JACC: CASE REPORTS VOL. 29, 2024

CASE REPORT

CLINICAL CASE

Balloon-Expandable Valve for the Treatment of Self-Expanding Valve Failure

The Need for a Tailored Approach

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ABSTRACT

An 82-year-old patient experienced symptomatic intra-prosthetic aortic regurgitation 5 years after self-expandable transcatheter heart valve (THV) implantation. Redo-transcatheter aortic valve replacement was initially considered at high risk of coronary obstruction. Using a systematic computed tomography-based approach planning a low implantation with a SAPIEN 3 Ultra THV, we effectively mitigated risks. (J Am Coll Cardiol Case Rep 2024;29:102388) © 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

An 82-year-old man was referred to our institution for rapidly progressive dyspnea 5 years following transcatheter aortic valve replacement (TAVR) with a 26-mm Evolut R transcatheter heart valve (THV) (Video 1). On admission, physical examination revealed severe aortic regurgitation murmur on cardiac auscultation. Transthoracic echocardiography (TTE) and transesophageal echocardiography showed normal left ventricular ejection and severe intravalvular leak, resulting from complete prolapse of the noncoronary cusp. Measurements indicated a regurgitation orifice area of 39 mm^2, telediastolic isthmic reflux at 21 cm/s, and increased cardiac flow at 8.5 L/min. (**Figure 1**, Video 2).

LEARNING OBJECTIVES

- To be able to assess feasibility of redo-TAVR regarding risk of coronary obstruction.
- To understand the tailored approach for optimal positioning of the second THV.

PAST MEDICAL HISTORY

A previous history of nephrectomy for renal cancer in remission and hypertension was noted.

INVESTIGATIONS

Preprocedural coronary angiogram confirmed the absence of coronary artery disease. Although the

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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.

Manuscript received February 19, 2024; revised manuscript received March 25, 2024, accepted April 1, 2024.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2024.102388

