

Research Article

Successful Transapical TAVI in Severe Aortic Stenosis With Hostile Peripheral Vasculature: A Case Report

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Abstract: **Background:** Calcific aortic stenosis (AS) is the most prevalent primary valvular heart disease in developed nations, frequently requiring transcatheter aortic valve implantation (TAVI) in elderly or high-risk populations. Precise anatomical measurement via multimodal imaging is crucial for procedural success and minimizing complications like paravalvular leak or conduction disturbances. **Case Presentation:** We present a comprehensive imaging and clinical analysis of a 74-year-old male diagnosed with severe degenerative valvular heart disease and hostile bilateral peripheral vasculature. Multidetector Computed Tomography (MDCT) and two-dimensional echocardiography (2D ECHO) were cross-evaluated pre- and post-intervention to assess structural parameters and guide procedural planning. **Results:** Pre-procedural 2D ECHO revealed severe AS with moderate aortic regurgitation (AR) and moderate concentric left ventricular hypertrophy (LVH), demonstrating an aortic valve area (AVA) of 0.6 cm² and a peak gradient of 92 mmHg. MDCT confirmed a tricuspid aortic valve configuration with moderate calcification extending into the LVOT. Annular average diameter was 22.5 mm (area: 413.6 mm²) with severe bilateral common iliac calcification. Post-TAVI echocardiography demonstrated a reduction in transvalvular gradient (PG/MG: 15/8 mmHg) with maintained LV systolic function (EF: 55%). **Conclusion:** This report highlights the synergy of quantitative MDCT planning and echocardiographic assessment in ensuring favorable hemodynamic outcomes for complex TAVI procedures when standard transfemoral access is not feasible.

Keywords: TAVI, aortic stenosis, transapical access, peripheral vascular disease, MDCT planning, structural cardiology

INTRODUCTION

Degenerative, calcific aortic stenosis (AS) is characterized by progressive fibro-calcific remodeling of the aortic valve leaflets, leading to restricted mobility and left ventricular outflow obstruction. When symptomatic, severe AS carries an exceedingly poor prognosis if left untreated. Transcatheter Aortic Valve Implantation (TAVI) has revolutionized the management of these patients, extending from high-risk cohorts to intermediate and low-risk populations.

While transfemoral access remains the standard delivery route, a significant subset of elderly patients presents with severe, tortuous, or highly calcified peripheral vascular anatomy that prohibits safe large-bore sheath progression. Achieving optimal outcomes in these complex scenarios requires detailed pre-procedural structural mapping using multimodal imaging.

This manuscript compiles and evaluates the baseline pathology, multi-slice computed tomography architecture, alternative transapical surgical approach, and 10-month post-interventional follow-up data of a 74-year-old male undergoing successful transapical TAVI.

2.1 Clinical Presentation and Coronary Status

The patient, a 74-year-old male, presented with a history of progressive exertional dyspnea (NYHA Class III) and recurrent episodes of syncope. As part of the standard pre-TAVI workup, a coronary angiography (CAG) was performed, which revealed normal coronary arteries, ruling out concomitant obstructive coronary artery disease as a contributor to his symptoms.

2.2 Baseline Echocardiographic Findings

A definitive baseline diagnostic evaluation was established utilizing two-dimensional transthoracic echocardiography (2D ECHO). Key pre-interventional parameters included:

- **Aortic Valve Architecture:** Highly sclerotic and thickened leaflets resulting in concurrent severe aortic stenosis (AS) and moderate aortic regurgitation (AR).
- **Hemodynamic Gradients:** Peak pressure gradient of 92 mmHg and mean gradient of 60 mmHg; critically restricted aortic valve area (AVA) of 0.6 cm².
- **Ventricular Remodeling:** Moderate concentric left ventricular hypertrophy (LVH): interventricular septum thickness 1.4 cm, posterior wall thickness 1.5 cm.
- **Chamber Volumetrics:** Dilated left atrium and left ventricle; baseline LVEF preserved at 55%.
- **Associated Valvular Pathologies:** Grade I mitral regurgitation (MR) and mild tricuspid regurgitation (TR) without secondary pulmonary arterial hypertension.

2. Baseline Clinical Profile and Diagnostic Evaluation

Table 1 summarizes the baseline clinical and diagnostic parameters for the patient.

