

Transcatheter mitral valve implantation using the Tendyne valve in a patient with prior transcatheter aortic valve implantation: a case report

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Background

The presence of aortic and mitral disease in a patient who is not a suitable candidate for surgical correction poses significant challenges in the diagnostic workup as well as management plans. Percutaneous treatment can be staged to fix the aortic valve with transcatheter aortic valve implantation (TAVI) as a first step, followed by reassessment and percutaneous correction of mitral regurgitation (MR).

Case summary

A 65-year-old female with multiple co-morbidities presented with acute coronary syndrome and heart failure. She was diagnosed with three-vessel coronary artery disease and degenerative low-flow low-gradient severe aortic stenosis, along with severe degenerative MR with a left ventricular ejection fraction of 35%. Because of the high surgical risk, she underwent multi-vessel percutaneous coronary intervention with stenting. Transcatheter aortic valve implantation was done as a staged procedure, which partially improved her symptoms. Mitral regurgitation was not suitable for percutaneous mitral valve edge-to-edge repair. After a discussion by the heart team, she underwent transcatheter mitral valve implantation, for which the Tendyne mitral valve (Tendyne™; Abbott) was used through a transapical approach. There was no paravalvular leak, and the mean gradient across the valve was 2 mmHg. She was symptomatically better at follow-up and an echocardiogram showed a normally functioning aortic valve and Tendyne mitral valves.

Discussion

Transapical transcatheter mitral valve implantation using the Tendyne valve is a feasible option for patients with prior TAVI. This can be considered an alternative treatment for MR in patients who are not suitable for edge-to-edge mitral repair.

Keywords

Case report • Transcatheter aortic valve implantation (TAVI) • Transcatheter mitral valve implantation (TMVI) • Transcatheter aortic valve replacement • Transcatheter mitral valve replacement • Tendyne

ESC curriculum

4.3 Mitral regurgitation • 4.2 Aortic stenosis • 6.2 Heart failure with reduced ejection fraction • 7.4 Percutaneous cardiovascular post procedure • 2.2 Echocardiography

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Learning points

- The combination of degenerative aortic stenosis and mitral regurgitation (MR) is not uncommon.
- If a patient is not a surgical candidate, aortic stenosis should be treated first by transcatheter aortic valve implantation, as it might reduce MR.
- Transcatheter mitral valve implantation using the Tendyne valve is a feasible option for patients who are not suitable for mitral edge-to-edge repair.

