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CASE REPORT

CLINICAL CASE

Endoaortic Balloon Occlusion for Minimally Invasive Mitral Valve Replacement After Previous Balloon-Expandable TAVI

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ABSTRACT

BACKGROUND Prior transcatheter aortic valve implantation (TAVI) may complicate minimally invasive mitral valve surgery when endoaortic balloon occlusion (EABO) is considered. Guidance for EABO after TAVI remains limited.

CASE SUMMARY A 56-year-old woman with radiation-induced multivalvular disease underwent staged transfemoral balloon-expandable TAVI and coronary revascularization, followed by minimally invasive mitral valve replacement using EABO. Pre-TAVI computed tomography identified a potential ascending-aortic landing zone, and continuous TEE confirmed balloon positioning above the TAVI frame. EABO achieved complete aortic occlusion without migration, frame contact, or evidence of cerebral malperfusion.

DISCUSSION Prior balloon-expandable TAVI may not preclude EABO in carefully selected patients with favorable ascending-aortic anatomy. Imaging-based selection, continuous TEE surveillance, and controlled inflation are central to safety.

TAKE-HOME MESSAGE Prior balloon-expandable TAVI does not preclude EABO in selected patients with a suitable ascending-aortic landing zone. (JACC Case Rep. 2026;■:111165) © 2026 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 56-year-old woman was referred for management of severe mixed aortic and mitral valve disease. She presented with dyspnea and easy fatigability, NYHA functional class III. On examination, blood pressure was mildly elevated, with a systolic murmur of mixed mitral stenosis/regurgitation and mild bilateral lower-extremity edema. Transthoracic and transesophageal echocardiography demonstrated severe mixed aortic stenosis and regurgitation, severe mixed mitral valve disease with extensive mitral annular calcification, and preserved biventricular function.

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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

