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CORONARY, PERIPHERAL, AND STRUCTURAL INTERVENTIONS

HOW WE DID IT

Staged Transcatheter Valve-in-Valve Replacement for Simultaneous Failure of 3 Surgical Bioprosthetic Valves

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ABSTRACT

OBJECTIVES To describe a heart team-driven staged transcatheter strategy for accelerated triple bioprosthetic valve failure in a patient with prohibitive surgical risk.

KEY STEPS A 78-year-old woman with systemic lupus erythematosus, stage 4 chronic kidney disease, permanent atrial fibrillation, and severe frailty presented with NYHA functional class III heart failure. She had undergone triple surgical bioprosthetic heart valve replacement 8 years earlier. Imaging demonstrated severe aortic, mitral, and tricuspid bioprosthetic valve failure. Given prohibitive surgical risk, a staged transcatheter strategy was selected. Valve-in-valve transcatheter aortic valve replacement with a 23-mm supra-annular self-expanding valve and bioprosthetic valve fracture was performed first, followed by valve-in-valve (ViV)–transcatheter mitral valve replacement and ViV transcatheter tricuspid valve replacement with 26-mm balloon-expandable valves. All procedures were successful without complications. At 2 months, NYHA functional class improved from III to II, with satisfactory function of all 3 valves.

POTENTIAL PITFALLS Coronary obstruction, patient-prosthesis mismatch, neo–left ventricular outflow tract obstruction, and hemodynamic intolerance.

TAKE-HOME MESSAGES Staged triple ViV intervention may provide a feasible alternative to redo surgery. Multimodality imaging and individualized sequencing are critical. (JACC Case Rep. 2026;31:110544)
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Accelerated bioprosthetic valve failure (BVF) involving multiple valves is uncommon but clinically significant, particularly in patients with systemic lupus erythematosus (SLE) and chronic kidney disease (CKD), conditions that promote leaflet calcification, fibrosis, and BVF.[1,2] Redo surgery for multiple failed bioprosthetic heart valves carries substantial risk in older and frail patients. Transcatheter valve-in-valve (ViV) intervention provides an alternative for selected patients with prohibitive surgical risk. We describe a 78-year-old woman with simultaneous failure of surgical aortic, mitral, and tricuspid bioprostheses who underwent successful staged ViV-transcatheter aortic valve replacement (TAVR), ViV-transcatheter mitral valve replacement (TMVR), and ViV-transcatheter tricuspid valve replacement (TTVR).

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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

BEV = balloon-expandable valve

BHV = bioprosthetic heart valves

BVF = bioprosthetic valve failure

CKD = chronic kidney disease

CT = computed tomography

EOA = effective orifice area

LVOT = left ventricular outflow tract

SLE = systemic lupus erythematosus

TAVR = transcatheter aortic valve replacement

TEE = transesophageal echocardiography

THV = transcatheter heart valves

TMVR = transcatheter mitral valve replacement

TTVR = transcatheter tricuspid valve replacement

ViV = valve-in-valve

HISTORY OF PRESENTATION

A 78-year-old woman presented with progressive dyspnea (NYHA functional class III), nonspecific chest pain, and peripheral edema (Figure 1). She had undergone surgical replacement of the aortic, mitral, and tricuspid valves in 2017. Her medical history included permanent atrial fibrillation, SLE, stage 4 CKD secondary to lupus nephritis, and severe frailty (Clinical Frailty Scale score, 7).

Examination revealed pulmonary rales, elevated jugular venous pressure, bilateral lower-extremity edema, and grade 2-3 systolic murmurs at the left lower sternal border, right upper sternal border, and cardiac apex. Electrocardiography demonstrated atrial fibrillation. Laboratory testing showed elevated N-terminal pro-B-type natriuretic peptide, high-sensitivity C-reactive protein, and creatinine levels, with anemia, hypokalemia, and hypocalcemia.

Transthoracic echocardiography demonstrated marked thickening, calcification, and restricted motion of all 3 surgical bioprosthetic valves.

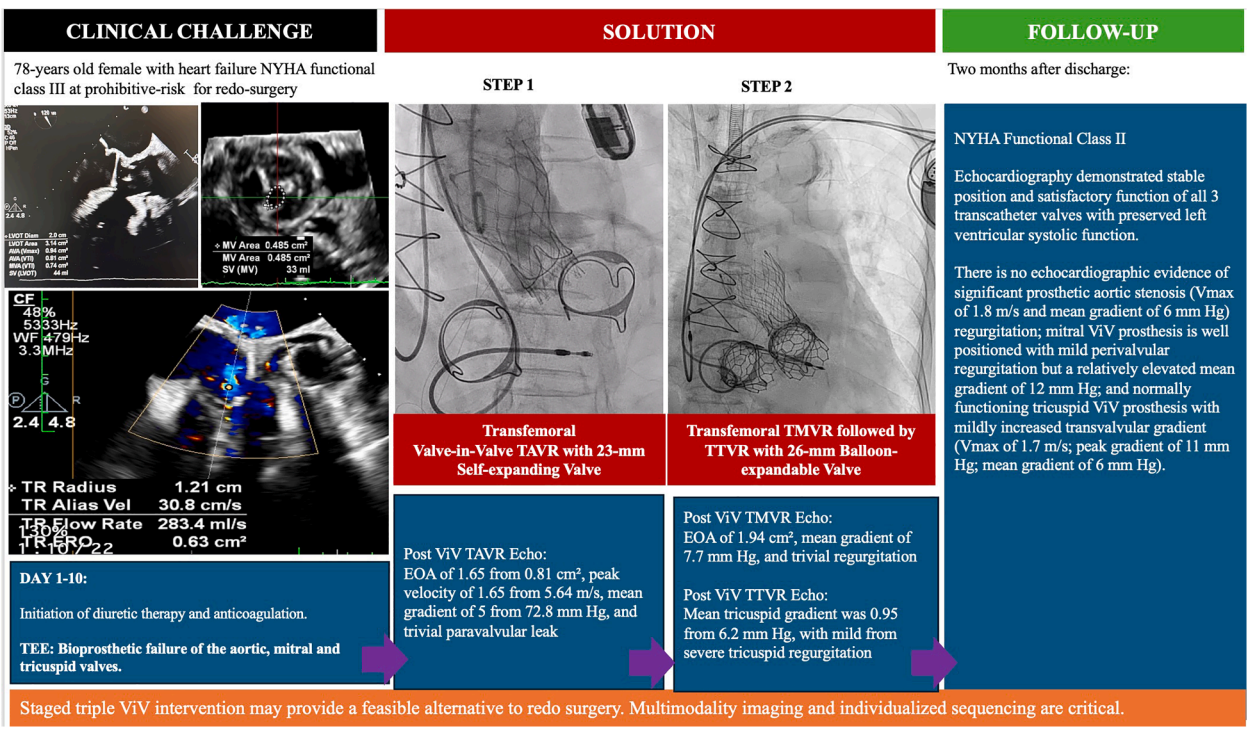
TAKE-HOME MESSAGES

- Triple bioprosthetic valve failure: Accelerated failure of multiple surgical bioprostheses may occur in patients with systemic lupus erythematosus and advanced chronic kidney disease.
- Staged strategy: Staged valve-in-valve intervention can reduce the physiologic burden of triple-valve intervention in frail patients with prohibitive surgical risk.
- Imaging and sequencing: Computed tomography and echocardiography are critical for procedural planning, while individualized valve sequencing can optimize hemodynamic tolerance and procedural safety.