Parameter	Findings
Age	74 Years
Sex	Male
Symptoms	Dyspnea, Syncope (NYHA Class III)
Diagnosis	Severe degenerative aortic stenosis
Ejection Fraction (EF)	55%
Aortic Valve Area (AVA)	0.6 cm ²
Peak / Mean Gradient	92 / 60 mmHg
Coronary Angiography	Normal coronary arteries
Peripheral Anatomy	Diffuse calcific vasculopathy

Table 1. Baseline clinical profile.

3. High-Resolution CT Anatomical Assessment

To map procedural logistics, high-resolution ECG-gated Multi-Detector Computed Tomography (MDCT) was performed at 36.0% cardiac phase reconstruction.

3.1 Aortic Root and Annular Morphometry

MDCT confirmed a standard tricuspid aortic valve configuration. Spatial segmentation of the aortic root provided critical dimensions for prosthesis sizing (Table 2).

Anatomical Landmark	Min Diameter	Max Diameter	Average / Derived Value
Aortic Annulus	18.0 mm	27.0 mm	22.5 mm (Ecc: 0.33)
Area-Derived Diameter	—	—	22.9 mm (Area: 413.6 mm ²)
Perimeter-Derived Diameter	—	—	24.2 mm (Perim: 76.0 mm)
Sinus of Valsalva	—	—	L: 31.6 R: 32.4 NC: 31.7 mm
Sinotubular Junction (STJ)	24.2 mm	25.4 mm	24.8 mm
LVOT	19.5 mm	27.1 mm	23.3 mm (Perim: 77.3 mm)
Ascending Aorta	26.2 mm	27.3 mm	26.7 mm

Table 2. MDCT aortic root morphometry. LVOT = left ventricular outflow tract; STJ = sinotubular junction.



Figure 1. MDCT annular morphometry: axial multi-planar reconstructions demonstrating aortic annular dimensions and calcification burden (min/max diameters, area-derived and perimeter-derived measurements).

The coronary ostial heights were balanced, with a Right Coronary Artery (RCA) height of 17.8 mm and a Left Coronary Artery (LCA) height of 12.7 mm, minimizing the risk of acute coronary occlusion during deployment.

3.2 Calcification Burden Analysis

Quantification of calcific deposits revealed an intermediate to high structural burden across the complexes:

- **Valvular & Subvalvular Structure:** Moderate calcification of the aortic valve leaflets with significant focal extensions projecting subannularly into the LVOT.
- **Vascular Tree:** Mild calcification at the sinotubular junction and descending aorta; moderate calcification within the aortic arch.

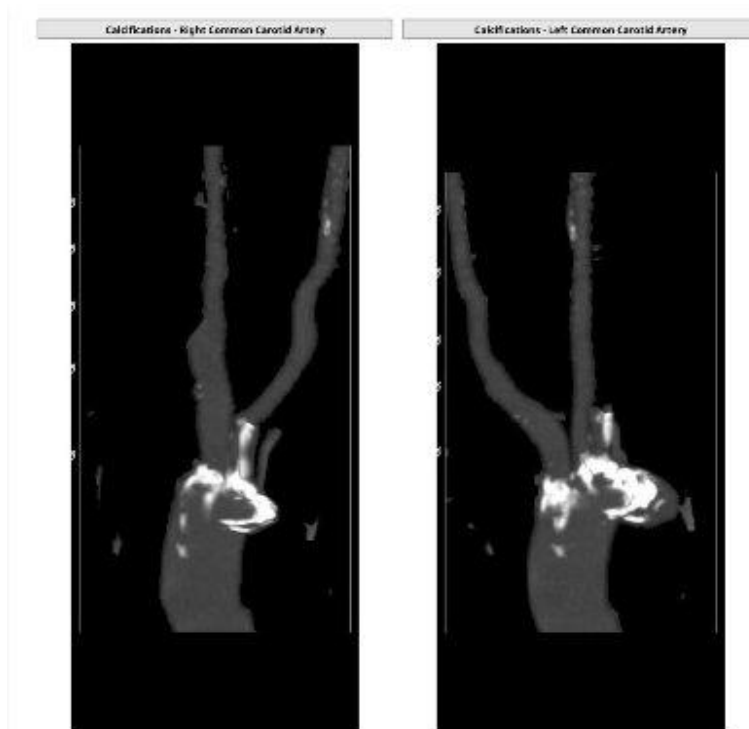


Figure 2. CT angiography: calcifications identified in the right and left common carotid arteries, illustrating the extent of diffuse calcific vasculopathy in this patient.