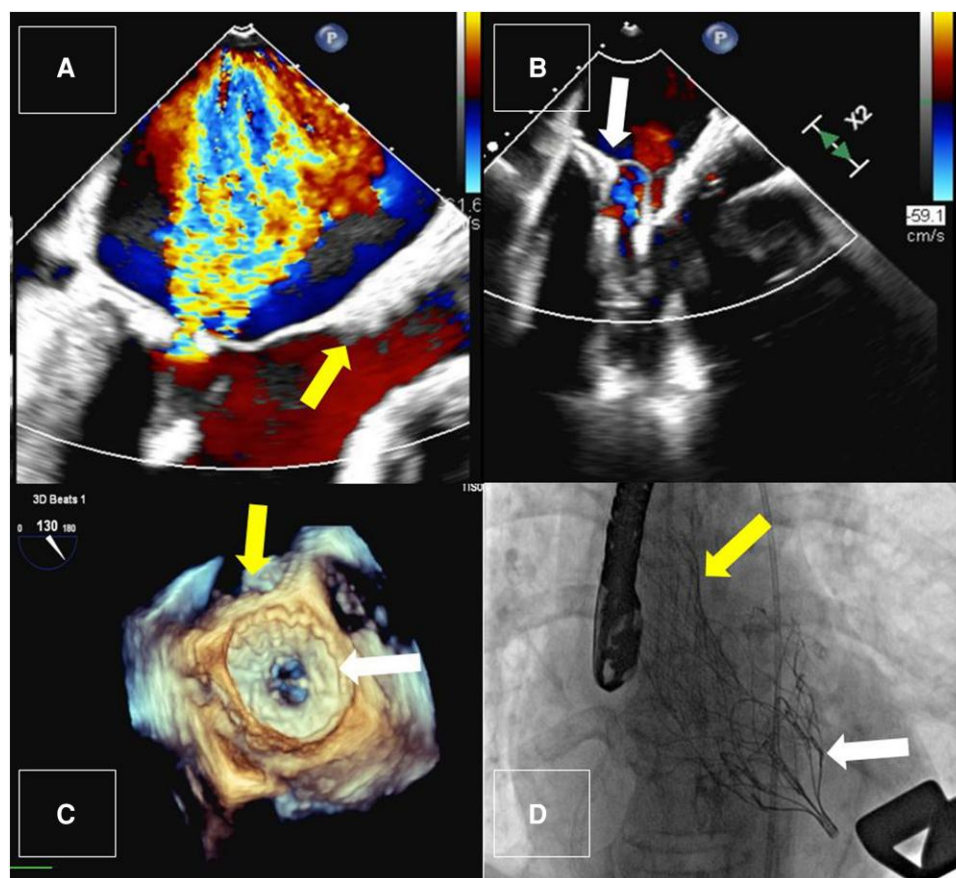
Introduction

The incidence of degenerative multiple valvular heart disease is growing with increasing life expectancy. Age-related degeneration (41%) is the second most common cause of multiple valve disease after rheumatic fever (51%).¹ Surgical intervention has been shown to improve survival significantly in symptomatic patients with multi-valvular disease.² The presence of aortic and mitral disease in a patient who is not a suitable candidate for surgical correction poses significant challenges in the diagnostic workup as well as management plans. The combination of aortic stenosis and mitral regurgitation (MR) is not uncommon.¹ The presence of significant aortic stenosis results in high mitral regurgitant volume at any given regurgitant orifice area because of an increased transmitral systolic gradient.² If the patient is not a candidate for double valve correction, then percutaneous treatment can be staged to fix the aortic valve with transcatheter aortic valve implantation (TAVI) as a first step, followed by a reassessment and percutaneous correction of MR. The feasibility and clinical outcomes of transcatheter mitral valve

implantation (TMVI) in patients who already had aortic valve prostheses are not well established. Here, we report a case of a female patient who underwent TAVI, followed by TMVI, for which the Tendyne™ mitral valve system (Abbott Vascular, Santa Clara, CA, USA) was used.

Summary figure

(A) Transoesophageal echocardiography view at 120° showing severe mitral regurgitation along with a transcatheter aortic valve implant *in situ* (yellow arrow). (B) Transoesophageal echocardiography image after the transcatheter mitral valve implantation showing a well-seated Tendyne valve (white arrow) without residual mitral regurgitation. (C) Three-dimensional zoom image of the mitral valve (atrial side) showing a well-seated Tendyne valve (white arrow). The frame of the transcatheter aortic valve implant is also seen (yellow arrow). (D) Still image of cardiac catheterization showing the Tendyne valve (white arrow) and transcatheter aortic valve implant (yellow arrow).



Case summary

A 65-year-old female (weight = 46 kg, body mass index = 21.2 kg/m²) is known to have diabetes mellitus, hypertension, hypothyroidism, peripheral vascular disease, and ischaemic heart disease. She presented to our hospital 4 years ago with acute coronary syndrome and heart failure. She was diagnosed with three-vessel coronary artery disease and degenerative low-flow low-gradient severe aortic stenosis, along with severe degenerative MR with a left ventricular (LV) ejection fraction of 35%. The cardiac surgeon declined coronary artery bypass grafting and double valve replacement for her because of the high risk of mortality and morbidity (EuroSCORE II 9.60%, STS score 8.84% risk of mortality). After a discussion by the heart team, she underwent multi-vessel percutaneous coronary intervention with stenting. Transcatheter aortic valve implantation was done as a staged procedure (26 mm Medtronic *Evolut R* valve), which partially improved her symptoms (Figure 1, see [Supplementary material online, Video S1](#)). Her LV ejection fraction also improved to 45%. She started developing worsening exertional dyspnoea and required multiple hospitalizations despite maximally tolerated guideline-directed medical therapy. Mitral regurgitation was assessed multiple times for transcatheter mitral valve edge-to-edge repair (TEER), but it was not done due to the high risk of functional mitral stenosis post repair, as the mitral valve area by three-dimensional planimetry was 1.9 cm² with a mean gradient of 4 mmHg (Figure 2, see [Supplementary material online, Videos S2 and S3](#)). There was significant mitral annular calcification with calcified mitral apparatus. Mitral regurgitation originated mostly through medial and lateral scallops, and correction by TEER would require the use of more than one clip (high risk for functional stenosis).