INVESTIGATIONS

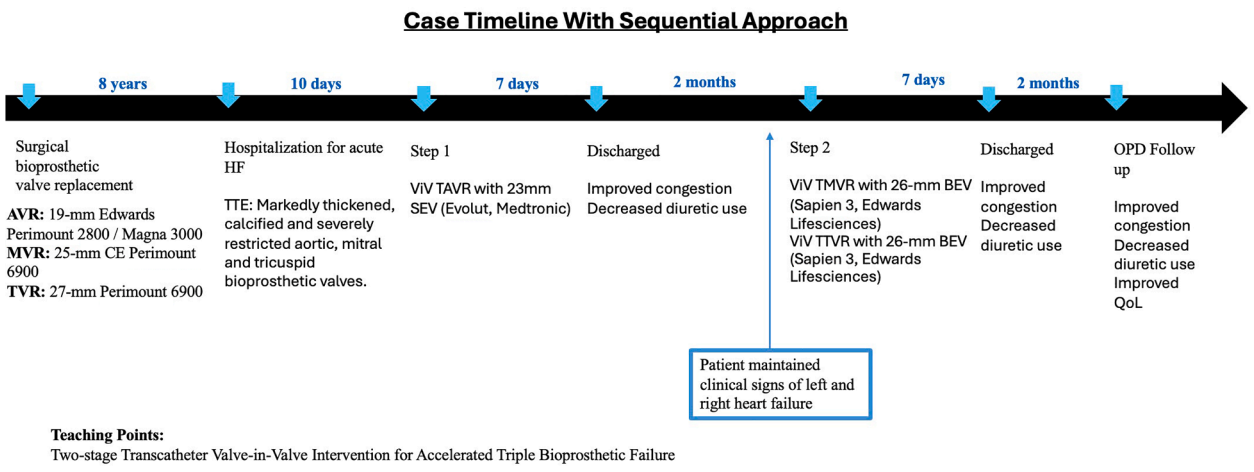
Transesophageal echocardiography (TEE) confirmed severe degeneration of all 3 bioprostheses (Figure 2). The 19-mm aortic bioprosthesis had an effective

VISUAL SUMMARY Staged Transcatheter Valve-in-Valve Replacement for Simultaneous Failure of Three Surgical Bioprosthetic Valves



EOA = effective orifice area; TAVR = transcatheter aortic valve replacement; TEE = transesophageal echocardiography; TMVR = transcatheter mitral valve replacement; TTVR = transcatheter tricuspid valve replacement; ViV = valve-in-valve.

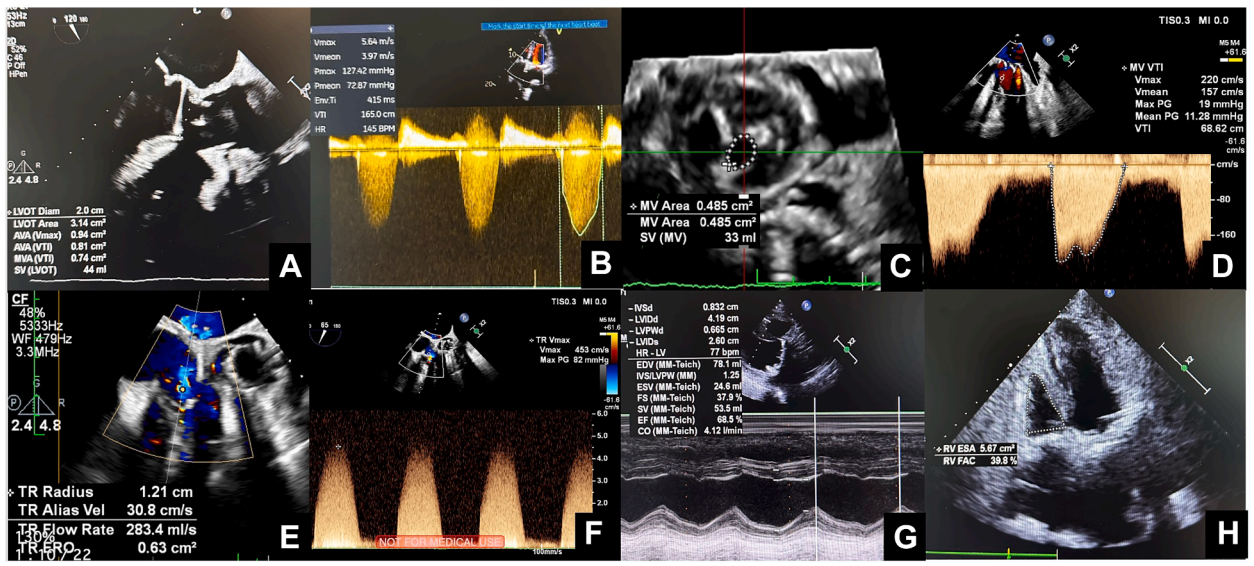
FIGURE 1 Case Timeline With Key Teaching Points



AVR = aortic valve replacement; BEV = balloon-expandable valve; HF = heart failure; MVR = mitral valve replacement; OPD = outpatient department; QoL = quality of life; SEV = self-expanding valve; TTE = transthoracic echocardiography; TVR = tricuspid valve replacement; ViV TAVR = valve-in-valve transcatheter aortic valve replacement; ViV TMVR = valve-in-valve transcatheter mitral valve replacement; ViV TTVR = valve-in-valve transcatheter tricuspid valve replacement.