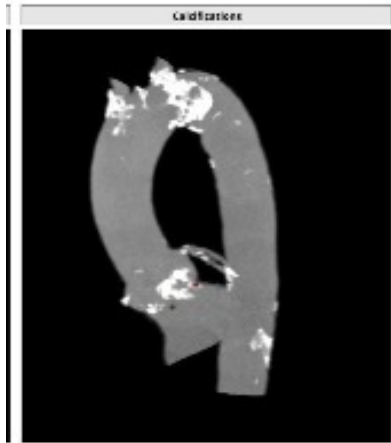


Figure 3. CT 3D rendering: aortic calcification burden demonstrating heavy leaflet and subannular calcific deposits guiding prosthesis selection and deployment strategy.

3.3 Fluoroscopic Angulation Vector Planning

Optimal planar deployment angles were computed using 3D volume rendering (VR) to minimize parallax during delivery:

- Coplanar View (3-Cusp View): LAO 34° / Cranial 12°
- Alternative Orthogonal Projection: RAO 67° / Cranial 46°

4. Peripheral Access Route Mapping and Procedural Strategy

4.1 Iliofemoral Axis Assessment

The lower limb arterial networks presented highly restricted dimensions paired with severe calcific barriers:

- **Right Iliofemoral System:** Common iliac artery (CIA) average diameter 3.9 mm (min: 3.6 mm) with severe calcification. External iliac artery (EIA) averaged 3.8 mm with mild calcification; femoral artery (FA) averaged 5.5 mm.
- **Left Iliofemoral System:** CIA average diameter 3.3 mm (min: 3.0 mm) with severe calcification. EIA averaged 3.8 mm; FA averaged 4.9 mm.

Given that typical TAVI delivery sheaths require a minimum luminal diameter of ≥6–7 mm, the bilateral severe common iliac narrowings (3.0 mm left, 3.6 mm right) posed a prohibitive risk for arterial perforation, dissection, or avulsion.

4.2 Subclavian Axis Evaluation

A right subclavian artery overview identified a proximal constriction down to a minimum diameter of 1.6 mm (average: 2.1 mm), rendering it completely unsuitable for large-bore access.

5. Intraoperative Details and Post-Procedural Outcomes

5.1 Operative and Deployment Parameters

Parameter	Findings
Access Route	Transapical (mini-left anterolateral thoracotomy)
Valve Implanted	Octacor 23 mm transcatheter bioprosthesis
Anesthesia	General anesthesia
Pacing	Right ventricular (RV) rapid pacing
Procedure Duration	1 hour
Complications	None
Hospital Stay	5 days post-procedure

Table 3. Intraoperative procedural parameters.

4.3 Final Procedural Approach: Surgical Transapical Access

Faced with all standard access paths blocked by severe peripheral vascular disease, the heart team selected a transapical approach as the optimal final procedural strategy. This direct-access technique avoids the peripheral arterial tree entirely by utilizing a mini-left anterolateral thoracotomy to gain direct surgical entry to the left ventricular apex.

The procedure was performed under general anesthesia via surgical cutdown to the left ventricular apex. Based on the area-derived diameter of 22.9 mm and average annulus of 22.5 mm, an Octacor 23 mm transcatheter bioprosthesis was selected. The valve was advanced directly through the apex and deployed precisely within the aortic annulus under rapid RV pacing.

