, MD,[a] Maria Teresa Cannizzaro, MD,[b] Cristina Inserra, MD,[b] Valeria Garretto, MD,[b] Elena Dipietro, MD,[a] Orazio Strazzieri, MD,[a] Silvia Motta, MD,[a] Marco Barbanti, MD,[c] Corrado Tamburino, MD, PhD[a]

ABSTRACT

Paravalvular regurgitation remains a frequent finding after transcatheter aortic valve replacement and is associated with unfavorable outcomes if more-than-mild grade. In this case, a patient underwent a third transcatheter aortic valve replacement procedure for worsening symptoms due to severe paravalvular regurgitation. The case underlines the role of preprocedural planning in achieving treatment success. (J Am Coll Cardiol Case Rep 2024;29:102259) © 2024 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/).

HISTORY OF PRESENTATION

A 73-year-old woman presented with new-onset dyspnea and fatigue (NYHA functional class III) 9 years after a transcatheter aortic valve replacement (TAVR)-in-TAVR procedure. She was referred to our institution for acute decompensated heart failure for a comprehensive evaluation. The transthoracic echocardiogram (TTE) showed severe aortic regurgitation (AR) with a left ventricular ejection fraction of 52% and moderate mitral and tricuspid valve regurgitation; thus, she was evaluated for a re-intervention.

LEARNING OBJECTIVES

- To adequately perform computed tomography angiography evaluation and plan bailout procedures for treatment of PVR after TAVR.
- To properly assess the risk of repeat TAVR for severe PVR.
- To choose the best transcatheter aortic valve and its positioning for redo TAVR in this setting.

PAST MEDICAL HISTORY

In 2012, the patient underwent TAVR with a 31-mm CoreValve prosthesis (Medtronic Inc) for severe aortic stenosis at another institution. Despite the initial procedure, residual severe paravalvular regurgitation (PVR) persisted. A year later, the patient presented to our facility due to worsening dyspnea. Given the low implantation of the previous prosthesis as the cause of PVR and the patient's high surgical risk, a TAVR-in-TAVR approach using a second 31-mm CoreValve prosthesis positioned higher was deemed the optimal solution. This approach led to a reduction in PVR severity, transitioning it from severe to moderate.

From the [a]Division of Cardiology, AOU Policlinico G. Rodolico-San Marco, Catania, Italy; [b]Division of Radiology, AOU Policlinico G. Rodolico-San Marco, Catania, Italy; and the [c]Università degli Studi di Enna "Kore", Enna, Italy.

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ABBREVIATIONS AND ACRONYMS

AR = aortic regurgitation

CTA = computed tomography angiography

PVR = paravalvular regurgitation

TAVR = transcatheter aortic valve replacement

TTE = transthoracic echocardiogram

DIFFERENTIAL DIAGNOSIS

Because of the presence of esophageal varices, a transesophageal echocardiogram was deemed unfeasible, and mechanisms of AR were investigated using TTE. The assessment ruled out intraprosthetic AR and confirmed the presence of PVR, with the regurgitant jet located near the left cusp. Four-dimensional computed tomography angiography (CTA) revealed a gap between the bioprosthesis frame and the aortic wall a few millimeters above the annulus with the presence of an annular calcium nodule below, corresponding to the location of the regurgitant jet (**Figure 1A**).

INVESTIGATIONS

Preprocedural planification relied on CTA assessment. The preprocedural plan included a transcatheter paravalvular leak closure and, in the event of unsuccessful attempts to cross the leak, a repeat TAVR. Leveraging the information about the regurgitant jet's location obtained from the TTE images, we selected an optimal fluoroscopic viewing angle (30 °left anterior oblique, 20 °cranial) for crossing the leak using 3-dimensional reconstruction of the aortic root from the CTA assessment (**Figure 1B**).

