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Case Reports

Transcatheter Aortic Valve Implantation Bailout for Severe Aortic Insufficiency due to Aortic Root Dissection Following Ascending Aortic Aneurysm Repair

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Abstract

This novel case documents the successful use of transcatheter aortic valve implantation to treat severe aortic insufficiency arising from aortic root dissection following the repair of an ascending aortic aneurysm in a 75-year-old female patient. After she presented with symptoms of congestive heart failure, investigation revealed new severe aortic insufficiency and an acute aortic dissection. Given the prohibitive risks of reoperation, a self-expanding 27-mm Portico (St Jude Medical) prosthetic aortic valve was deployed, resulting in substantial clinical improvement without procedural complications. This case highlights the versatility of transcatheter aortic valve implantation in managing complex aortic disease and emphasizes the critical role of multidisciplinary evaluation and careful prosthesis selection.

Keywords: Aneurysm, ascending aorta; aortic dissection; aortic valve insufficiency; transcatheter aortic valve replacement

Case Report

Presentation and Physical Examination

A 75-year-old woman presented 17 days after an elective surgical ascending aortic aneurysm repair and aortic valve commissurotomy repair. The patient was experiencing new, sudden-onset symptoms indicative of congestive heart failure, including dyspnea with minimal activity, orthopnea, and peripheral edema. Physical examination was notable for a wide arterial pulse pressure (150/50 mm Hg), jugular venous distention, bilateral pulmonary rales, and anasarca.

Medical History

The patient had a medical history of ascending aortic aneurysm with mild aortic insufficiency and a chronic type B aortic dissection. The patient's condition had been managed conservatively since the initial diagnosis in 2012, with stringent blood pressure control and annual surveillance computed tomography (CT) imaging. Surgical repair was recommended to address rapid ascending aortic aneurysm expansion on the latest CT images that measured 4.8 cm, indicating progression from a previous measurement of 4.5 cm. The aortic root, thoracic aortic arch, and descending thoracic aorta measured 3 cm, 2.9 cm, and 2.8 cm, respectively, with a structurally normal tricuspid aortic valve. The patient underwent ascending aortic aneurysm repair with a 32-mm Gelweave (Terumo Aortic) graft as well as a single-vessel bypass from the aorta to the right coronary artery and aortic valve repair employing the Cabrol

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commissuroplasty technique (Fig. 1). This decision not to replace the aortic valve was made because of the aortic valve's structural integrity, which was normal aside from mild aortic insufficiency, and a preference for preserving the valve's natural function. Following the operation, the patient required temporary inotropic support, but she exhibited a satisfactory recovery and was discharged 15 days after surgery in stable medical condition to an acute rehabilitation facility.

Technique

Transthoracic echocardiography and transesophageal echocardiography revealed the presence of new severe aortic insufficiency (Fig. 2) with preserved left