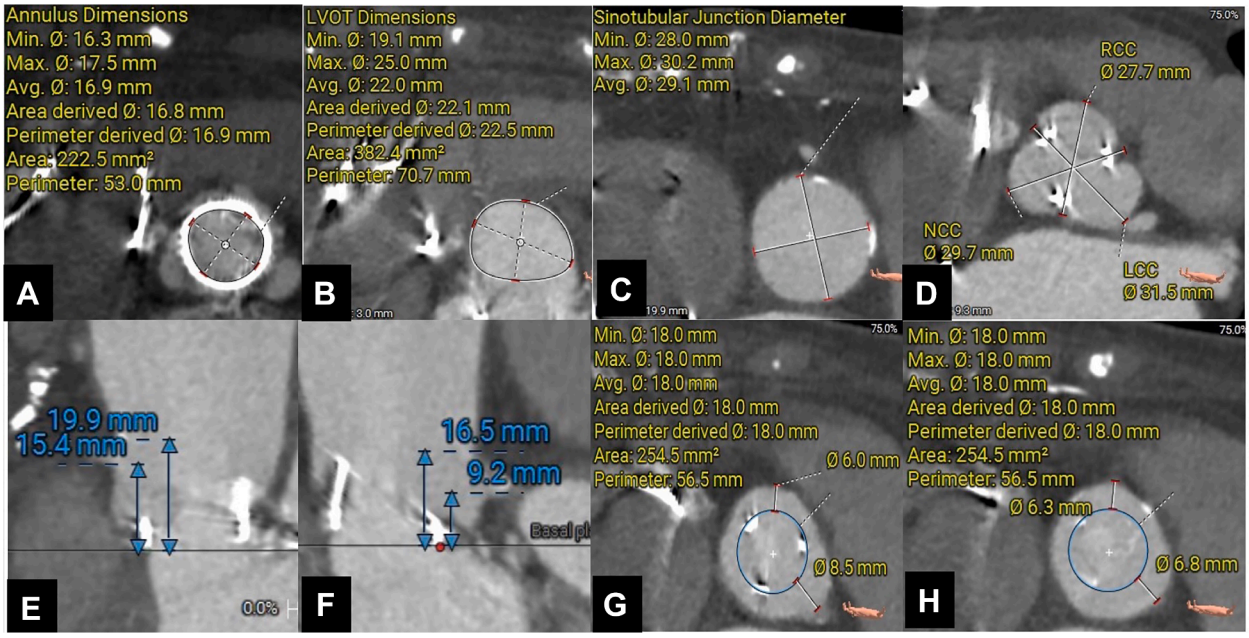
orifice area (EOA) of 0.81 cm^2, peak velocity of 5.64 m/s, and mean gradient of 72.8 mm Hg, with mild aortic regurgitation. The 25-mm mitral bioprosthesis had an EOA of 0.48 cm^2 and mean gradient of 11 mm Hg, with moderate regurgitation. The 27-mm tricuspid bioprosthesis had a tricuspid regurgitant effective regurgitant orifice area of 0.63 cm^2 and maximum pressure gradient of 82 mm Hg. Pulmonary

FIGURE 2 Transthoracic and Transesophageal Echocardiography



(A) Aortic BHV is thickened and calcified with EOA of 0.8 cm^2 and (B) MPG of 73 mm Hg. (C) Mitral BHV is thickened and calcified with EOA of 0.48 cm^2 and (D) MPG of 11 mm Hg. (E)Tricuspid BHV is thickened and calcified with tricuspid regurgitation EROA of 0.63 cm^2 and (F) tricuspid regurgitation (TR) Max pressure gradient of 82 mm Hg. (G) M-mode showing left ventricular ejection fraction of 68 percent. (H) 2D echocardiography showed right ventricular fractional area change of 39 percent. BHV = bioprosthetic heart valve; EOA = effective orifice area; EROA = effective regurgitant orifice area; MPG = mean pressure gradient.

FIGURE 3 Aortic ViV Assessment to Identify Risk of Coronary Obstruction During Redo-TAVR



(A) Failed bioprosthetic aortic valve annulus is 16.9 mm. (B) Left ventricular outflow tract (LVOT) area is 22.1 mm. (C) STJ maximum diameter is 30.2 mm. (D) SOV width in the RCC, LCC, and NCC are 27.7 mm, 31.5 mm, and 29.7 mm, respectively. (E) Right coronary height is 15.4 mm, and (F) left coronary height is 9.2 mm. (G) Virtual 23-mm SEV simulated within the surgical valve, from which VTC distances in the right and left coronary ostia are 6 mm and 8.5 mm, respectively. (H) Virtual 23-mm SEV simulated within the surgical valve, from which VTSTJ distances in the right and left coronary ostia are 6.3 mm and 6.8 mm, respectively. LCC = left coronary cusp; NCC = noncoronary cusp; RCC = right coronary cusp; SEV = self-expanding valve; SOV = sinus of Valsalva; STJ = sinotubular junction; VTC = valve to coronary; VTSTJ = valve to sinotubular junction; other abbreviations as in Figure 1.

artery systolic pressure was 115 mm Hg. Left ventricular ejection fraction was 68% and right ventricular fractional area change was 39%.

Given her age, frailty, SLE, stage 4 CKD, and need for triple-valve intervention, redo surgery was considered prohibitive (EuroSCORE II, 43.7%; Society of Thoracic Surgeons predicted mortality, 42.3%). The Heart Team therefore selected a staged transcatheter strategy.

ViV-TAVR PLANNING

Cardiac computed tomography (CT) demonstrated a failed 19-mm stented surgical aortic bioprosthesis. The small annulus and low coronary ostial height increased the risk of coronary obstruction; however, adequate sinus of Valsalva dimensions, virtual valve-to-coronary distance, and virtual valve-to-sinotubular junction distance supported conventional ViV-TAVR (Figure 3).

Because a 19-mm surgical valve carries a high risk of residual gradient and patient-prosthesis mismatch, a 23-mm supra-annular self-expanding valve was selected. Bioprosthetic valve fracture was planned to further improve the EOA and hemodynamics (Figure 4).