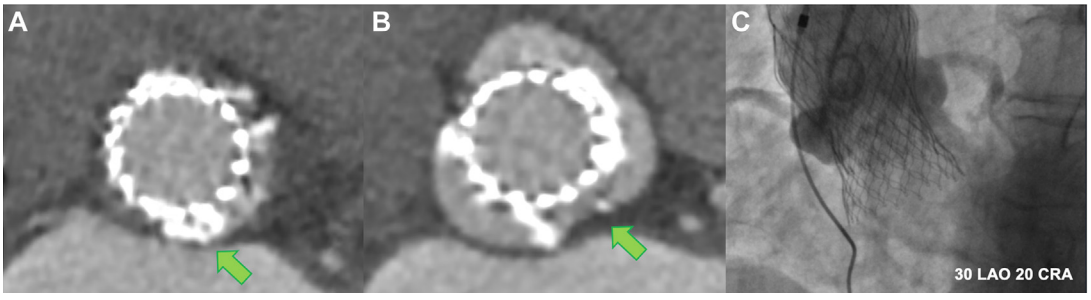
The feasibility of repeating TAVR was hindered by the risk of coronary obstruction and of annular injury.

A 29-mm Sapien 3 (S3, Edwards Lifesciences) was considered in case of redo TAVR. Factors that could potentially impair coronary flow were investigated. Coronary ostia lied below the top of sealing skirt created after the first TAVR-in-TAVR procedure (**Figure 2A**), but the distance between the transcatheter valve frame and sinotubular junction (minimum 4.6 mm) was considered safe; it was also considered safe after considering the possible expansion of the frame of the failed bioprosthesis by the 29-mm S3 valve (**Figures 2B and 2C**).[1,2]

MANAGEMENT

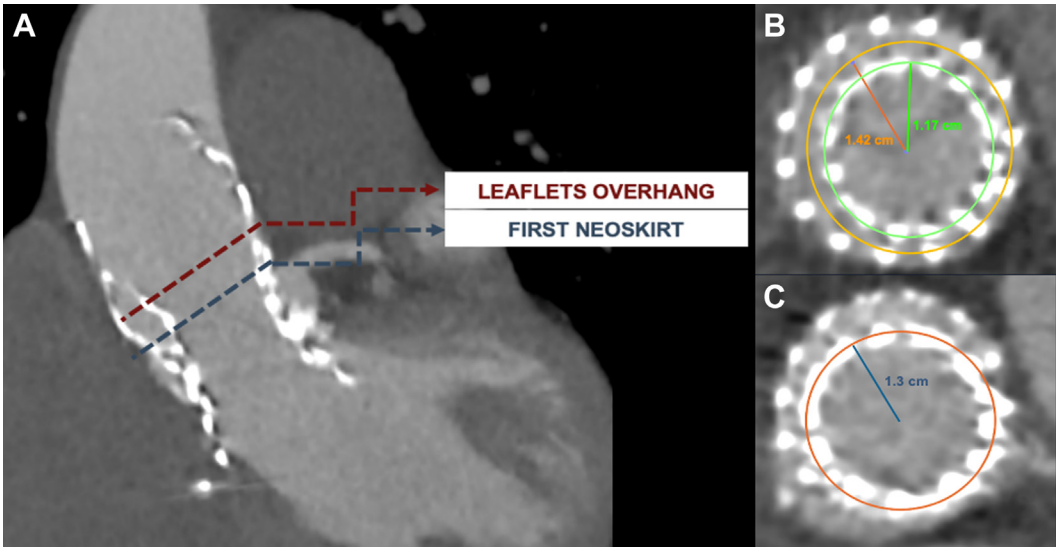
The procedure was performed under local anesthesia. Operators initially performed different attempts to pass through the leak, using hydrophilic 0.03-inch (Terumo Radifocus M) and coronary 0.01-inch (Terumo Runthrough NS) guidewires. Retrograde approach was attempted using a 4-F Ber II catheter, whereas anterograde approach was attempted using 6-Fr AL-1 or angled pig-tail catheters (**Figure 3**). Both approaches were unsuccessful, and it was then decided to proceed with redo-TAVR. After valve deployment, a recoil of the new valve was detected with unchanged PVR grade. Therefore, we performed post-dilatation using the balloon of the device overfilled with the addition of 3 mL solution (**Figures 4A and 4B**). After post-dilatation, the PVR grade reduced from severe to less-than-moderate with a marked improvement in hemodynamics (pulse pressure decreased from 80 mm Hg to 40 mm Hg) (Video 1). Despite no symptoms, electrocardiogram showed ventricular overload signs and repeat angiography showed good coronary flow, but aortic