CT = computed tomography

EABO = endoaortic balloon occlusion

LAD = left anterior descending artery

PCI = percutaneous coronary intervention

TAVI = transcatheter aortic valve implantation

TEE = transesophageal echocardiography

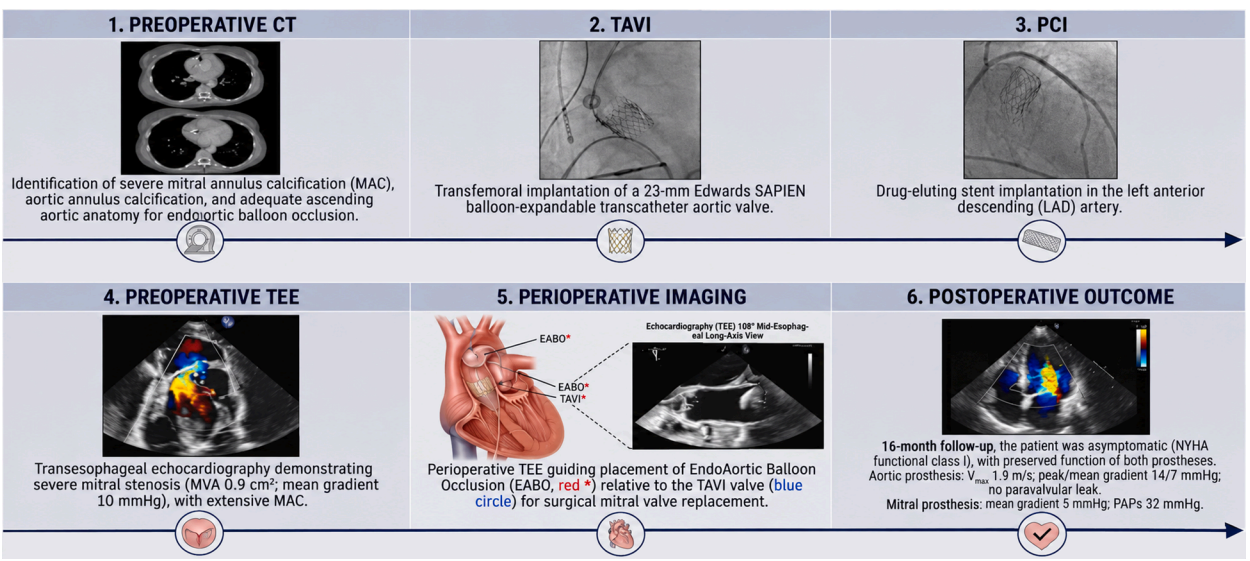
PAST MEDICAL HISTORY

Her history included Hodgkin lymphoma treated with chemotherapy and mediastinal radiotherapy, and a recent cryptogenic stroke on antiplatelet therapy. Coronary angiography had demonstrated multivessel disease: a 75% stenosis of the second segment of the left anterior descending artery (LAD), a 75% stenosis of the first diagonal branch, and a 90% stenosis of the first segment of the right coronary artery; functional assessment (fractional flow reserve/instantaneous wave-free ratio) of the diagonal and right coronary lesions was negative, and revascularization was therefore limited to the LAD. Although her calculated surgical risk was low by standard scores (EuroSCORE II 1.18%; logistic EuroSCORE I 4.38%), the Heart Team judged conventional combined aortic and mitral valve surgery via sternotomy to carry substantially higher risk than these scores suggested, given radiation-related factors not captured by standard risk models: a hostile mediastinum with postactinic adhesions and fibrosis, and a porcelain aorta with calcification extending into the ascending aorta and arch, precluding safe aortic cross-clamping and cannulation. These findings,

TAKE-HOME MESSAGES

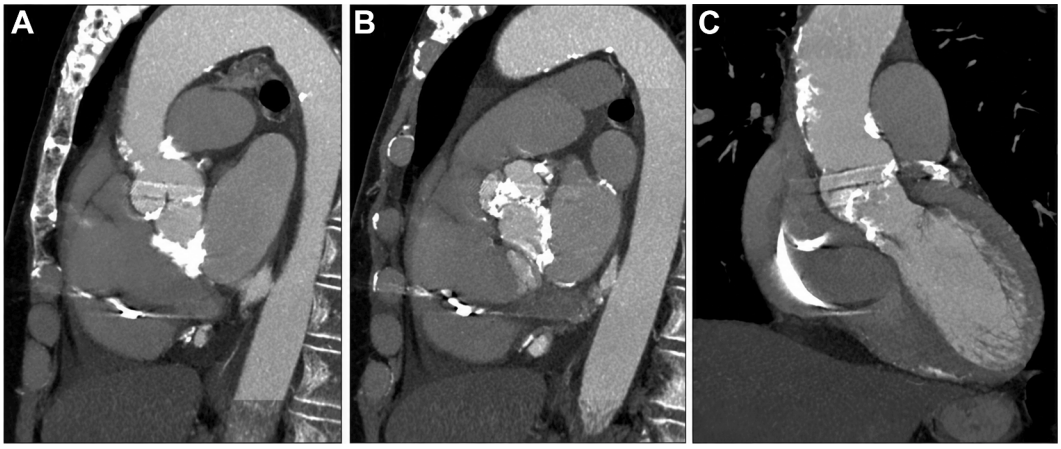
- Previous balloon-expandable transcatheter aortic valve implantation (TAVI) does not preclude endoaortic balloon occlusion for minimally invasive mitral valve surgery when guided by computed tomography-based patient selection.
- Pre-TAVI computed tomography can support anatomical planning, whereas continuous transesophageal echocardiography surveillance is essential to confirm and maintain a safe balloon position above the TAVI frame.

VISUAL SUMMARY **Clinical Timeline Illustrating the Staged Management of Radiation-Induced Multivalvular Heart Disease and the Use of EABO During Minimally Invasive MVR**