She presented to the emergency department with exertional dyspnoea (New York Heart Association Functional Class III) and epigastric pain for 5 days. She was vitally stable with a pulse rate of 68 beats/min

and a blood pressure of 130/58 mmHg. She was afebrile, and her oxygen saturation at room air was 95% on 2 L of oxygen through the nasal cannula. A cardiac examination revealed a soft first heart sound with a pan-systolic murmur at the apex, radiating to the axilla, and a soft S2 with a Grade II ejection systolic murmur at the base of the heart. Her electrocardiogram showed a normal sinus rhythm but with poor R-wave progression in the chest leads. The blood investigations showed a haemoglobin level of 9.1 g/dL (normal 12–16 g/dL), a serum creatinine level of 131 µmol/L (normal 40–90 µmol/L in females), and a troponin I level of 814 ng/L (normal <15.6 ng/L), and chest X-rays showed bilateral congestion with mild right pleural effusion. She was admitted with a diagnosis of non-ST-elevation myocardial infarction and acute decompensated heart failure. After initial management, she underwent coronary angiography, which showed severe in-stent restenosis of the right coronary artery stent, which was treated with a drug-eluted balloon angioplasty. Her echocardiography showed a normally functioning TAVI valve and severe MR of degenerative aetiology.

After the heart team discussion, she was worked up for TMVI, for which the Tendyne mitral valve (Tendyne™; Abbott) was used, as her MR was not suitable for percutaneous mitral valve edge-to-edge repair. Transcatheter mitral valve implantation was done using the Tendyne valve (~22 months after TAVI) through the left anterolateral mini-thoracotomy under transoesophageal echocardiography guidance (Figures 3–5, see [Supplementary material online, Videos S4–S6](#)). There was no paravalvular leak, and the mean gradient across the valve was 2 mmHg. She was discharged on anticoagulation (warfarin for 6 months), a single antiplatelet (clopidogrel 75 mg daily), and heart failure therapy. On follow-up after 4 weeks, she was symptomatically better with pain at the thoracotomy site without any sign of infection. A follow-up (at 4 weeks) echocardiogram showed normally functioning TAVI and Tendyne valves. The LV ejection fraction dropped to 35–40%, which is expected after a correction of MR.

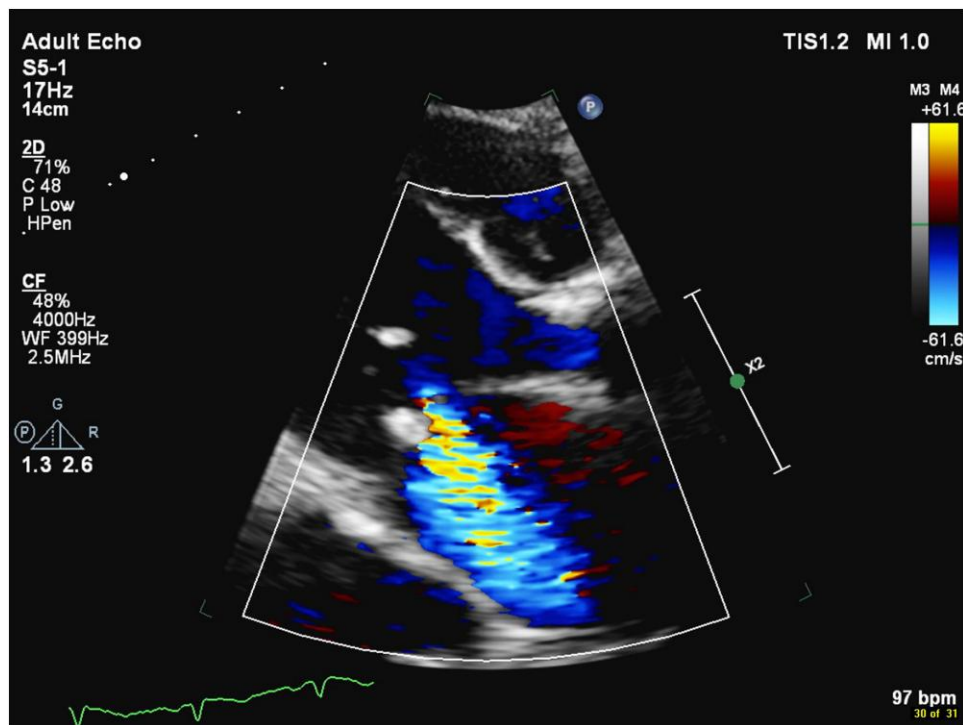


Figure 1 Para-sternal long-axis view with colour Doppler showing degenerative changes in the mitral valve with severe mitral regurgitation. The transcatheter aortic valve implant is seen in the aortic position.