ABBREVIATIONS AND ACRONYMS

CT = computed tomography

S3U = Sapien 3 Ultra

TAVR = transcatheter aortic valve replacement

THV = transcatheter heart valve

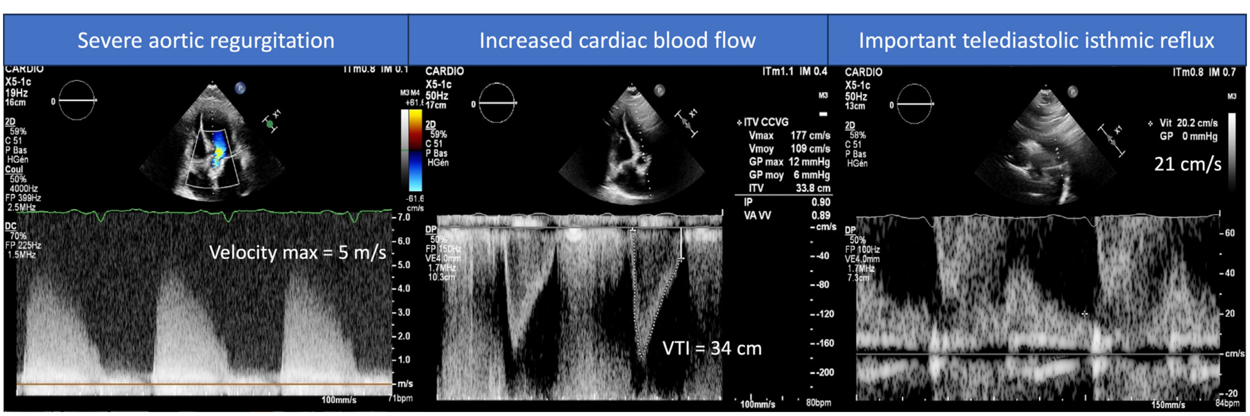
TTE = transthoracic echocardiography

pre-index TAVR CT is crucial for preprocedural planning, it was unfortunately not available in our case. Indeed, we focused the analysis on post-index TAVR, and measured inflow dimensions were 18 × 21 mm (area = 354 mm^2 / perimeter = 63 mm), waist portion dimensions were 20 × 22.5 mm (area = 374 mm^2 / perimeter = 67 mm) (**Figure 2**). Moreover, CT showed a severe commissural misalignment (**Central Illustration**). To assess the risk of coronary obstruction, we considered the projected risk plane, which varies based on the design and implant depth of the index THV, as well as the design and planned Evolut node implantation level (ie, low [node 4], intermediate [node 5], or high [node 6]) of the second short frame THV (**Central Illustration**, **Figure 3**). Considering the critical need to minimize the risk of coronary obstruction, a redo-TAVR using a 23-mm balloon-expandable SAPIEN 3 Ultra (S3U) valve with a low implantation was planned (ie, S3U THV outflow at the level of the index Evolut R THV node 4). This approach resulted in a projected neoskirt of 17.1 mm, with 90% overhang, and 0.5 mm of expansion of the index THV.[1] Notably, the projected neoskirt of 17.1 mm is positioned just below the coronary ostia and sinotubular junction (**Figure 3**).

MANAGEMENT

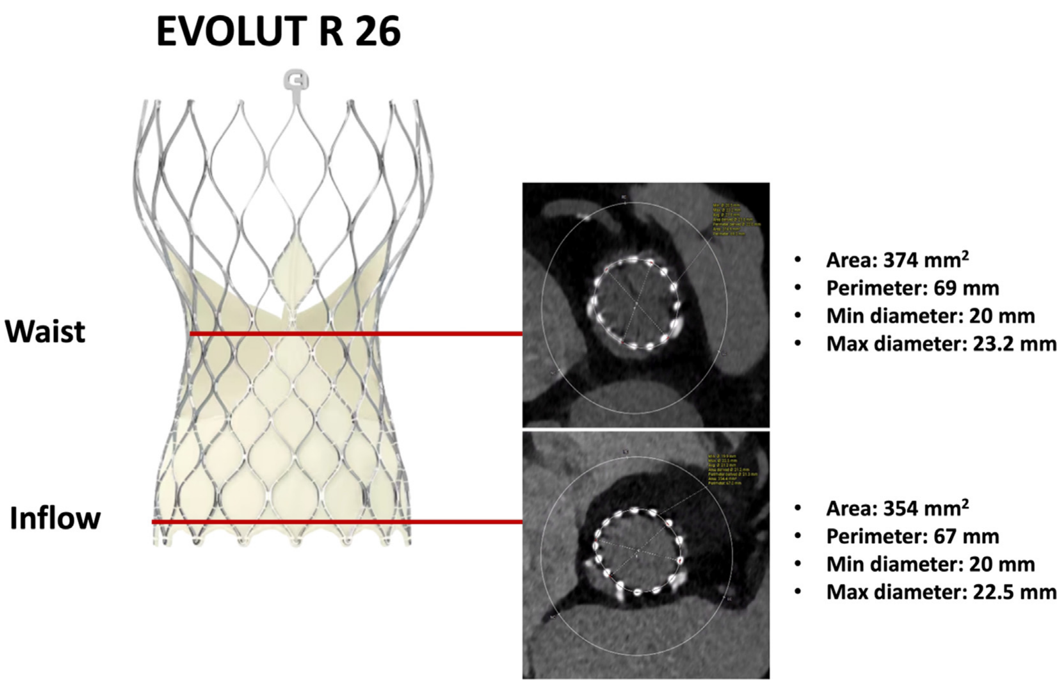
The procedure involved the transcatheter implantation of a S3U 23 mm (Edwards) at nominal level, through a transfemoral approach and using locoregional anesthesia. Because of the planned low implantation of the second THV, a high risk of severe conductance disturbance was anticipated. Pacing was achieved with a temporary pacemaker inserted through the left femoral vein. Coronary protection was used for both left main and right coronary artery with guidewires, used as landmarks for the second THV positioning. The S3U THV was strategically implanted low to minimize the risk of coronary obstruction, by alignment the second S3U THV outflow at the level of the fourth node of the index Evolut R THV. S3U THV deployment occurred after rapid ventricular pacing (Video 3). Final angiogram confirmed a well-implanted device without leakage or coronary obstruction (Video 4). The final electrocardiogram indicated sinus rhythm without significant conductive disorder; thus, the pacing lead was removed at the end of the procedure. Patient was discharged 2 days after the index procedure, supported by day 1 TTE showing no paravalvular leakage and a final residual mean gradient of 13 mmHg (**Figure 4**). Single antiplatelet therapy with aspirin