FIGURE 1 Preprocedural CTA



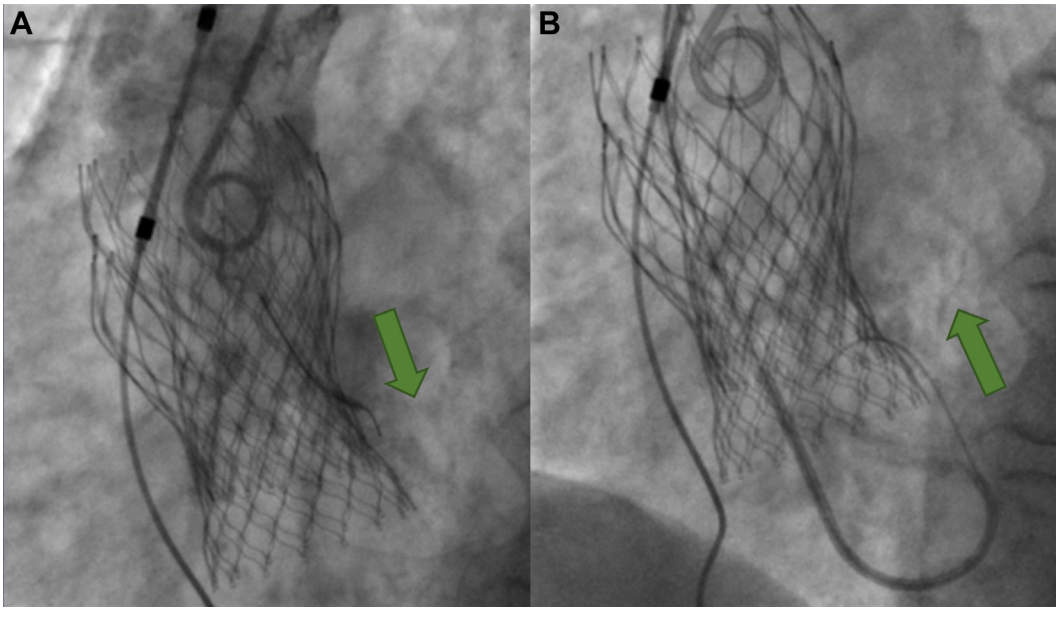
Preprocedural computed tomography angiography (CTA) revealed a gap between the bioprosthesis frame and the aortic wall at the levels of the (A) aortic annulus and (B) sinus of Valsalva (green arrow), corresponding to the precise location of the regurgitant jet. (C) Corresponding optimal fluoroscopic viewing angle for guiding the paravalvular leak closure procedure.

FIGURE 2 **Pre- and Post-Procedural Comparison**



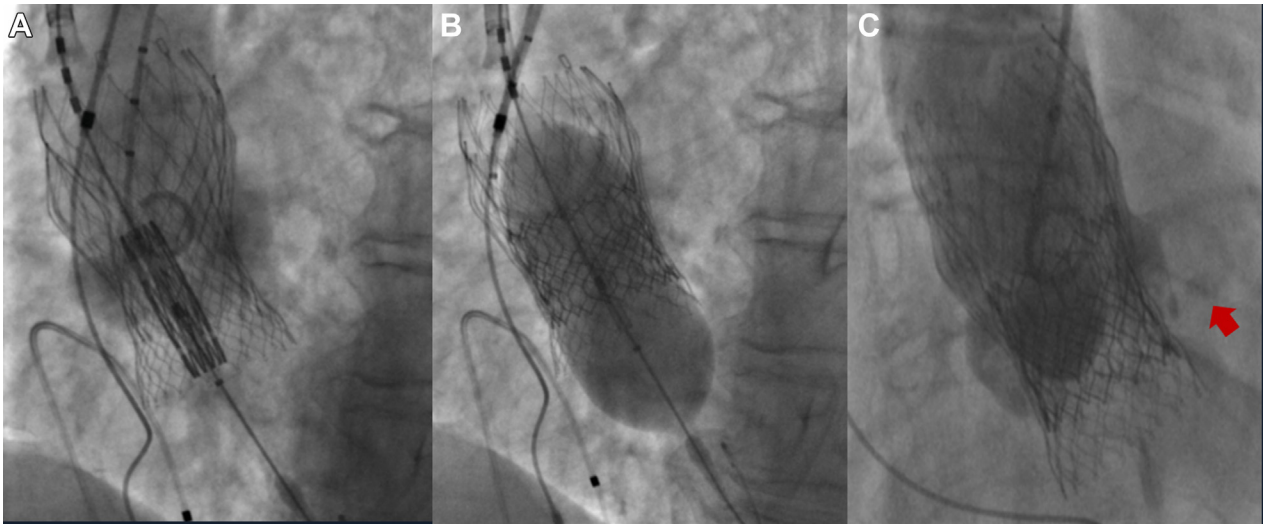
(A) First neoskirt (blue dashed line) and leaflets overhang (red dashed line) level. (B) Second CoreValve dimensions (green circle and radius) and its simulated maximum expansion after redo transcatheter aortic valve replacement (TAVR) with 29-mm Sapien 3 (orange circle and radius). (C) Post-procedural computed tomography re-assessment after third TAVR (red circle) with increase in radius of 0.13 mm (blue radius).