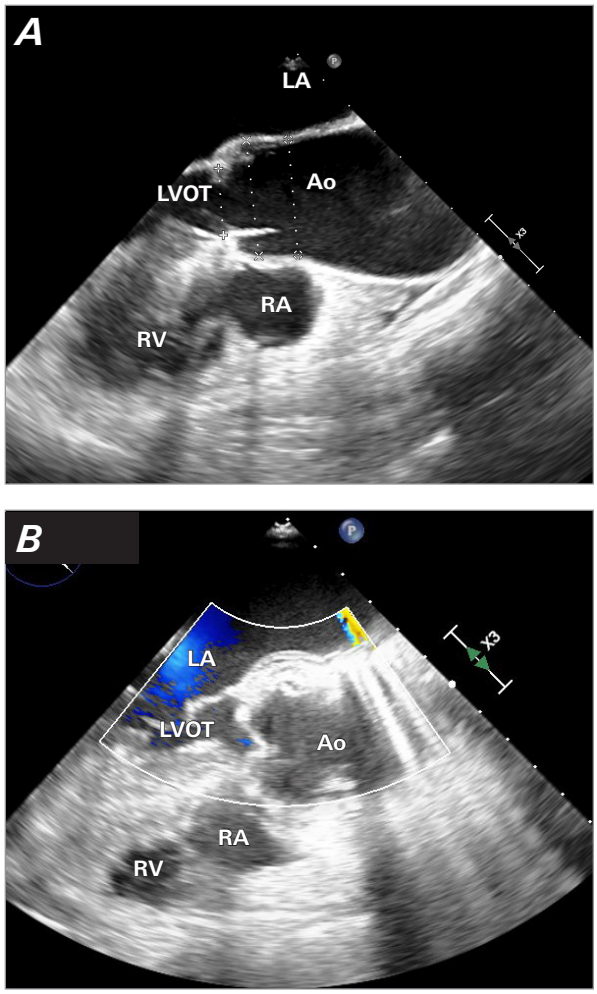

Fig. 1 Transesophageal echocardiogram in a midesophageal long-axis, 3-chamber view, captured before and after the surgical repair, shows (**A**) the initial measurements of the aortic root and (**B**) the absence of residual aortic insufficiency jet after surgical repair by color Doppler imaging.

Ao, aorta; LA, left atrium; LVOT, left ventricular outflow tract; RA, right atrium; RV, right ventricle.

Key Points:

- This case underscores the efficacy of TAVI in managing severe aortic valve insufficiency after aortic dissection, offering a less invasive alternative for patients with high surgical risk. Clinicians can consider TAVI in similar high-risk scenarios, expanding its application beyond conventional indications.
- The successful deployment of TAVI in this complex case highlights the value of a comprehensive multidisciplinary team discussion. This approach ensures optimal patient-centered care, encouraging practitioners to adopt a collaborative strategy for complex cardiovascular interventions.
- A self-expanding bioprosthesis with calculated oversizing demonstrates effective anchoring within the aortic annulus and ascending aorta. This technique minimizes embolization risks, suggesting that meticulous preprocedural planning and device selection are crucial for procedural success in nonstandard TAVI applications.

Abbreviations

CT, computed tomography
TAVI, transcatheter aortic valve implantation

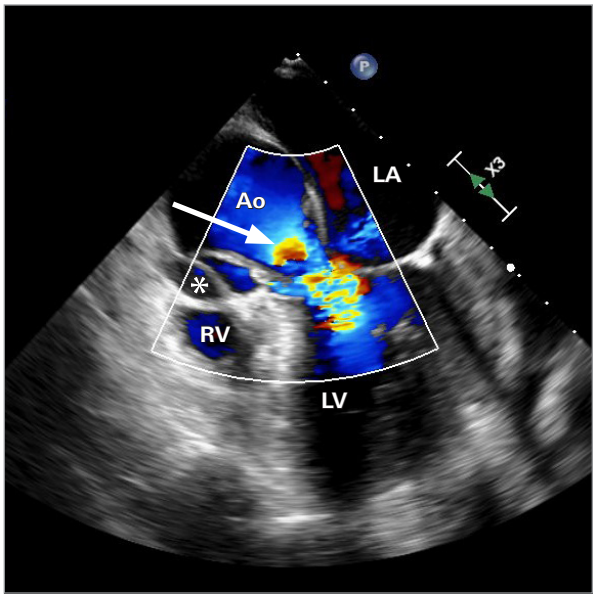

Fig. 2 Transesophageal echocardiogram midesophageal long-axis, 3-chamber view illustrates an aortic root dissection with severe aortic valve regurgitation, as visualized by color Doppler imaging. The asterisk indicates the dissection false lumen, while the arrow points to the aortic regurgitation jet.

Ao, aorta; LA, left atrium; LV, left ventricle; RV, right ventricle

ventricular ejection fraction. A chest CT angiogram showed an acute aortic dissection at the proximal and distal segments of the aortic graft. The new dissection involved the right and noncoronary sinuses (Fig. 3) and extended cranially into the right brachiocephalic artery, bilateral common carotid arteries, and proximal left subclavian artery.