FIGURE 1 TTE for Assessment of Severity of Intraprosthetic Aortic Regurgitation



Max = maximum; VTI = velocity time integral.

FIGURE 2 Pre Redo-TAVR CT Analysis



Max = maximum; Min = minimum.

alone was introduced after a redo-TAVR procedure, similarly as current post-TAVR antithrombotic strategy.

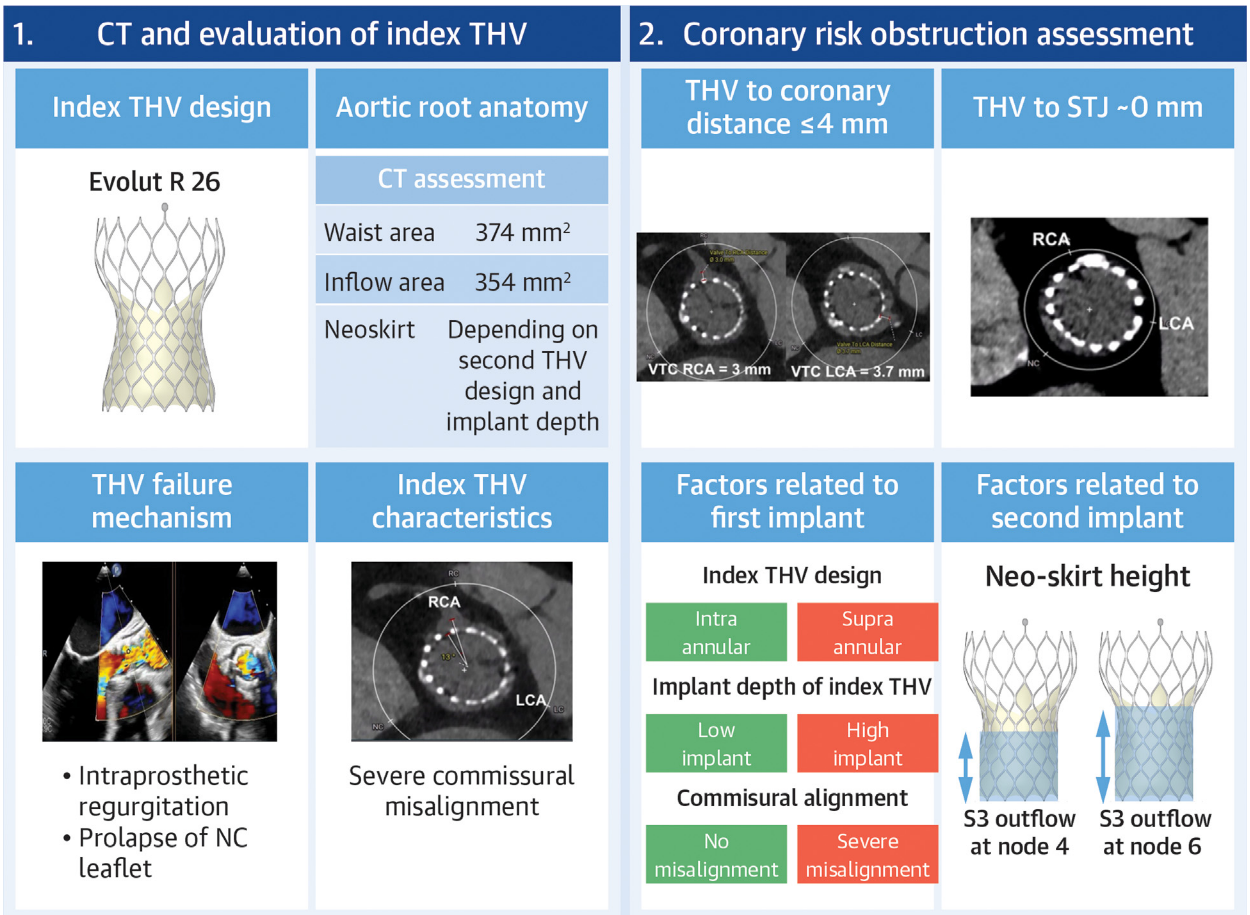
DISCUSSION

We examined an 82-year-old patient referred for symptomatic self-expandable THV failure resulting from structural valve deterioration, with severe intraprosthetic regurgitation 5 years after the initial TAVR. The noncoronary leaflet prolapse caused severe isolated leakage, yet the precise cause remains unclear despite ruling out endocarditis. The index TAVR procedure followed standard protocol with no complications during crimping or deployment, with only one recapture, which is currently not associated with an increased risk of leaflet degeneration.

Options for THV failure include surgical THV explant or redo-TAVR. While direct randomized comparisons are lacking, registry data indicate low 30-day and 1-year mortality with redo-TAVR as opposed to THV explant.