FIGURE 3 **Paravalvular Leak Closure Failure**



(A) Different attempts at paravalvular leak crossing with a 4-F Ber II (retrograde approach) and a (B) 6-F angled pigtail (anterograde approach).

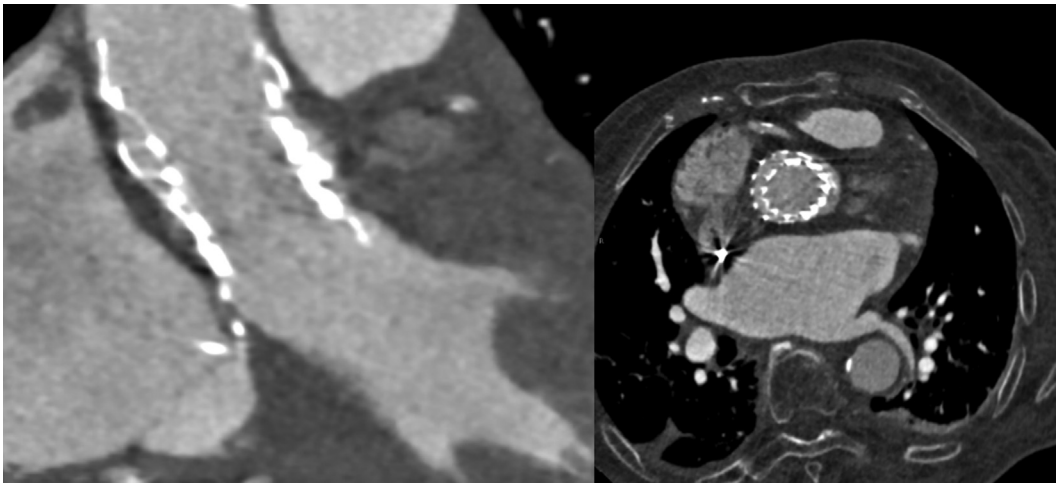
FIGURE 4 Redo-TAVR Procedure



(A) Third TAVR procedure with 29-mm Sapien 3 valve. (B) Device post-dilatation with proprietary balloon overfilled with the addition of 3-mL solution due to frame recoil after deployment. (C) The final angiogram revealed contrast dye leakage at the level of aortic annulus (red arrow). Abbreviation as in Figure 2.

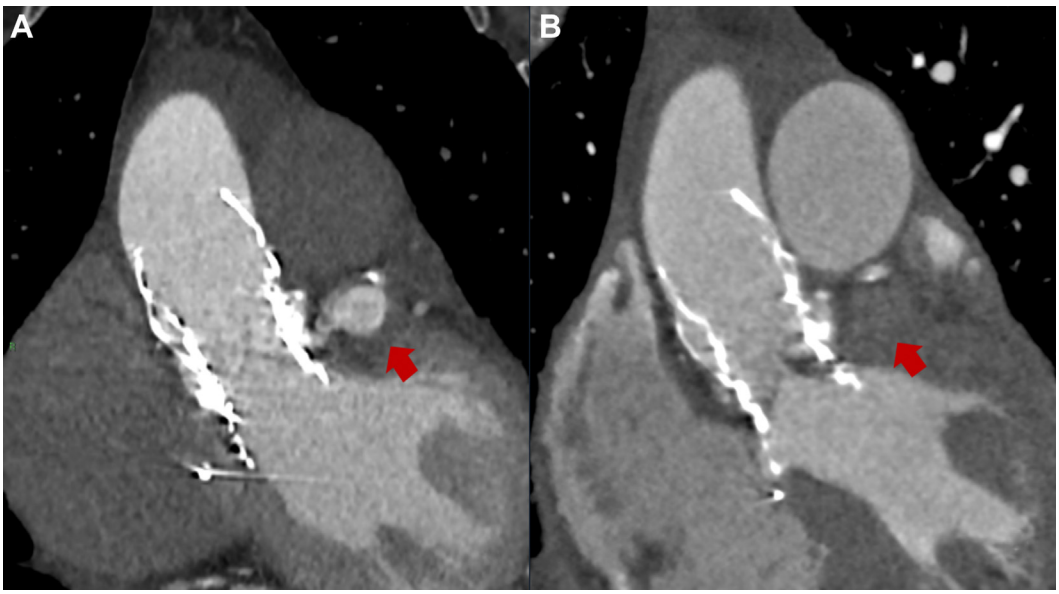
fissuration was at the level of aortic annulus (Figure 4C). An urgent CTA was performed, allowing a diagnosis of an aortic annulus-contained rupture (Figure 5). The patient was transferred back to the catheterization laboratory. After 2 hours monitoring, considering the absence of symptoms and the stability of the hemodynamic status, a conservative approach was chosen.