1. Preoperative (pretranscatheter aortic valve implantation [TAVI]) computed tomography (CT) demonstrated severe mitral annular calcification and a potential ascending-aortic landing zone for future EABO. 2. Transfemoral implantation of a 23-mm Edwards SAPIEN 3 Ultra balloon-expandable TAVI was performed successfully. 3. Four months later, percutaneous coronary intervention (PCI) with drug-eluting stent implantation was performed in the left anterior descending artery. 4. Preoperative transesophageal echocardiography (TEE) confirmed severe mitral valve disease with extensive mitral annular calcification. 5. Minimally invasive mitral valve replacement was performed using EABO, with continuous TEE guidance confirming balloon positioning above the TAVI frame without contact or migration. 6. At 16-month follow-up, the patient was asymptomatic (NYHA functional class I), with preserved prosthetic valve function. The TAVI demonstrated a maximum velocity of 1.9 m/s, peak/mean gradients of 14/7 mm Hg, and no paravalvular leak; the mitral bioprosthesis had a mean gradient of 5 mm Hg and pulmonary artery systolic pressure of 32 mm Hg. LAD = left anterior descending coronary artery; MAC = mitral annulus calcification; MVA = mitral valve area; PAPs = pulmonary artery systolic pressure; Vmax = maximum velocity.

FIGURE 1 **Pretranscatheter Aortic Valve Implantation Computed Tomography Demonstrating the Potential Endoaortic Balloon Occlusion Landing Zone and Calcific Burden**



(A) Sagittal view: Severe calcific involvement of the aortic root and mitral annulus. (B) Adjacent sagittal reconstruction: Close anatomical relationship between the heavily calcified aortic valve complex and the anterior mitral leaflet. (C) Oblique long-axis reconstruction showing circumferential extension of calcium involving the aortic annulus and mitral apparatus.

together with the coronary artery disease, favored a staged strategy: transfemoral transcatheter aortic valve implantation (TAVI) (23-mm SAPIEN 3 Ultra, Edwards Lifesciences) was performed first, with an uncomplicated course, followed 4 months later by percutaneous coronary intervention (PCI) to the LAD once antiplatelet therapy could be adjusted. TAVI was prioritized over PCI because her severe aortic stenosis was the dominant hemodynamic lesion: fixed left ventricular outflow obstruction limits tolerance of PCI-related hypotension or ischemia, making aortic relief first the lower-risk strategy. She was referred for minimally invasive mitral valve replacement 8 months after TAVI, after completion of dual antiplatelet therapy.

DIFFERENTIAL DIAGNOSIS

Differential diagnosis included radiation-induced valvulopathy, age-related degenerative calcific disease, and rheumatic heart disease.[1] The history of mediastinal radiotherapy for Hodgkin lymphoma, the combined pattern of aortic and mitral annular calcification, and the absence of commissural fusion or other features typical of rheumatic disease supported a radiation-induced etiology.

INVESTIGATIONS

Because no post-TAVI computed tomography (CT) was available, the pre-TAVI CT dataset was retrospectively reviewed to assess the ascending-aortic anatomy and identify a potential endoaortic balloon occlusion (EABO) landing zone (**Figure 1**). The final balloon position relative to the implanted TAVI frame was confirmed intraoperatively by continuous transesophageal echocardiography (TEE). Pre-TAVI CT measurements informed the assessment: sinotubular junction 27 × 30 mm, ascending aorta 32 × 35 mm with diffuse calcification, an available ascending-aortic length of 78 mm between the sinotubular junction and the brachiocephalic trunk, and aortic arch 24 × 26 mm with minor ostial calcific plaques. Three criteria guided selection: adequate ascending-aortic length and diameter to seat the balloon above the transcatheter valve; a more favorable landing zone with a balloon-expandable than a self-expanding platform, given its shorter intra-annular frame and reduced ascending-aortic extension;[2] and absence of significant flow-limiting atheroma along the planned trajectory. CT (Video 1) demonstrated the extent of mitral annular calcification and identified a potential landing zone.

MANAGEMENT

A transcatheter mitral option was not pursued: the extensive, irregular annular calcification of radiation-induced valvular disease is poorly suited to transcatheter edge-to-edge repair, in which leaflet fibrosis restricts mobility, or to transcatheter mitral replacement, whose devices are sized for the more classic

EQUIPMENT LIST **Equipment List Used for Endoaortic Balloon Occlusion and Minimally Invasive Mitral Valve Replacement**