[2] However, the decision involves multiple factors (detailed in Table 1).[3] Because of the patient's age and explant surgery associated risks, we opted for redo-TAVR. Indeed, given that the Evolut THV was implanted 5 years ago with potential entrapment risk and acceptable coronary occlusion risk after thorough CT analysis, redo-TAVR with low implantation of a second THV appeared the safest and most feasible option.

This complex case of redo-TAVR strongly emphasizes the crucial need to anticipate the feasibility of a future redo-TAVR before the initial implantation, especially in patients with increased longevity, without compromising the outcomes of the first THV implant. Careful planning is crucial for coronary reaccess, commissural alignment, and optimal implantation depth of the first valve to allow for potential redo-TAVR. Balancing implantation depth to avoid conduction disturbances while ensuring redo

CENTRAL ILLUSTRATION CT Assessment of Index THV and Coronary Risk Obstruction Risk



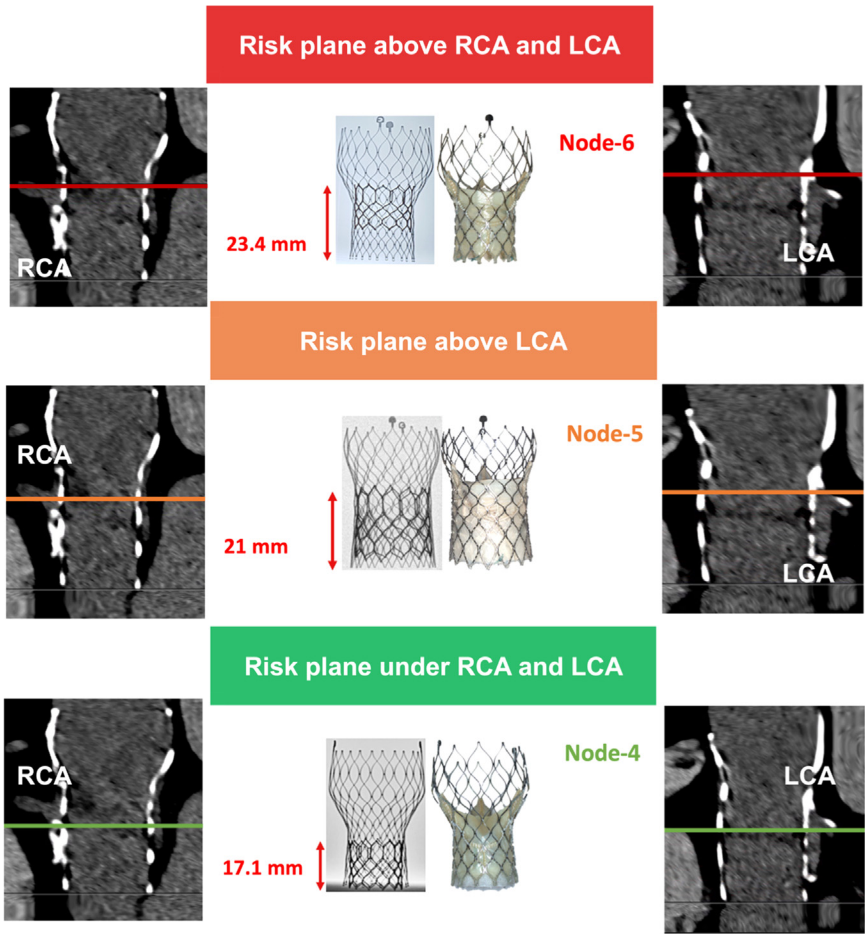
Gall E, et al. J Am Coll Cardiol Case Rep. 2024;29(13):102388.