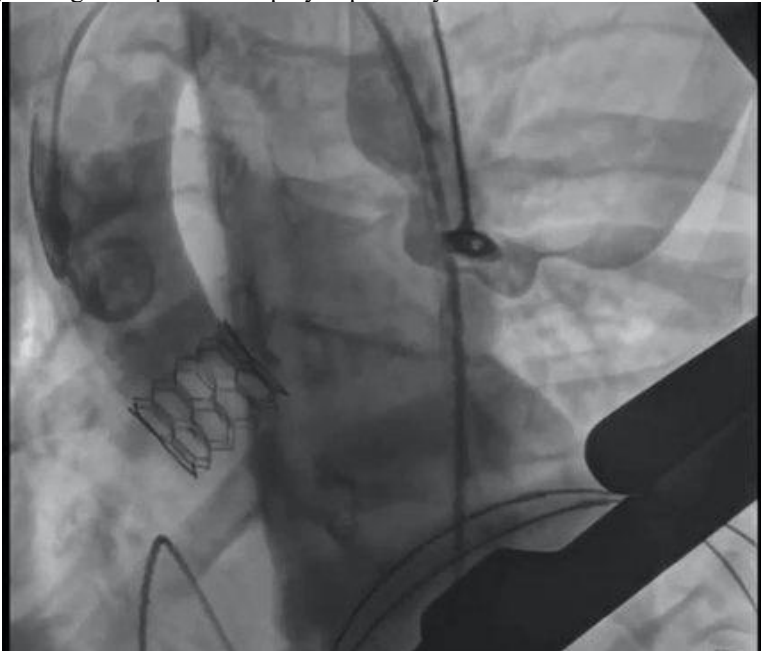


Figure 4. Intraoperative fluoroscopy: deployed MyVal Octacor 23 mm transcatheter bioprosthesis via transapical access, demonstrating accurate positioning within the aortic annulus under RV rapid pacing.

5.2 Post-Operative Hospital Course

The patient experienced rapid recovery and early mobilization following ventricular closure. Pre-discharge 2D ECHO confirmed technical success and acute hemodynamic restoration:

- **Valvular Gradient Resolution:** The severe transvalvular gradient dropped dramatically: post-procedural peak gradient 15 mmHg, mean gradient 8 mmHg.
 - **Myocardial Recovery:** Left ventricular systolic function was maintained (EF: 55%). LV internal dimensions in diastole (LVIDd) reduced from 5.2 cm to 4.3 cm, indicating favorable early reverse remodeling.
 - **Concomitant Valvular Competence:** Mitral regurgitation remained mild; mild residual tricuspid regurgitation noted.
 - **Safety Endpoints:** Absence of intracardiac thrombi or pericardial effusions. IVC diameter 0.5 cm with stable fluid balance.
- The patient was safely discharged from hospital on day 5 post-procedure.

5.3 Comparative Outcomes

Parameter	Pre-TAVI	Post-TAVI
Peak Gradient	92 mmHg	15 mmHg
Mean Gradient	60 mmHg	8 mmHg
Ejection Fraction	55%	55%
LVIDd	5.2 cm	4.3 cm
Pericardial Effusion	None	None

Table 4. Pre- and post-TAVI hemodynamic and echocardiographic outcomes. LVIDd = left ventricular internal diameter in diastole.

5.4 Long-Term Follow-Up

The patient was evaluated at a clinical follow-up duration of 10 months. He reported complete resolution of baseline syncope and significant improvement in functional capacity, restoring him to NYHA Class I status. Long-term echocardiographic parameters confirmed sustained durability of the 23 mm Octacor valve with stable low transvalvular gradients and no late paravalvular leaks or structural valve deterioration.

DISCUSSION

This case highlights the clinical utility and life-saving nature of alternative-access TAVI workflows. The patient presented with classic parameters of severe, high-gradient degenerative aortic stenosis (peak gradient 92 mmHg, AVA 0.6 cm²), with concentric left ventricular hypertrophy serving as a physiological testament to chronically elevated afterload pressures.

The primary clinical hurdle was the patient's severe peripheral arterial disease, presenting as extensive severe calcification and critical narrowings (≤ 4 mm) along both common iliac pathways. In an era where transfemoral access is heavily favored, this case demonstrates that a carefully executed surgical transapical approach remains an excellent, safe option when peripheral or subclavian access routes are anatomically hostile.

By securing direct ventricular apex access through a controlled surgical cutdown, the heart team successfully delivered an Octacor 23 mm valve. Rapid RV pacing ensured accurate positioning, mitigating the risk of displacement against subannular calcification. The dramatic post-procedural drop in mean gradient from 60 mmHg to 8 mmHg, combined with complete lifestyle recovery at 10 months, demonstrates that matching

thorough multi-modality pre-planning with tailored alternative-access approaches yields exceptional long-term outcomes.

This report underscores the continued relevance of MDCT-guided pre-procedural planning, comprehensive team decision-making, and alternative access strategies in the modern structural interventional cardiology era.

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