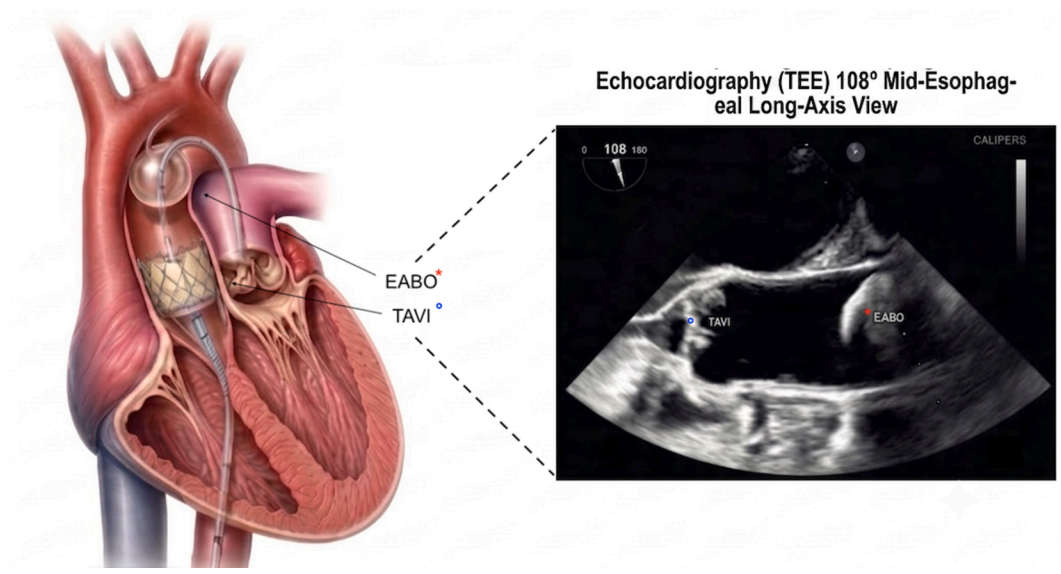
EndoClamp Endoaortic Balloon Catheter With Dedicated Side-Arm Arterial Cannula Port
Femoral arterial and venous cannulae, with Y-connected jugular venous cannula for peripheral cardiopulmonary bypass
Intraoperative transesophageal echocardiography for continuous EABO positioning and balloon-frame surveillance
Aortic root pressure line for confirmation of aortic occlusion and cardioplegia delivery
Right radial arterial pressure line for continuous upper-extremity pressure monitoring
Adenosine for transient asystole during EABO positioning
Crystalloid cardioplegia system for single-dose antegrade cardioplegia

EABO = endoaortic balloon occlusion; TEE = transesophageal echocardiography.

calcification pattern rather than this radiation-induced one; we therefore favored surgical replacement via a minimally invasive approach. A minimally invasive double-valve procedure was also considered; however, the Heart Team favored TAVI for the aortic valve to avoid additional surgical manipulation of the irradiated mediastinum and to limit the extent of a combined operation.

For the mitral procedure, peripheral cardiopulmonary bypass was established via right femoral arterial and bicaval venous cannulation under mild hypothermia through a right anterolateral minithoracotomy. An EndoClamp (Edwards Lifesciences) balloon catheter was advanced through a side-arm port on the arterial cannula under continuous TEE guidance[3,4] to seat above the TAVI frame, in the segment identified on preoperative CT; TEE in a long-axis view continuously visualized the balloon-frame relationship, allowing repositioning before contact if needed (Figure 2). The balloon, positioned well above the transcatheter valve frame, did not interfere with left atrial exposure. It was inflated gradually with saline to 350-450 mm Hg, stopped once complete occlusion was confirmed rather than

FIGURE 2 **Anatomical and Intraoperative Echocardiographic Correlation of EABO Positioning Relative to the TAVI Frame**



Left: conceptual illustration showing the endoaortic balloon inflated in the ascending aorta above the transcatheter heart valve. Right: intraoperative transesophageal echocardiography (108° midesophageal long-axis view) confirming the balloon (EABO) positioned well above the TAVI, with no contact between the 2 structures throughout occlusion. TEE = transesophageal echocardiography.

at a fixed volume, with position, aortic root, and right radial arterial pressure monitored for signs of balloon migration. An adenosine bolus induced transient asystole for positioning, followed by single-dose antegrade crystalloid cardioplegia. Through a left paraseptal atriotomy, the mitral valve was replaced with a 25-mm bioprosthesis after leaflet excision and decalcification of extensive posterior annular calcification. The balloon was deflated and withdrawn under TEE guidance, confirming normal valve motion, and the patient was weaned from bypass.