A comprehensive multidisciplinary team meeting was convened to discuss the optimal approach for managing this patient's current clinical condition. Considering her frailty and recent sternotomy, the potential risks associated with surgical intervention were deemed excessively high. The decision was therefore made to perform transcatheter aortic valve implantation (TAVI) via right common femoral artery access. Because of the patient's lack of aortic valve leaflet calcification, a self-expanding bioprosthesis with sufficient oversizing was chosen. Based on cardiac CT angiographic analysis, the annular area was 370 mm^2, the perimeter was 69 mm, and the ascending aortic dimension within the graft was 32 mm. A 27-mm Portico valve (Abbott Cardiovascular) with an approximate calculated nominal area of 570 mm^2, a perimeter of 84 mm, and an outflow dimension of 42 mm was used to provide sufficient oversizing to secure the bioprosthesis at the annular level and the ascending aorta, minimizing the risk of embolization.

During the TAVI procedure, meticulous attention was paid to maintaining the wire within the true lumen of the aorta. The bioprosthesis was advanced through the aorta without difficulty and positioned across the aortic valve. Depth of deployment was assessed by transesophageal echocardiography and aortic root angiography. The bioprosthesis was then released under rapid pacing at a rate of 160/min. To avoid potential coronary flow obstruction resulting from the displacement of the dissection flap toward the ostium of the left main coronary artery during deployment, protective measures were implemented, including the placement of a wire into the left main coronary artery. Transesophageal echocardiographic guidance helped identify the true annulus from the dissection plane and prevent the bioprosthesis from interacting with the anterior mitral valve leaflet (Fig. 4).

Outcome

The procedure was successful without acute complications; afterward, the patient's heart showed normal electrical conduction. The patient was subsequently discharged to an acute rehabilitation facility and has remained clinically stable, with no further admissions related to congestive heart failure.

Latest Follow-Up

One month after TAVI, both an echocardiogram and a CT scan demonstrated the continued satisfactory function and positioning of the bioprosthesis and aortic graft (Fig. 5). The CT scan showed an aneurysmal dilatation

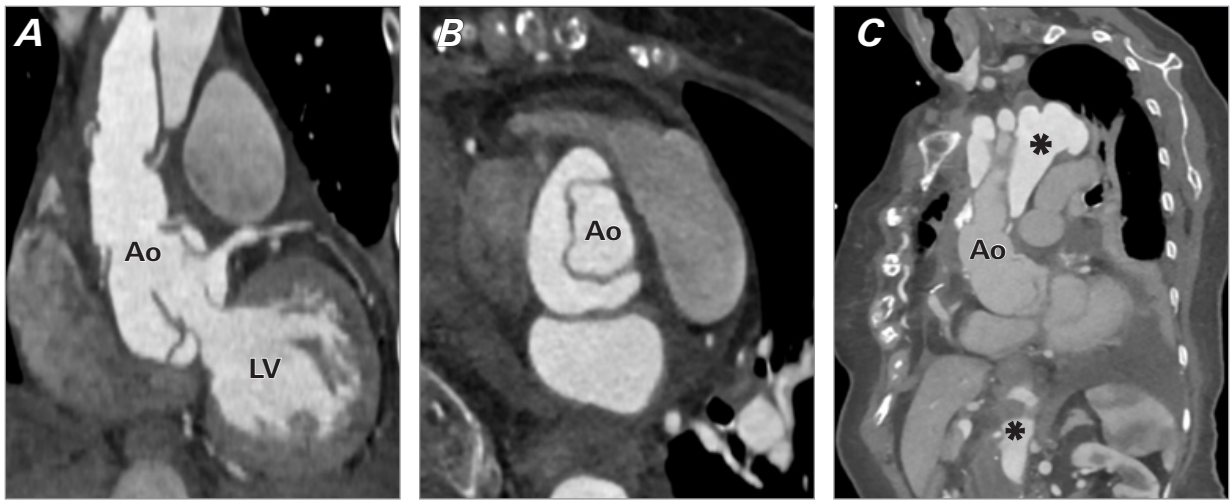

Fig. 3 Gated computed tomographic angiograms reveal an absence of calcification in the aortic valve leaflets and an extensive aortic root dissection involving the aortic arch while preserving patent distal flow to major vascular branches, specifically (**A**) the first-pass images (long axis), where the true and false lumens are enhanced; (**B**) the first-pass images (short axis), where the true and false lumens are enhanced; and (**C**) a delayed acquisition with contrast specifically observed within the dissection false lumen (asterisk).