CT = computed tomography; LCA = left coronary artery; NC = noncoronary; RCA = right coronary artery; S3 = Sapien 3; STJ = sinotubular junction; THV = transcatheter heart valve; VTC = valve to coronary.

feasibility is essential, especially in younger patients. If redo feasibility is compromised, surgical aortic valve replacement strategy should be reconsidered.

In redo-TAVR planning, detailed preprocedural cardiac CT analysis is essential for assessing aortic root anatomy and understanding the index THV's accurate positioning. This systematic approach, as recommended in a recent redo-TAVR expert consensus, simplifies post-index TAVR CT analysis for screening and implantation guidance.[4] Indeed, this case was at high risk of coronary obstruction, as depicted in the **Central Illustration**. To mitigate this risk, two options are available in clinical practice. The first involves modifying the leaflets of the index THV using dedicated techniques, such as bioprosthetic aortic scallop intentional laceration to prevent iatrogenic coronary artery obstruction during TAVR, but the severe commissural misalignment and coronary overlap in this case prevented us from pursuing this strategy. The second option is a low implantation of the second THV, accepting a high degree of leaflet overhang. Therefore, we selected the second option, guided by bench model study that can provide us insights into the optimal THV positioning and the

FIGURE 3 **Anticipated Risk Plane According to Different Sapien 3 Implant Position**



LCA = left coronary artery; NC = non coronary; RCA = right coronary artery.

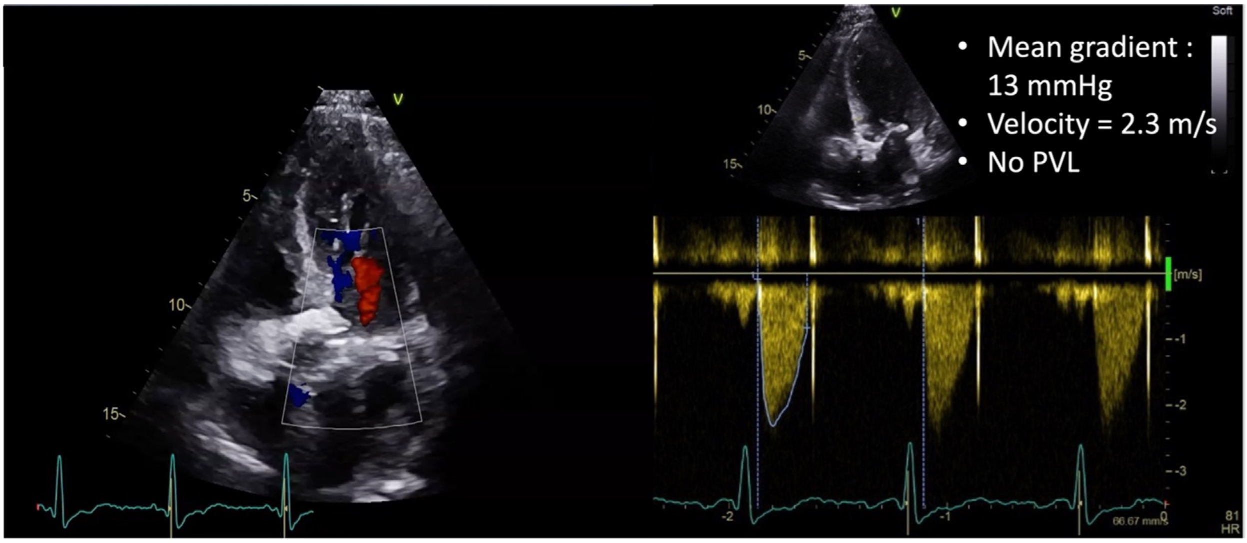
interaction between the second THV and the failed index THV.[1] In our case, using the S3U THV for redo-TAVR in an index Evolut THV involved aligning the S3 outflow to landmarks on the index THV frame, ensuring a better assessment of the expected resultant neoskirt height and the degree of leaflet overhang.