OUTCOME AND FOLLOW-UP

Cardiopulmonary bypass and cross-clamp times were 157 and 129 minutes, respectively. There was no balloon migration or contact with the TAVI frame, and no clinically evident neurologic event. The postoperative course was uneventful, without transient ischemic attack, stroke, bleeding, vascular, or renal complications, and the patient was discharged after 7 days. At 16-month follow-up, the patient was in NYHA functional class I. Transthoracic echocardiography demonstrated preserved function of both prostheses: the TAVI with peak/mean gradients of 14/7 mm Hg, without paravalvular leak; the mitral bioprosthesis had a mean gradient of 5 mm Hg (Video 2).

DISCUSSION

EABO is well established for aortic occlusion in minimally invasive mitral surgery,[5,6] avoiding external clamping morbidity in a small field. As TAVI expands to younger, lower-risk patients,[7] more will later require mitral valve surgery[8]; however, specific guidance on EABO after TAVI remains limited. Balloon-frame contact was neither required nor intended, and no data define the risk of balloon damage or rupture from such contact. In our patient, because no post-TAVI CT was available, the frame-to-sinotubular junction relationship was not measured directly; pre-TAVI CT showed a sinotubular junction measuring 27 × 30 mm, an ascending aorta measuring 32 × 35 mm, and an available ascending-aortic length of 78 mm between the sinotubular junction and the brachiocephalic trunk, supporting a potential landing zone. Because CT preceded TAVI implantation, the balloon-prosthesis relationship was instead confirmed intraoperatively by continuous TEE, demonstrating balloon positioning above the TAVI frame without contact or migration. This relationship is not necessarily generalizable, however: the position of the upper edge of the transcatheter frame relative to the sinotubular junction can vary with anatomy, valve size, and implantation depth, and should be assessed with patient-specific imaging and confirmed intraoperatively by TEE rather than assumed a priori. EABO itself is not novel; this case's contribution lies in a structured, imaging-based approach combining CT-defined landing-zone selection, continuous TEE surveillance, and upper-extremity arterial pressure monitoring for potential balloon migration. Balloon migration toward the transcatheter frame or the arch could cause frame contact, balloon rupture, or cerebral malperfusion, and neurologic events occur more frequently with EABO than with transthoracic clamping[9]; this risk is mitigated by the landing-zone selection and monitoring described above, with prompt balloon deflation and conversion to an alternative aortic occlusion or myocardial-protection strategy if migration or malperfusion is suspected. Inadequate occlusion pressure can permit cardioplegia washout; inflation should be titrated to confirmed complete occlusion by TEE and root pressure rather than a fixed volume. Aortic dissection, a recognized EABO complication,[10] similarly warrants immediate deflation and conversion to an alternative strategy if suspected. We selected EABO over fibrillatory arrest, hyperkalemic arrest, or transthoracic clamping, which offer less controlled arrest or require manipulation in a radiotherapy-constrained thoracotomy field; comparative series report similar safety outcomes with transthoracic clamping. This single case does not establish comparative safety or generalizability across anatomies or TAVI platforms. These findings should not be extrapolated to self-expanding valves, whose longer frames may extend farther into the aortic root or ascending aorta, potentially limiting the available landing zone. Further experience is needed to define EABO feasibility and safety after TAVI.

CONCLUSIONS

In selected patients with a balloon-expandable transcatheter aortic valve, EABO for minimally invasive mitral valve replacement is feasible when guided by a structured, imaging-based approach: preoperative CT-based landing-zone selection, continuous TEE surveillance of the balloon-frame relationship, gradual pressure-targeted inflation, and continuous upper-extremity arterial pressure monitoring for early detection of hemodynamic changes potentially related to balloon migration. Previous balloon-expandable TAVI may not represent an absolute

contraindication to EABO in carefully selected patients with suitable aortic anatomy.

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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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KEY WORDS aortic cross-clamping, balloon-expandable valve, mitral annular calcification, multimodality imaging, radiation-induced valvular disease, transesophageal echocardiography

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