

Combined transfemoral TAVI and direct-vision valve-in-MAC through the transaxillary approach

Michele Galeazzi, Erlil Mali, Olimpia Bifulco, Beatrice Buratto, Filippo Capestro, Marco Di Eusanio

Cardiac Surgery Department, Lancisi Cardiovascular Center - AOURL, Minimally Invasive and Trans Catheter Cardiac Surgery Research Center, Polytechnic University of Marche, Ancona, Italy

Correspondence to: Michele Galeazzi, MD. Via Conca 71, Cardiac Surgery Department, Lancisi Cardiovascular Center - AOURL, Ancona, Italy. Email: michelegaleazzi96@gmail.com.

Keywords: Transaxillary approach; mitral annular calcification (MAC); valve-in-MAC; transcatheter aortic valve implantation; minimally invasive cardiac surgery



Submitted Aug 23, 2026. Accepted for publication Sep 20, 2026. Published online Sep 22, 2026.

doi: 10.21037/acs-2026-0300-tdv

View this article at: <https://dx.doi.org/10.21037/acs-2026-0300-tdv>

Clinical vignette

A 70-year-old female with a history of hypertension, paroxysmal atrial fibrillation, previous ischemic stroke, and extensive atherosclerotic disease was referred to our center for symptomatic severe rheumatic aortic stenosis (mean gradient 43 mmHg) with severe aortic regurgitation and hemodynamically significant rheumatic mitral stenosis (mean gradient 8–9 mmHg). She presented with New York Heart Association (NYHA) class III symptoms, with preserved left ventricular systolic function (LVEF 60%). Preoperative transthoracic echocardiography and multiplanar computed tomography (CT) reconstruction confirmed a heavily calcified aortic valve alongside massive, circumferential calcification of the mitral annulus extending into the posterior leaflet [severe mitral annular calcification (MAC)]; the ascending aorta also exhibited diffuse calcifications. Due to the severe aortic calcifications and the patient's very high surgical risk profile, conventional surgery via full sternotomy was deemed to carry an unfavorable risk-benefit ratio (1). Following a comprehensive Heart Team evaluation, a tailored minimally invasive hybrid surgical strategy was planned: transfemoral transcatheter aortic valve implantation (TAVI) followed by direct transatrial valve-in-MAC via a right transaxillary minithoracotomy (2); the latter was selected over a fully percutaneous transseptal approach to allow direct resection of the anterior mitral leaflet [reducing the risk of left ventricular outflow tract (LVOT) obstruction, otherwise predicted on preprocedural CT scan] and to safely manipulate the calcified annulus under direct vision while minimizing systemic calcium embolization risk. Indeed, preoperative CT virtual valve simulation (using 3mensio software) demonstrated a predicted Neo-LVOT area with an intact anterior leaflet critically reduced at 125.9 mm², while the resection would have expanded the predicted Neo-LVOT area to a safe threshold of 240.8 mm². The CT-derived mitral annular area was 8.6 cm².

Surgical techniques

Preparation

The patient was positioned supine with the right arm fixed over the head to mirror the posture used during the preoperative CT scan, thereby minimizing anatomical spatial discrepancies. A right jugular venous cannula was positioned to optimize venous drainage, and an ultrasound-guided serratus anterior plane block was performed for postoperative analgesia. The procedure began with the transcatheter phase. Under fluoroscopic guidance, with secondary vascular access via the right femoral artery for diagnostic angiography, a 14-Fr eSheath was advanced through the left femoral artery. After crossing the aortic valve, a 23-mm Edwards SAPIEN 3 Ultra (Edwards Lifesciences, Irvine, CA, USA) prosthesis was successfully deployed under rapid ventricular pacing. Intraoperative echocardiographic and angiographic assessments confirmed stable prosthetic positioning without paravalvular leakage.

Exposure

Following completion of the TAVI procedure, the left femoral arterial access was converted for arterial cardiopulmonary bypass (CPB) cannulation. Venous drainage was established through a femoral venous cannula together with the previously positioned right jugular venous cannula. A 5-cm skin incision was performed along the right anterior axillary line, and the thorax was entered through the fourth intercostal space under direct vision. CPB was then established. Exploiting the natural anatomical geometry of the transaxillary approach, optimal surgical exposure of the heart was accomplished by placing seven pericardial stay sutures secured directly to the skin. This key maneuver effectively reduced the working distance to approximately 10 cm, drawing the valvular structures into a direct line of sight for the operator.

Operation

Attention was then turned to the surgical phase on the mitral valve. Following aortic cross-clamping with a flexible clamp and antegrade administration of a single dose of del Nido cardioplegia, a left atriotomy was performed parallel to the interatrial groove. Direct inspection revealed a hostile, severely calcified mitral annulus. The anterior mitral leaflet was partially excised, and multiple pledgeted supra-annular sutures were placed to reinforce the prosthetic landing zone and promote circumferential sealing and anchoring (3,4). Balloon sizing was conducted to simulate the circularization of the calcified orifice and validate the CT-based sizing measurements. A 29-mm Edwards SAPIEN 3 Ultra valve (Edwards Lifesciences, Irvine, CA, USA) was positioned into the MAC landing zone and expanded to nominal inflation volume. Following deployment, the delivery system was retrieved and prosthetic seating was evaluated. While the prosthetic frame was properly positioned posteriorly, its anterior portion lay just below the remnants of the anterior leaflet. Since initial sealing appeared satisfactory, the previously placed supra-annular sutures were passed through the prosthetic skirt and tied to complete the anchoring. Upon the initial aortic declamping and weaning from CPB, intraoperative transesophageal echocardiography (TEE) revealed a severe LVOT obstruction with a peak gradient of 73 mmHg and a mean gradient of 38 mmHg, caused