Ao, aorta; LV, left ventricle

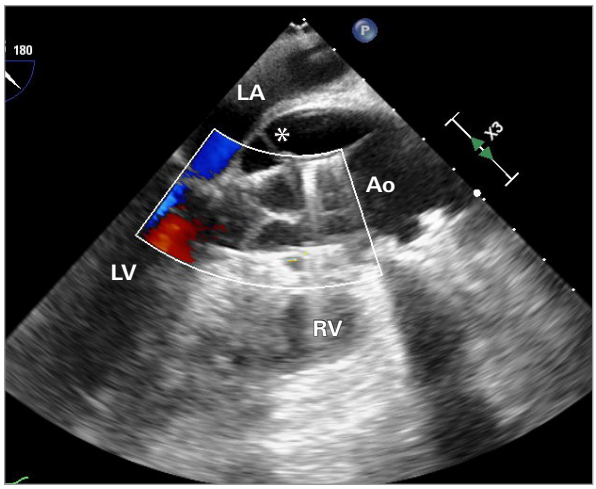

Fig. 4 A transesophageal echocardiogram (midesophageal long-axis, 3-chamber view) shows guided prosthetic valve deployment in the true aortic lumen and no evidence of aortic regurgitation, by color Doppler imaging. The asterisk indicates the dissection false lumen.

Ao, aorta; LA, left atrium; LV, left ventricle; RV, right ventricle

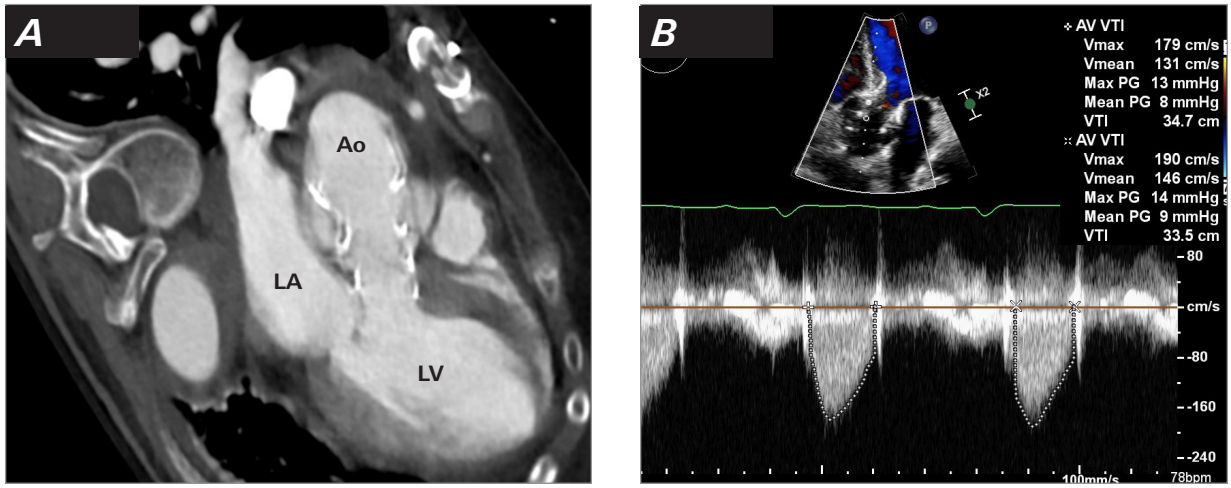

Fig. 5 A) A nongated computed tomographic angiogram with normal prosthetic valve anchoring and position is shown. **B**) A follow-up transthoracic echocardiogram with continuous-wave Doppler imaging confirms normal prosthesis function, with no paravalvular leak and a mean gradient of 9 mm Hg. Both imaging studies were performed at 1-month follow-up.