ViV-TMVR PLANNING

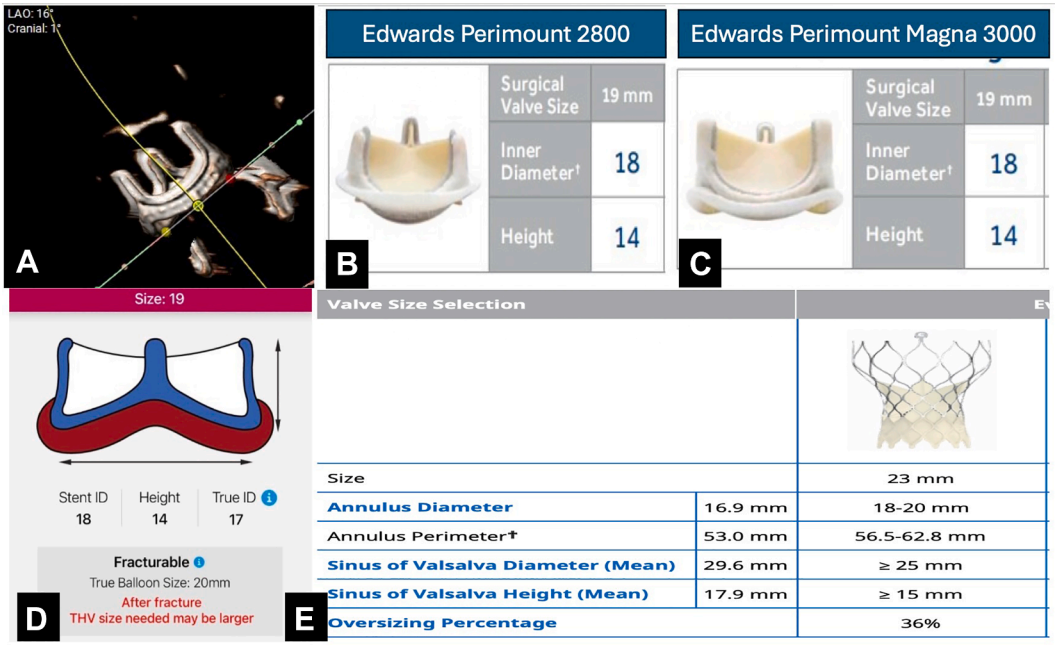
CT demonstrated degeneration of the 25-mm surgical mitral bioprosthesis (Figure 5). A 26-mm balloon-expandable valve (BEV) was selected. CT simulation demonstrated a predicted neo-left ventricular outflow tract (LVOT) area of 427.1 mm^2 and an inverse aortomitral angle of 129°, indicating low predicted risk of LVOT obstruction.

A transfemoral transseptal approach was favored over transapical access because of its less invasive nature. A BEV was selected because of its suitability for transseptal ViV-TMVR.

ViV-TTVR PLANNING

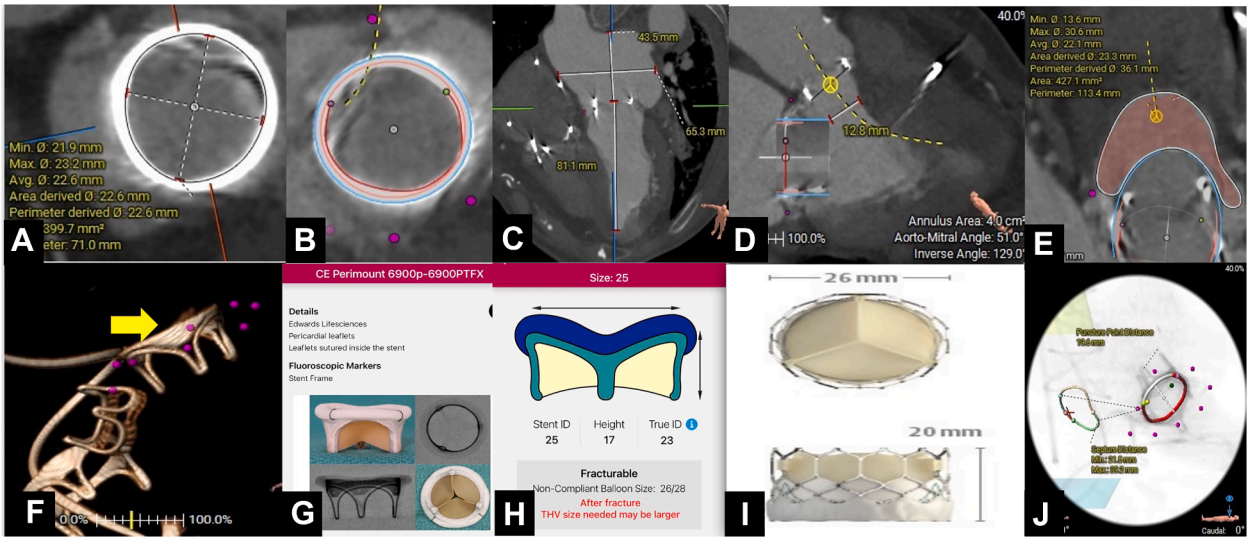
CT demonstrated degeneration of the 27-mm surgical tricuspid bioprosthesis (Figure 6). The internal diameter provided an adequate landing zone for a

FIGURE 4 **Aortic ViV Assessment to Identify Surgical Bioprosthetic Valve and Sizing for Redo-TAVR**



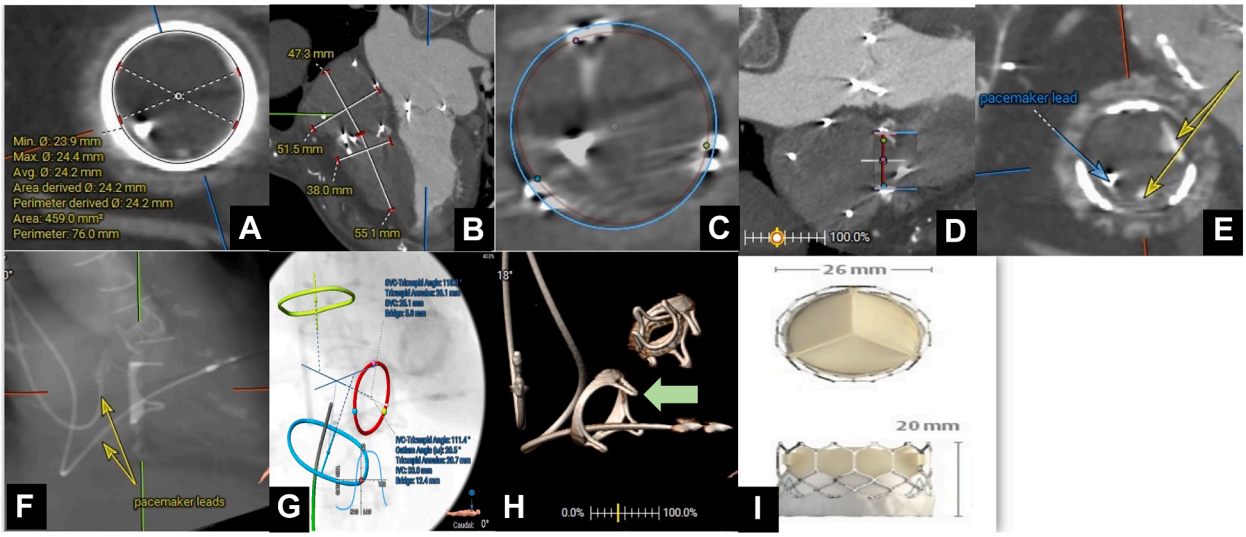
(A) MDCT 3D maximal intensity projection rendering analysis of failed bioprosthetic aortic valve resembling (B) Edwards Perimount 2800 or (C) Edwards Perimount Magna 3,000. (D) ViV aortic digital apps analysis of failed surgical bioprosthetic aortic valve with stent ID and true ID of 18 mm and 17 mm, respectively. (E) Selected 23 mm SEV. MDCT = multidetector computed tomography; other abbreviations as in Figure 3.