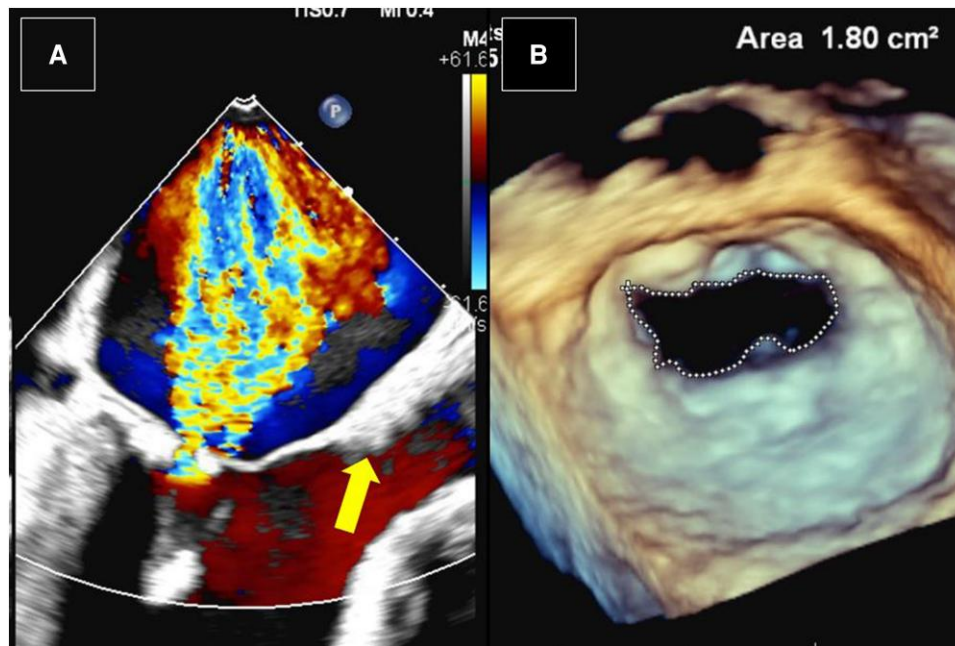


Figure 2 (A) Transoesophageal echocardiography view at 120° showing severe mitral regurgitation along with transcatheter aortic valve implant *in situ* (yellow arrow). (B) A Three-dimensional zoom image of the mitral valve (en face view) showing restricted mitral opening.

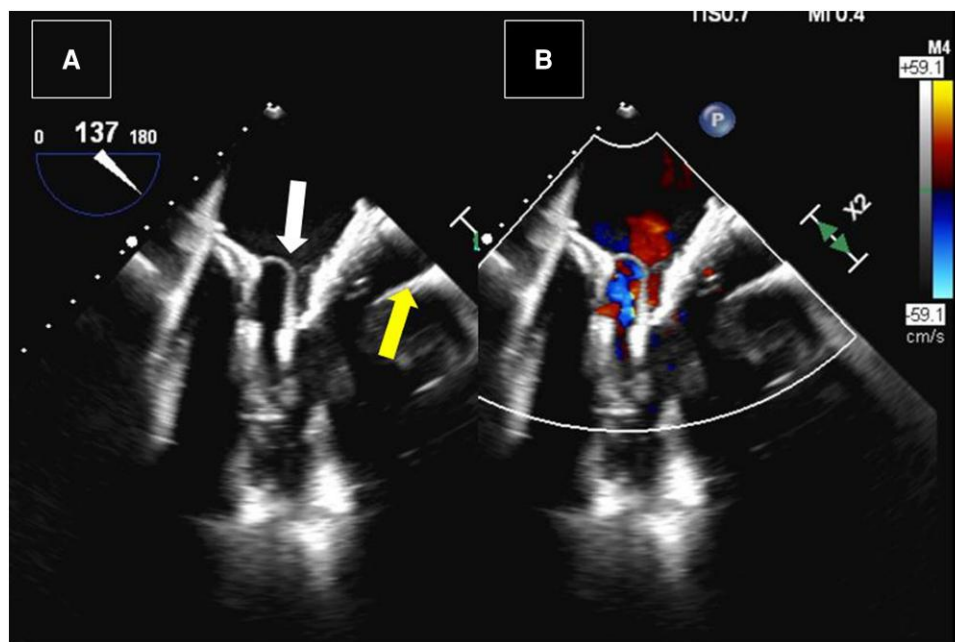


Figure 3 Transoesophageal echocardiography after the transcatheter mitral valve implantation showing a well-seated Tendyne valve (A, white arrow) without residual mitral regurgitation (B) on colour Doppler. A transcatheter aortic valve implant is also seen (yellow arrow).