The mechanism of SVD is intraprosthetic leak, but the effects of leaflet overhang on final hemodynamics remains unclear, and thus represent a high-risk procedure in term of hemodynamic result. Since no gradient and leaflet calcifications of the Evolut THV was seen before redo-TAVR, we anticipated no stenotic effect on the second THV because of the degeneration mechanism of first THV, which was confirmed later. However, the evolution of leaflet overhang and its effects on the second THV's hemodynamics require further study.

FOLLOW-UP

At 1 month, the patient was asymptomatic. The follow-up CT revealed a well-positioned S3U THV, moderately underexpanded, and exhibiting a good commissural alignment without hypoattenuating leaflet thickening (Figure 5). Furthermore, a partial

FIGURE 4 Final TTE Before Discharge



PVL = paravalvular leak.

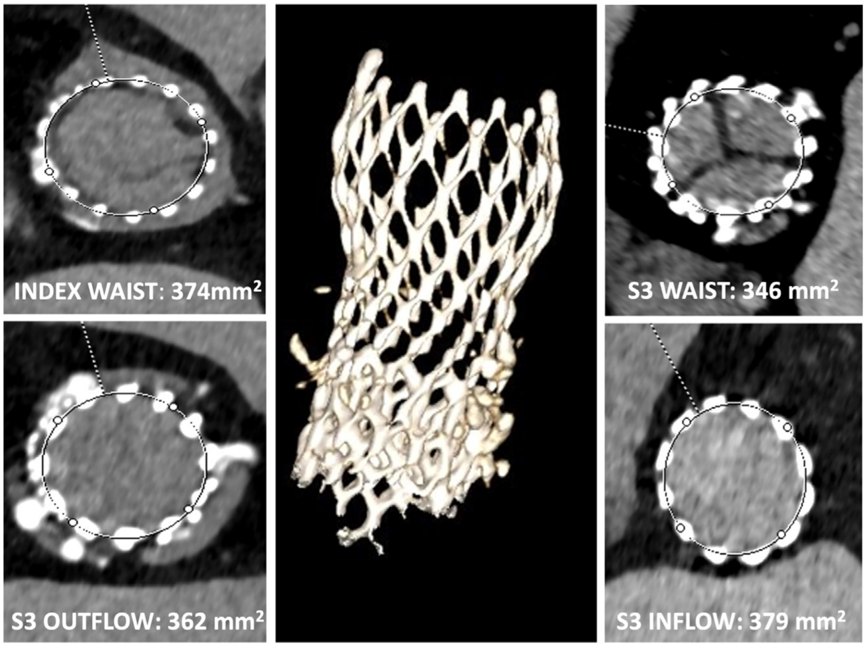
TABLE 1 Factors Influencing Eligibility for Redo-TAVR versus TAVR Explant for Our Patient