FIGURE 5 **Mitral ViV Assessment**



(A) Failed surgical mitral bioprosthetic valve internal diameter is 22.6 mm. (B to D) Computed tomography (CT) image of 3-chamber view with virtual valve implantation of a 26-mm BEV (blue) in the mitral position (red) with inverse angle of 129°. (E) Simulated neo-LVOT area (red) is 427.1 mm^2. (F) MDCT 3D maximal intensity projection rendering analysis of failed bioprosthetic mitral valve (yellow arrow) resembling Perimount 6,900. (G) CE Perimount 6,900 fluoroscopic markers. (H) ViV mitral digital apps analysis of failed surgical mitral BHV with stent ID and true ID of 25 mm and 23 mm, respectively. (I) Selected 26 mm BEV (J). Transeptal puncture point minimum and maximum distance of 21.5 mm and 39.2 mm, respectively. LVOT = left ventricular outflow tract; MDCT = multidetector computed tomography; TAVR = transcatheter aortic valve replacement; other abbreviations as in Figure 1 and 2.

FIGURE 6 Tricuspid ViV Assessment



(A) Failed tricuspid bioprosthetic valve internal diameter is 24.2 mm. (B) Measurements of right atrium height and right ventricle depth are 47.3 mm and 55.1 mm, respectively. (C) Simulated 26-mm BEV (blue) in failed tricuspid bioprosthetic valve (red). (D) 4-chamber view with virtual valve implantation of a 26-mm BEV (blue line). (E) Calcified prosthesis leaflet (yellow arrow) and pacemaker lead (blue arrow). (F) Right atrial and right ventricular pacemaker lead (yellow arrow). (G) Anticipated delivery-axis orientation of 118° and 111° in the SVC-tricuspid angle and IVC-tricuspid angle, respectively. (H) MDCT 3D maximal intensity projection rendering analysis of failed bioprosthetic tricuspid valve (green arrow) resembling Perimount 6,900. (I) Selected 26 mm BEV. Abbreviation as in Figure 1 and 4.

26-mm BEV. The superior vena cava-tricuspid and inferior vena cava-tricuspid delivery angles were 118° and 111°, respectively, indicating favorable alignment. The short stent frame of the BEV was considered advantageous for ViV-TTVR.

MANAGEMENT

RATIONALE FOR A STAGED STRATEGY. The principal Heart Team decision was whether to perform all 3 interventions in a single session or stage them.

A single-session procedure could reduce cumulative hospitalization and vascular access but would expose this frail patient with severe pulmonary hypertension and advanced CKD to prolonged procedural time, greater contrast exposure, bleeding risk, acute kidney injury, and hemodynamic instability.[3]

ViV-TAVR was therefore performed first. Severe aortic stenosis represented a major fixed obstruction to forward flow, and relieving it was expected to reduce left ventricular afterload and improve cardiac output. Treating the mitral valve first could abruptly increase left ventricular preload; in an elderly patient with potentially reduced ventricular compliance, this could precipitate pulmonary congestion.[4] Staging allowed reassessment of hemodynamics and optimization of heart failure before ViV-TMVR.

The Heart Team also considered deferring ViV-TTVR until after ViV-TMVR. However, the tricuspid pathology represented severe structural failure of the surgical bioprosthesis rather than isolated functional regurgitation; meaningful improvement after left-sided intervention was therefore considered unlikely. Performing ViV-TTVR during the second stage avoided a third invasive procedure and limited cumulative vascular access, radiation, contrast exposure, hospitalization, and cost.[3]

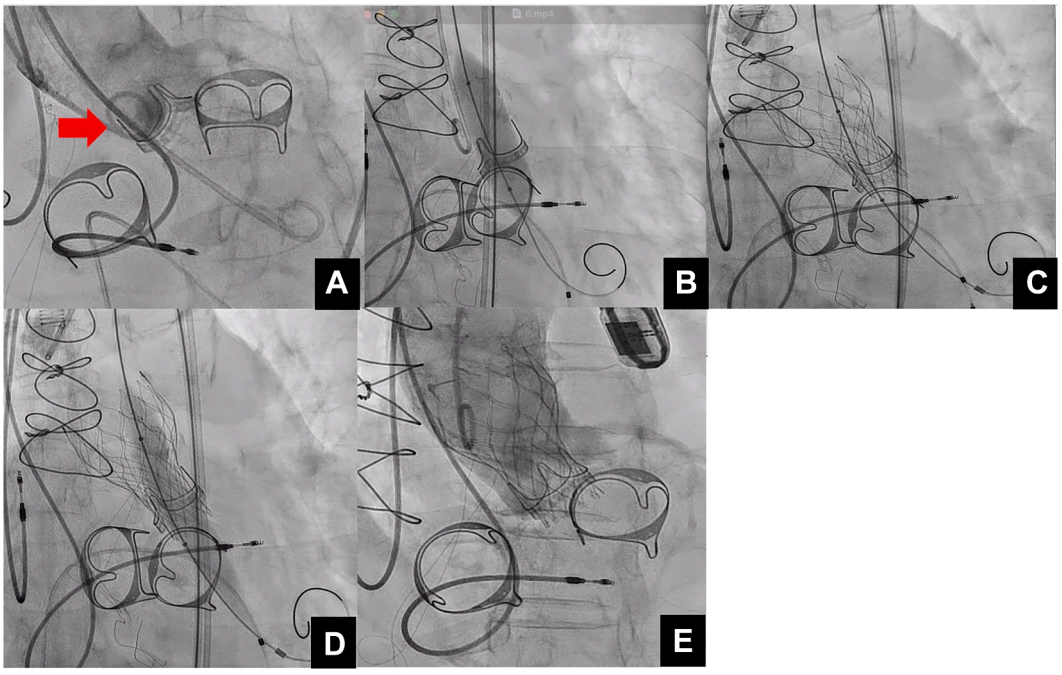
PROCEDURAL STEPS

STAGE I: ViV-TAVR. A 20-F sheath was introduced through the right common femoral artery. The surgical aortic valve was predilated using a 16 × 40-mm balloon.