Discussion

Patients with mixed aortic and mitral valve disease show a rapid deterioration of symptoms and LV systolic function. In patients with low surgical risk, double valve replacement or repair is the treatment

of choice. Transcatheter aortic valve implantation is becoming the standard of care for patients with moderate-to-high surgical risk.³ As the technology and experience of percutaneous valve repair and implantation are growing in clinical practice, it is not uncommon to encounter patients with MR with a prior history of TAVI. In patients

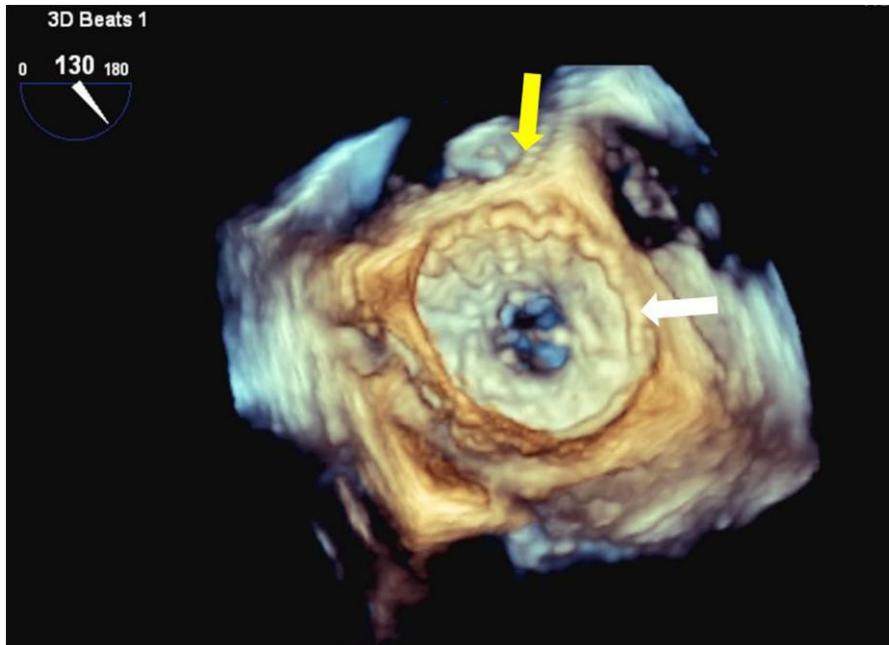


Figure 4 Three-dimensional zoom image of the mitral valve (atrial side) showing a well-seated Tendyne valve (white arrow). The frame of the transcatheter aortic valve implant is also seen (yellow arrow).

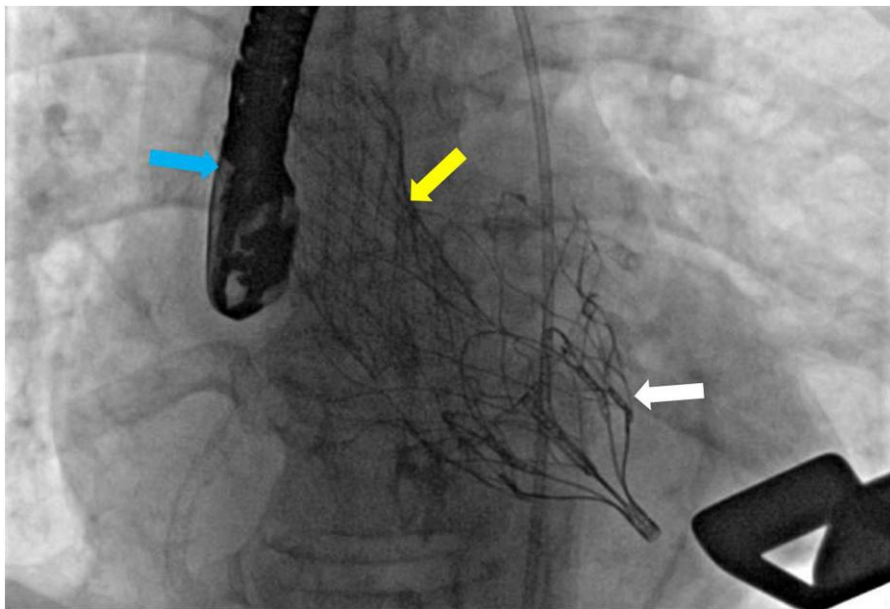


Figure 5 Cardiac catheterization still image showing the Tendyne valve (white arrow), transcatheter aortic valve implant (yellow arrow), and transoesophageal echocardiography probe (blue arrow).