Ao, aorta; AV, aortic velocity; LA, left atrium; LV, left ventricle; PG, Vmax, maximum aortic velocity; Vmean, mean aortic velocity; VTI, velocity-time integral.

of the proximal thoracic aorta measuring 4.2 × 4.4 cm, with the dissection flap extending into the proximal right brachiocephalic artery. Nearly 1 year after the procedure, the patient is actively engaging in physical therapy, with no further heart failure admissions. To date, no substantial procedural complications have been observed. A follow-up plan has been established to repeat the CT scan and echocardiogram every 6 months.

Discussion

The management of the acute severe aortic valve insufficiency that arises as a complication of aortic dissection poses a substantial challenge, particularly in patients with elevated surgical risk. Though TAVI has seen increased use, questions linger about its effectiveness and safety as an off-label solution for aortic valve insufficiency. Information about the utility and safety of employing TAVI in patients with aortic dissection is also lacking.

Although TAVI was initially established for the treatment of severe native degenerative aortic stenosis of tricuspid valves, its use has expanded to include a wider scope of pathologies. This scope now involves stenotic bicuspid aortic valves, valve-in-valve implantation in patients with failed previous surgical aortic bioprostheses,

and even off-label use for the management of chronic aortic valve insufficiency.

In cases where TAVI has been performed to address aortic valve insufficiency, available data suggest acceptable rates of complications, secondary valve implantations, and residual aortic insufficiency.[1] Notably, reported rates of successful valve implantation are high, accompanied by 30-day all-cause mortality rates of approximately 10%.[2,3] This relatively higher rate of all-cause mortality could be attributed to the underlying medical complexity and severity of illness that initially led to this patient group being considered unsuitable candidates for surgical interventions. Ongoing research is investigating the potential of next-generation TAVI devices tailored specifically to individuals with pure severe aortic valve insufficiency.

For self-expanding TAVI bioprostheses, accurate sizing relies on annular measurements obtained through cardiac CT scans.[4] Typically, for calcific aortic valve stenosis, 15% oversizing is recommended to ensure secure anchoring and minimize the risk of paravalvular leaks.[5] In this specific case, considering the annular perimeter, a 25-mm Portico device would have been the choice for patients with calcific aortic valve stenosis. Because of the absence of leaflet calcifications, however, the decision was made in this case to deploy a 27-mm Portico valve to achieve robust anchoring at the annular level and within the ascending aorta. The choice of a self-expanding valve over a balloon-expandable valve was individualized and guided by careful consideration of the patient's unique anatomic and clinical situation.

Although type A aortic dissection has been reported as a complication following TAVI,[6] there have been no reported uses of TAVI in patients with aortic root dissection or ascending aortic dissection following a surgical repair. As in this case, though, TAVI has been used after valve-sparing aortic root replacement in expert centers.[7] Transcatheter aortic valve implantation has been reported in patients with thoracic aortic aneurysms and does not substantially affect rates of in-hospital mortality, stroke, myocardial infarction, or bleeding, though it does increase the risk for aortic dissection and cardiac tamponade.[8] Patients with aortic aneurysms have a successful device implantation rate similar to patients without aortic aneurysms.[9] The patient in this case had a unique situation: an acute aortic dissection occurring proximal and distal to a surgical graft. Ensuring adherence to the aortic true lumen while safeguarding the left main coronary artery against dissection flap displacement and potential obstruction of coronary blood flow during valve deployment became a critical consideration to the team.

Article Information

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Author Contributions: All doctors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Dr Sanchez-Nadales developed the concept and design and drafted the manuscript. All authors performed critical revision of the manuscript for important intellectual content.

Conflict of Interest Disclosure: The authors declare that they have no competing interests.

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