	Redo-TAVR Favored	TAVR-explant Favored
Patient characteristics		
Age (y)	82	
Comorbidity/frailty		Few
Surgical risk[a]	Intermediate	
Lifetime management[b]	Yes	
Anatomic assessment		
Risk of coronary obstruction[c]	Low if S3U implant ≤ node 4	High if S3U implant > node 4
Mechanism of THV failure		
Endocarditis	Absent	
Severe PPM	Absent	
Severe PVL	Absent	
Index THV failure		
Evolut[d]	Yes	
Protusion of Evolut stent frame THV in the LVOT[e]	Yes	
Timing of THV failure[f]	Late	
Implant of the index THV	Low	

[a]Surgical risk assessed by STS score might not represented the real observed risk. Recent published observational study showed that TAVR explant was associated with an increased observed-to-expected mortality ratio across all surgical risk categories.[5] [b]The current patient age should not outdate the longevity of redo-TAVR. However, if this is the case, and there is early degeneration with a patient becoming inoperable, we could consider a third valve-in-valve with S3U implanted at the same height as the second THV to avoid the risk of coronary occlusion. [c]The projected neoskirt height is just below the coronary ostia with a low-planned implantation of S3U THV. [d]Long-framed THVs (eg, Evolut R) may pose challenges in TAVR explant because of heightened risks of injuring adjacent structures (eg, aortic root, mitral valve), necessitating more extensive cardiac surgery repair than with shorter-framed THVs. [e]The Evolut was implanted with a protrusion of 5 mm within the LVOT, which favors a redo-TAVR. Indeed, the functional neoskirt will thus be positioned lower than if the Evolut had been implanted higher during the index procedure. In addition, this can result in damage to the LVOT (in addition to that at the level of the annulus and aortic root) during surgical explant, which again argues in favor of a redo-TAVR. [f]The THV stent frame is usually fully adhered to the native tissue at 5 years, making TAVR explant more challenging.

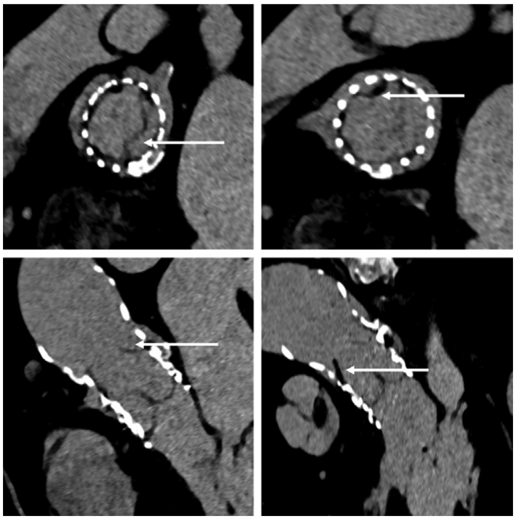
PPM = patient prothesis-mismatch; PVL = paravalvular leakage; TAVR = transcatheter aortic valve replacement; THV = transcatheter heart valve.

FIGURE 5 Post Redo-TAVR CT Analysis at 1 Month



S3 = Sapien 3.

FIGURE 6 Physiological and Partial Retraction of Leaflet Overhang at 1 Month



Arrows indicates retracted leaflet of index THV.

and physiological retraction of the index THV degenerated leaflets was observed (Figure 6, Video 5).

CONCLUSIONS

This case highlights the challenges in managing THV failure, emphasizing the need for a tailored approach guided by comprehensive preprocedural planning and bench model studies. Although early outcome appears optimal here, close clinical follow-up and CT imaging seem indispensable for these patients at risk of structural valve deterioration.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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JACC: CASE REPORTS, VOL. 29, 2024
JULY 3, 2024:102388

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KEY WORDS aortic stenosis, redo-Transcatheter aortic valve replacement, self-expanding valve failure

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