undergoing TAVI, about one-fourth have Grade 2 MR, and ~2–5% have severe MR.⁴ The implantation of the aortic valve, both percutaneously and surgically, has been shown to significantly decrease the severity of MR, although a minor percentage of patients showed a worsening of MR as well.⁵ Primary MR is less likely to improve than functional regurgitation.

Transcatheter aortic valve implantation has provided an opportunity to stage the percutaneous repair or replacement of concomitant mitral valve disease. The reported reduction in the severity of MR is likely multi-factorial and includes decreased transmitral gradients, decreased afterload, and remodelling of the LV cavity. The balloon-expandable aortic valve is associated with better MR reduction when compared with

the self-expandible aortic valve post-TAVI. This effect is probably caused by an impairment of mitral leaflet motion, which is attributed to the self-expandible valve and a higher incidence of paravalvular leak.⁶ However, the newer generation of self-expandible TAVI valves might have different outcomes, and there is a gap in current data in this regard. The residual MR after TAVI is associated with worse short- and long-term prognoses.^{6,7}

It is not well established whether the concomitant MR should be observed conservatively, percutaneously repaired simultaneously, or staged, as evidence is lacking in this regard. The management of MR is thus individualized based on symptoms, suitable anatomy, procedural risks, and local expertise.⁸ Transcatheter mitral valve edge-to-edge repair is a safe and effective alternative method for the correction of primary and secondary MR in patients who are considered unsuitable for surgical correction.⁹ Currently, the MitraClip (Abbott) is widely used in TEER procedures, both in primary and in secondary MR. However, the use of TEER in patients with prior TAVI showed less favourable outcomes in terms of residual MR and cardiac output.¹⁰ These outcomes are probably caused by an altered mitral valve anatomy, which is attributed to a prior TAVI procedure.

Transcatheter mitral valve implantation has emerged as a treatment option for severe symptomatic MR for those who are either failed or unsuitable for percutaneous repair.^{11–13} The Tendyne™ mitral valve system (Abbott Vascular) is implanted transapically without the need for conducting a bypass. The valve is anchored to the epicardial pad via a chord. The feasibility of TMVI by using the Tendyne mitral valve in patients with prior surgical transcatheter aortic valve replacement is not well established because of limited data. The risk of left ventricular outflow tract (LVOT) obstruction is probably high because of post-TAVI mitral anatomy, LV hypertrophy, and a smaller LV cavity in these patients. A recently published small series showed that the Tendyne system is a safe and feasible treatment option for MR in patients with prior TAVI procedures.¹⁴ Our patient had low-flow, low-gradient severe aortic stenosis and a moderate-to-severe degenerative MR. She underwent TAVI and showed improvement in LV ejection fraction. She remained symptomatic with heart failure admissions despite optimized guideline-directed medical therapy. After a heart team discussion, she underwent successful TMVI, for which the Tendyne valve was used, following which there was a complete resolution of regurgitation.

Conclusion

In summary, transapical transcatheter mitral valve implantation using the Tendyne valve is a feasible option for patients with prior TAVI. This can be considered an alternative treatment for MR in such patients who are not suitable for edge-to-edge mitral repair.

Lead author biography



Dr Muhammad Azam Shah is a qualified cardiologist with a subspecialized qualification in echocardiography and cardiac computed tomography with a keen interest in the area of research and development. After obtaining cardiology fellowship from Pakistan, he joined King Fahad Medical City, Riyadh, Saudi Arabia, where he underwent subspecialty training in advanced cardiac imaging. He is a consultant cardiologist and works in the imaging section.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Consent: The authors confirm that written consent for the submission and publication of this case report, including images and associated text, has been obtained from the patient and family in line with COPE guidance.

Conflict of interest: None declared.

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Data availability

The data underlying this article are available in the article and its online supplementary material.

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