A 23-mm supra-annular self-expanding valve was deployed approximately 3 mm below the surgical annulus to optimize supra-annular leaflet function. Bioprosthetic valve fracture was subsequently performed using a 20 × 40-mm balloon, with resolution of the balloon waist confirming fracture (Figure 7).

Final echocardiography demonstrated an EOA of 1.65 cm^2, peak velocity of 1.65 m/s, mean gradient of 5 mm Hg, and trivial paravalvular leak (Figure 8).

FIGURE 7 ViV Transcatheter Aortic Valve Replacement



(A) Failed aortic bioprosthetic valve (red arrow). (B) Predilatation of aortic bioprosthetic valve with 16 × 40 mm balloon. (C) Deployment of 23-mm SEV at 3 mm below the surgical annulus. (D) Postdilatation of SEV with 20 × 40 mm balloon. (E) Aortogram showing TAVR device in stable position with good activity. TAVR = transcatheter aortic valve replacement; other abbreviations as in Figure 1.

STAGE II: ViV-TMVR. An 8.5-F transseptal sheath was introduced through the right femoral vein. The transseptal puncture site was planned using CT and confirmed with TEE to optimize the delivery trajectory (Figures 9A and 9B). The interatrial septum was further dilated with a 12 × 40-mm balloon.

A 26-mm BEV was positioned within the failed 25-mm surgical mitral bioprosthesis, with the central marker aligned with the basal ring. This position provided stable anchoring while minimizing potential interaction with the previously implanted aortic transcatheter valve. The valve was deployed under fluoroscopic and TEE guidance (Figure 9).

Final assessment showed an EOA of 1.94 cm^2, mean gradient of 7.7 mm Hg, and trivial regurgitation (Figure 8).

STAGE II: ViV-TTVR. The mitral delivery system was exchanged for the tricuspid delivery system. A 26-mm BEV was advanced and positioned within the failed 27-mm surgical tricuspid bioprosthesis, with the central marker aligned with the basal ring (Figure 10).

The valve was deployed under fluoroscopic and echocardiographic guidance. Final mean tricuspid gradient was 0.95 mm Hg, with mild residual regurgitation (Figure 8).

All 3 transcatheter ViV procedures were completed without procedural complications.

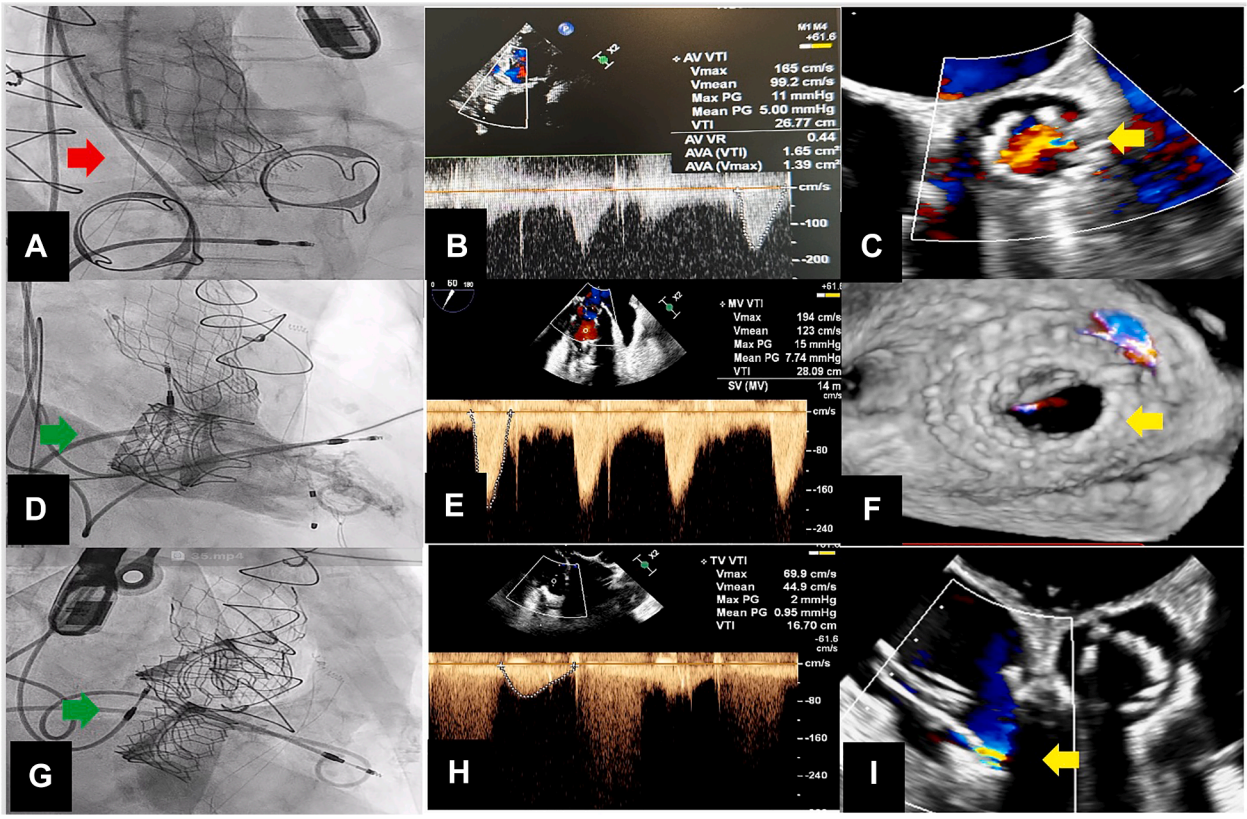
FOLLOW-UP

The patient was discharged 1 week after the procedure with improvement in dyspnea. Home medications were angiotensin receptor-neprilysin inhibitor, β-blockers, sodium-dependent glucose transporter 2 and mineralocorticoid receptor antagonist. Given her advanced CKD and frailty, dose-adjusted Endoxaban 30 mg daily was the chosen anticoagulant based on the atrial fibrillation indication.

At 2-month follow-up, NYHA functional class improved from III to II. Echocardiography demonstrated stable position and satisfactory function of all 3 transcatheter valves with preserved left ventricular systolic function.