FIGURE 5 Post-Procedure Computed Tomography Angiography



Urgent computed tomography assessment after the procedure showing contained aortic fissuration.

FIGURE 6 In-Hospital Follow-Up



Computed tomography re-assessment at (A) 3 days and (B) 7 days. The latter showed the complete sealing of the pseudoaneurysm without contrast medium enhancement (red arrow).

DISCUSSION

Despite optimization of TAVR procedure in recent years, PVR remains a challenging issue for several reasons. First, it is associated with increased morbidity and mortality.[3,4] Second, with use of the TAVR procedure expanded to include younger patients, the clinical impact of longstanding PVR may potentially have further impact on bioprosthesis functioning.

The management of PVR depends on the primary mechanism (eg, underexpansion, malpositioning, or protruding calcification), patient anatomy (eg, sinotubular junction height/diameter and distance to the coronary arteries), echocardiographic features (eg, number and size of jets), and patient characteristics such as suspected infection, frailty, and expected longevity. Treatment options include conservative management, surgery, and transcatheter intervention. Conservative management or surgical transcatheter valve explantation are associated with poor outcomes. Transcatheter treatments, including plug closure, redo-TAVR, and balloon valvuloplasty, seem attractive; however, supportive data are limited.

The largest study of patients (n = 201) who underwent transcatheter re-intervention for PVR after index TAVR has been recently published[5] (43% of patients were treated with redo-TAVR, 39% with plug-device, and 18% with balloon valvuloplasty). Landes et al[5] have reported that overall mortality was 5% at 30 days and 14.4% at 1 year; despite re-intervention, persistent AR ≥moderate was not infrequent (17.4% overall). Patients with residual AR ≥ moderate despite re-intervention had higher mortality at 1 year, regardless of the type of treatment.

In this case, we devised a primary, less-invasive treatment strategy, along with a bail-out approach (TAVR-in-TAVR-in TAVR) in case of initial procedure failure. It is crucial to highlight the significance of preprocedural planning based on the patient's clinical status and imaging.

FOLLOW-UP

The patient's status indicated CTA reassessment during the hospitalization (**Figure 6**). Evaluation at 7 days from the index procedure showed complete sealing of the pseudoaneurysm without contrast medium enhancement. The in-hospital course was otherwise uneventful, and the patient was discharged after 10 days with improved symptoms. The TTE at discharge showed good bioprosthesis performance

with mild-to-moderate grade PVR and no pericardial effusion.

CONCLUSIONS

The case underlines the challenges inherent in repeated TAVR procedures and the pivotal role of meticulous preprocedural planning as well as the selection of an appropriate transcatheter heart valve type in achieving a successful and favorable outcome.

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Dr Barbanti has received consulting fees from Medtronic, Boston Scientific, and Edwards LifeSciences. Dr Tamburino has received consulting fees from Medtronic. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr Marco Barbanti, Hospital Umberto I, ASP 4 Enna, Università degli Studi di Enna "Kore," Enna 94100, Italy. E-mail: mbarbanti83@gmail.com.

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KEY WORDS aortic valve, complication, computed tomography, valve replacement

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