by partial ventricular tilting of the newly implanted mitral prosthesis. Capitalizing on the outstanding direct line of sight and ergonomic setup of the transaxillary platform, CPB was re-established, the aorta was safely re-clamped, the left atrium reopened, and the anterior securing sutures were cut. Under clear direct vision, the anterior mitral leaflet was further resected, and the valve was carefully elevated and “atrialized” by approximately 5 mm (leaving the entire sealing skirt within the left atrium while exposing the bare metal frame). New pledgeted U-sutures were anchored lower on the prosthetic skirt to fix the valve in this optimized position, taking care not to interfere with leaflet motion. Following the second aortic declamping, TEE and invasive catheter measurements confirmed resolution of the significant LVOT obstruction, with a residual peak/mean gradient of 16/9 mmHg, excellent mitral valve function (mean gradient 4–5 mmHg), and stable hemodynamics.

Completion

The left atrium was closed with a double running suture, CPB weaning was completed successfully, and chest wall closure was performed in standard anatomical layers after chest drain placement.

Comments

Clinical results

The postoperative course was uneventful, with an intensive care unit stay of 2 days and discharge home on postoperative day 7. Our broader institutional experience with the transaxillary approach has consistently demonstrated excellent outcomes (2), significantly reducing surgical trauma and enhancing postoperative recovery. In the present high-risk patient with concomitant severe MAC and aortic stenosis, the integration of a hybrid procedure with the transaxillary approach allowed for successful and safe treatment of both valvular lesions. The cumulative CPB and cross-clamp times were 159 and 100 minutes, respectively. Postoperative echocardiography confirmed well-functioning prostheses in both positions, with low gradients and resolution of the significant intraoperative LVOT obstruction.

Advantages

Hybrid strategies may expand therapeutic options in selected high-risk patients for whom conventional surgery is particularly challenging. In this evolving landscape, it is paramount that modern cardiac surgeons acquire proficiency in transcatheter techniques, effectively filling the gap when traditional open-surgical strategies reach their limits. Mastering transcatheter procedures empowers the surgeon to approach high-risk and anatomically challenging scenarios with greater clinical awareness, enhanced procedural flexibility, and a broader armamentarium at their disposal.

In this context, the direct-vision transaxillary approach serves as an ideal surgical platform, providing optimal exposure and simplifying complex procedural steps. The paramount advantage of this technique lies in its extraordinary versatility, adaptability, and scalability, even in extreme or borderline clinical scenarios. The direct line of sight preserves the surgeon’s native hand-eye coordination, offering a wide, centered

operative field and an expanded operative comfort zone. This direct exposure provides a critical safety margin during complex procedures like direct valve-in-MAC. As demonstrated in our case, when acute LVOT obstruction occurred, the direct-vision environment permitted a safe and swift re-clamping, re-atriotomy, and prosthetic repositioning—an intraoperative rescue maneuver that would be exceptionally laborious and technically demanding through indirect, video-assisted access. Direct visual access allowed for immediate release of the anchoring U-sutures, controlled prosthetic elevation toward the atrium, and secure re-fixation—a targeted surgical bailout maneuver that is virtually impossible during fully percutaneous procedures.

Caveats

Patients presenting with severe MAC represent a particularly complex and fragile population, intrinsically associated with significant perioperative risk and technical hurdles when managed via conventional surgery. Despite its reproducibility, the transaxillary direct-vision strategy demands meticulous preoperative CT planning. Accurate selection of the intercostal space is mandatory to maintain a perpendicular trajectory to the target valvular structures. Furthermore, while the valve-in-MAC step could be performed through a fully transcatheter approach, treating severe MAC carries important risks including prosthetic malposition or migration, paravalvular leakage (1,3,4), and LVOT obstruction (5). In such demanding scenarios, surgeons must be fully prepared to perform immediate intraoperative bail-out procedures and master specific technical adjustments to safely secure optimal alignment. It is precisely in this context that the transaxillary direct-vision approach proves its value, providing the ideal surgical platform to manage these critical complications safely and effectively.

Acknowledgments

None.

Footnote

Funding: None.

Conflicts of Interest: The authors have no conflicts of interest to declare.

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

1. El-Eshmawi A, Halas M, Bethea BT, et al. The American Association for Thoracic Surgery (AATS) 2025 Expert Consensus Document: Surgical management of mitral annular calcification. *J Thorac Cardiovasc Surg* 2025;170:502-22.
2. Malvindi PG, Bifulco O, Spagnolo F, et al. Simplified Approach for Minimally Invasive Mitral Valve Surgery Through a Transaxillary Minithoracotomy Access. *Ann Thorac Surg* 2026;121:1394-402.
3. Praz F, Khalique OK, Lee R, et al. Transatrial implantation of a transcatheter heart valve for severe mitral annular calcification. *J Thorac Cardiovasc Surg* 2018;156:132-42.
4. Fatehi Hassanabad A, Rabbani M, Tam DY, et al. Direct Implantation of Transcatheter Valve in Mitral Annular Calcification: A Multicenter Study. *Ann Thorac Surg* 2025;119:129-36.
5. Yoon SH, Bleiziffer S, Latib A, et al. Predictors of Left Ventricular Outflow Tract Obstruction After Transcatheter Mitral Valve Replacement. *JACC Cardiovasc Interv* 2019;12:182-93.

Cite this article as: Galeazzi M, Mali E, Bifulco O, Buratto B, Capestro F, Di Eusanio M. Combined transfemoral TAVI and direct-vision valve-in-MAC through the transaxillary approach. *Ann Cardiothorac Surg* 2026;15(5):75. doi: 10.21037/acs-2026-0300-tdv