There is no echocardiographic evidence of significant prosthetic aortic stenosis (Vmax of 1.8 m/s and mean gradient of 6 mm Hg) regurgitation; mitral ViV

FIGURE 8 Staged Transcatheter Valve-in-Valve Replacement for Simultaneous Failure of Three Surgical Bioprosthetic Valves Outcome



(A) 23-mm SEV (red arrow) placed through transfemoral ViV TAVR, with the (B) mean pressure gradient decreasing from 72.3 to 5 mm Hg and (C) trivial paravalvular regurgitation. (D) 26-mm BEV (green arrow) placed through transfemoral ViV TMVR, with the (E) mean pressure gradient decreasing from 11 to 7.7 mm Hg and (F) trivial regurgitation. (G) 26-mm BEV (green arrow) placed through transfemoral ViV TTVR, with the (H) mean pressure gradient of 0.95 mm Hg and (I) tricuspid regurgitation decreasing from severe to mild (yellow arrow). Abbreviations as in Figure 1.

prosthesis is well positioned with mild perivalvular regurgitation but a relatively elevated mean gradient of 12 mm Hg; and normally functioning tricuspid ViV prosthesis with mildly increased transvalvular gradient (Vmax of 1.7 m/s; peak gradient of 11 mm Hg; mean gradient of 6 mm Hg).

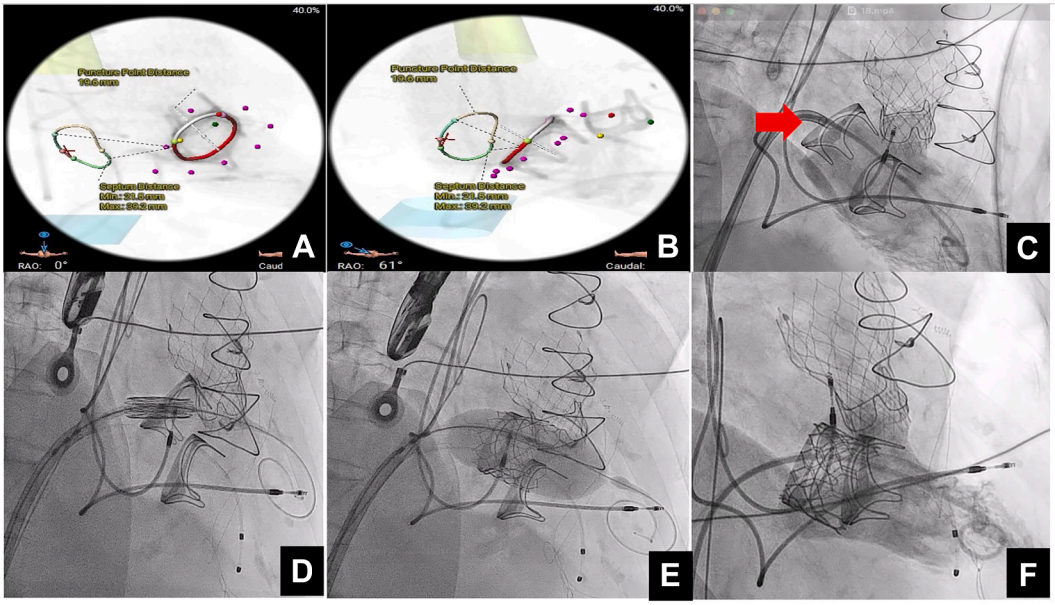
DISCUSSION

This case demonstrates the feasibility of staged triple transcatheter ViV replacement for simultaneous failure of 3 surgical bioprosthetic valves in a patient with prohibitive surgical risk. Although combined transcatheter interventions involving native valves[5] and double-valve replacement[6,7] have been described, experience with simultaneous failure of surgical aortic, mitral, and tricuspid bioprostheses remains limited.

The optimal sequence of multivalvular transcatheter intervention is not established and should be individualized according to the dominant lesion, ventricular physiology, pulmonary pressures, comorbidities, and procedural anatomy. In this case, aortic intervention was prioritized because severe aortic stenosis represented a fixed obstruction to forward flow. Correcting it first reduced afterload and allowed reassessment before increasing left ventricular preload through mitral valve replacement.

The staged approach also allowed interval CT-based planning and avoided the physiologic burden of a prolonged triple-valve procedure. Although

FIGURE 9 ViV Transcatheter Mitral Valve Replacement



(A and B) Optimal transseptal puncture site with minimum and maximum distance of 21.5 mm and 39.2 mm, respectively. (C) Failed mitral bioprosthetic valve (red arrow). (D) Positioning of the 26-mm BEV with the central marker at the basal ring of the surgical valve. (E) Deployment of TMVR device. (F) LV angiography showing stable position with insignificant regurgitation. LV = left ventricle; other abbreviations as in Figure 1.

staging requires an additional procedure, this was considered preferable in a frail patient with severe pulmonary hypertension and advanced CKD.

Multimodality imaging was essential. CT enabled assessment of coronary obstruction risk, neo-LVOT dimensions, surgical valve internal diameters, prosthesis-prosthesis relationships, and delivery trajectories. TEE provided real-time guidance for transseptal puncture, valve positioning, and assessment of immediate valve function.

POTENTIAL PITFALLS AND HOW TO AVOID THEM

CORONARY OBSTRUCTION DURING ViV-TAVR. Small surgical valves and low coronary heights increase risk. CT assessment of coronary height, sinus dimensions, valve to coronary, and valve-to-sinotubular junction is essential.[8] Coronary protection should be considered in high-risk anatomy.

PATIENT-PROSTHESIS MISMATCH. ViV-TAVR in a 19-mm surgical valve may result in high residual gradients. Supra-annular valve designs and bioprosthetic valve fracture, when anatomically feasible,[8] can improve the final EOA.

LVOT OBSTRUCTION DURING ViV-TMVR. CT-based neo-LVOT simulation is essential.[9] High-risk anatomy may require alternative strategies such as LAMPOON or septal reduction.

INTERACTION BETWEEN ADJACENT VALVES. Precise CT and fluoroscopic planning is required to avoid interference between the mitral transcatheter valve and previously implanted aortic prosthesis.[10]

HEMODYNAMIC INTOLERANCE. Frailty, severe pulmonary hypertension, advanced CKD, and prolonged procedural time increase risk. Staging should be considered when physiologic reserve is limited.

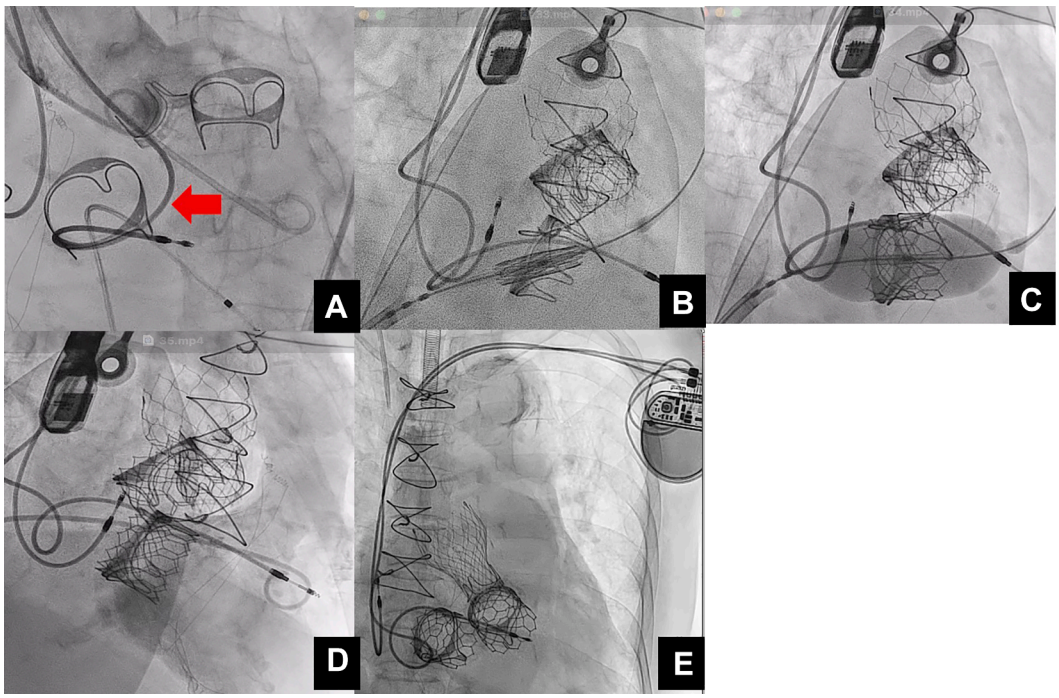
CONCLUSIONS

Simultaneous failure of multiple surgical bioprostheses presents a complex therapeutic challenge in patients with prohibitive surgical risk. A staged ViV-TAVR, ViV-TMVR, and ViV-TTVR strategy may provide a feasible alternative to redo triple-valve surgery.

Detailed multimodality imaging is essential for valve sizing, coronary and LVOT obstruction

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FIGURE 10 ViV Transcatheter Tricuspid Valve Replacement



(A) Failed tricuspid bioprosthetic valve (red arrow). (B) Positioning of the 26-mm BEV with the central marker at the basal ring of the surgical valve. (C) Deployment of TTVR device. (D and E) RV angiography showing stable position with insignificant regurgitation. RV = right ventricle; other abbreviations as in Figure 1.

EQUIPMENT LIST List of Equipment Used in this Case

Valve-in-Valve Transcatheter Aortic Valve Replacement	
Imaging	TEE machine (Philips Healthcare) 0.035-inch X7 TEE probe
Access	TEE machine (Philips Healthcare) Micropuncture needle and wire 0.035-inch J wire and 7-F sheath 0.035-inch Extra-stiff guidewire (Lunderquist, Cook Medical) 20-F Introducer sheath (Dryseal Flex, Gore)
TAVR device	23-mm Self-Expanding Valve (Evolut, Medtronic)
Valve-in-valve transcatheter mitral valve replacement	
Imaging	TEE machine (Philips Healthcare) 0.035-inch X7 TEE probe
Access	TEE machine (Philips Healthcare) 12-F dilator 0.035-inch J wire and 7-F sheath 0.035 Superstiff guidewire (Amplatz, Boston Scientific)
TMVR device	26-mm Balloon Expandable Valve (Sapien 3, Edwards Lifesciences)
Valve-in-valve transcatheter tricuspid valve replacement	
Imaging	TEE machine (Philips Healthcare) 0.035-inch X7 TEE probe
Access	TEE machine (Philips Healthcare) 12-F dilator 0.035-inch J wire and 7-F sheath 0.035 Superstiff guidewire (Amplatz, Boston Scientific)
TTVR device	26-mm Balloon Expandable Valve (Sapien 3, Edwards Lifesciences)

TAVR = transcatheter aortic valve replacement; TEE = transesophageal echocardiography; TMVR = transcatheter mitral valve replacement; TTVR = transcatheter tricuspid valve replacement.

assessment, prosthesis-prosthesis interaction, and procedural access planning. Procedural sequencing should be individualized; in this case, treatment of severe aortic bioprosthetic stenosis first improved forward flow and facilitated subsequent mitral and tricuspid interventions

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

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REFERENCES

1. D'arrigo P, Capodanno D. Structural deterioriation and bioprosthetic valve failure. *Card Intervention*. 2020;14(2):54–61. https://citoday.com/articles/2020-mar-apr/structural-valve-deterioration-and-bioprosthetic-valve-failure

2. Fazzari F, Baggiano A, Fusini L, et al. Early biological valve failure: structural valve degeneration, thrombosis, or endocarditis? *J Clin Med*. 2023;12:5740. https://doi.org/10.3390/jcm12175740

3. Elbadawi A, Elgendy IY, Afify H, et al. Combined transcatheter aortic and mitral valve interventions: insights from a national database. *JACC Cardiovasc Interv*. 2021;14(13):1505–1507.

4. Echarte-Morales J, Caneiro-Queija B, Barreiro-Perez M, et al. Concomitant transcatheter aortic and mitral valve replacement. *JACC Case Rep*. 2025;30(16):103772.

5. de A. Magalhaes FM, Pinesi HT, Franco RA, Ribeiro LTC, Esteves FA, Esteves V. Percutaneous treatment of multivalvular disease including refractory tricuspid regurgitation in a frail elderly patient. *JACC Case Rep*. 2025;30(33):104666.

6. Garg P, Chouhan N, Wander GS, Chandra P, Kashyap R. Simultaneous transcatheter dual valve replacement (mitral and tricuspid valves): a case report. *Eur Heart J Case Rep*. 2022;7(8):ytad344.

7. wienemann H, Mauri V, Kuhn E, Baldus S, Adam M. Simultaneous transcatheter valve-in-valve replacement of severely degenerated bioprosthetic aortic and mitral prosthesis. *Clin Res Cardiol*. 2022;111(12):1396–1400.

8. Simonato M, Palma JH, Alirhayim Z, Guddeti R, Kaneko T, Garcia S. The essential aortic valve-in-valve transcatheter aortic valve replacement update: procedural strategies and current clinical results. *Struct Heart*. 2025;9(3):100318.

9. Reid A, Ben Zehry S, Turaga M, et al. Neo-LVOT and transcatheter mitral valve replacement: expert recommendations. *JACC Cardiovasc Imaging*. 2021;14(4):854–866.

10. Shenoda M, Tedesco D, Shafer C, et al. Protection of transcatheter mitral valve replacement during valve-in-valve transcatheter aortic valve replacement. *J Soc Cardiovasc Angiogr Interv*. 2025;4(6):103619.

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