Case report of a transcatheter tricuspid valve-in-valve replacement

DN Pillay, SC Brown, and DG Buys

Division of Paediatric Cardiology, Department of Paediatrics and Child Health, Faculty of Medicine, University of the Free State, Bloemfontein, South Africa

Address for correspondence:
Paediatric Cardiology Department,
1st Floor
Universitas Academic Hospital
1 Logeman Street
Bloemfontein
Free State
9301

Email:
dhesan.n.pillay@gmail.com

DN Pillay https://orcid.org/0009-0007-8493-7819
SC Brown https://orcid.org/0000-0002-8508-8667
DG Buys https://orcid.org/0009-0001-2795-9276
DOI: https://doi.org/10.24170/23-1-7751

ABSTRACT

Transcatheter valve implantations in the tricuspid position are infrequent. We report a case of an Edwards SAPIEN 3 (S3) implantation in the tricuspid position as a transcatheter valve-in-valve procedure in a 12-year-old patient deemed at high risk for surgical reintervention.
Keywords: percutaneous valve, Edwards valve, congenital heart disease, tricuspid replacement, percutaneous intervention.
SA Heart® 2026;23:26-30

INTRODUCTION

Transcatheter valve-in-valve is a growing field of interest, most commonly in the aortic and pulmonary positions. Implantation in the tricuspid position has been limited, especially in children.[1-3] We report a tricuspid transcatheter valve-in-valve replacement of a stenotic bioprosthetic valve in a 12-year-old patient.

CASE REPORT

The patient was a 12-year-old female (39 kg) with a large muscular ventricular septal defect (VSD) and dysplastic tricuspid valve. At 5 weeks of age, due to the complexity of the VSD, a pulmonary artery banding was performed. At 16 months of age, the VSD was closed. During this surgery, it was noted that the tricuspid valve appeared grossly abnormal with sessile chordae tendineae to the anterior leaflet and marked hypertrophy of the anterior papillary muscle. A permanent pacemaker was placed with epicardial leads a month later due to sinus node dysfunction.

The patient's next presentation was at the age of 6 years, with an arrhythmia and hepatomegaly. Her workup identified severe tricuspid insufficiency (TI) that warranted surgical intervention. A tricuspid valve annuloplasty was performed using a 24 mm Edwards spiro ring (Edwards Lifesciences, Irvine, United States). The TI was significantly reduced but still deemed unacceptable; thus, the ring was removed, and a tricuspid valve replacement was performed using a 25 mm Edwards PERIMOUNT Plus stented pericardial valve (Edwards Lifesciences, Irvine, United States), along with a redo of the pacemaker box and leads during the same surgery.

At age 11, a pacemaker pulse generator change was performed. The patient was considered for a repeat valve replacement at age 12 due to tricuspid stenosis (TS) and symptomatic right atrium (RA) enlargement with hepatomegaly. Due to the multiple previous surgeries, a decision was made in agreement with the family to perform the valve replacement as a percutaneous valve-in-valve procedure.

The pre-procedure transthoracic echocardiogram (TTE) showed a congested inferior vena cava (IVC), dilated RA, tricuspid annular plane systolic excursion (TAPSE) of 12 mm, and no dilation of the right ventricle (RV). Doppler evaluation of the Edwards PERIMOUNT valve noted a peak instantaneous gradient (PIG) of 26 mmHg and a mean gradient of 16 mmHg. Mild TI was noted with colour Doppler.

Procedure

The procedure was performed under general anaesthesia with transoesophageal echocardiography (TOE) guidance. The patient was heparinised as per the unit's standard protocol (50 U/kg) and ACT monitoring. Prophylactic antibiotics (cefazolin) were administered. Femoral vascular access was obtained under sonar guidance. A 6 Fr and 5 Fr sheath was inserted in both the left femoral vein and artery, respectively. The right femoral vein was cannulated with a 12 Fr sheath (Cook Medical, Bloomington, United States). Haemodynamic data were collected pre- and post-valve implantation (Table I).

TABLE I: Haemodynamic information from cardiac catheterisation.

	Pressure measurements (mmHg)	
	Pre-valve	Post-valve
Right atrium	23	14
Right ventricle	52/6	47/14
Tricuspid valve gradient	17	0

Pre-implantation TTE and TOE demonstrated a dilated RA, 16 mmHg PIG over the tricuspid valve, and mild TI (Figures 1–3). The tricuspid valve was crossed with a 6 Fr wedge catheter. Using a 0.035-inch Amplatz Super Stiff guide (Boston Scientific, Marlborough, United States), a stable guide wire position was obtained in the distal right pulmonary artery. The 12 Fr sheath was up-dilated to accommodate the Edwards 14 Fr eSheath. A 20 mm × 40 mm Atlas percutaneous transluminal angioplasty (PTA) balloon (Bard Peripheral Vascular Inc., Tempe, United States) was inflated at 16 atmospheres to dilate and size the tricuspid valve (Figure 4). A waist of 16.5 mm was noted, representing a 56% functional area reduction. The delivery system was tracked over the wire, and the valve was aligned with the previous bioprosthetic valve in a coaxial position. An Edwards S3 26 mm valve was placed in the PERIMOUNT ring during rapid pacing at 140 bpm using the patient's pacemaker (Figure 5).

Following valve implantation, haemodynamics improved immediately. TOE post-implantation demonstrated a 10 mmHg PIG over the valve, with no insufficiency, no paravalvular leak, and a well-functioning tricuspid valve (Figure 6). Haemostasis at the right femoral vein access was achieved percutaneously using Perclose™ ProStyle™ (Abbott Laboratories, Chicago, United States). The patient was extubated and transferred to the paediatric intensive care unit (PICU) for high-care monitoring. TTE performed in the PICU after the intervention demonstrated normal left ventricle (LV) function, mild collapse of the IVC with a dilated RA, and good flow over the Edwards valve, with Doppler interrogation noting a 7 mmHg PIG and a mean gradient of 3 mmHg. The patient was discharged on aspirin 100 mg. Endocarditis prophylaxis and good dental and skin hygiene practices were advised.

Clinical course

At the 6-month follow-up, the patient reported improved effort tolerance and no adverse events following the percutaneous valve implantation. TTE showed the IVC and RA were not dilated, with good flow across the tricuspid valve, PIG of 9 mmHg and a mean gradient of 6 mmHg, good RV function with TAPSE of 18 mm, and good LV function.

DISCUSSION

Transcatheter valve-in-valve procedures are a growing area of interest in the literature, offering a viable, low-risk alternative to high-risk repeated surgical interventions. Percutaneous tricuspid valve-in-valve (TVIV) via a transjugular approach was first described by Van Garsse, et al. in 2011, and via a transfemoral approach by Calvert, et al. in 2012.[4,5] At present, the available percutaneous valve devices are used off-label when in the tricuspid position.[3] TVIV has thus far been accomplished using

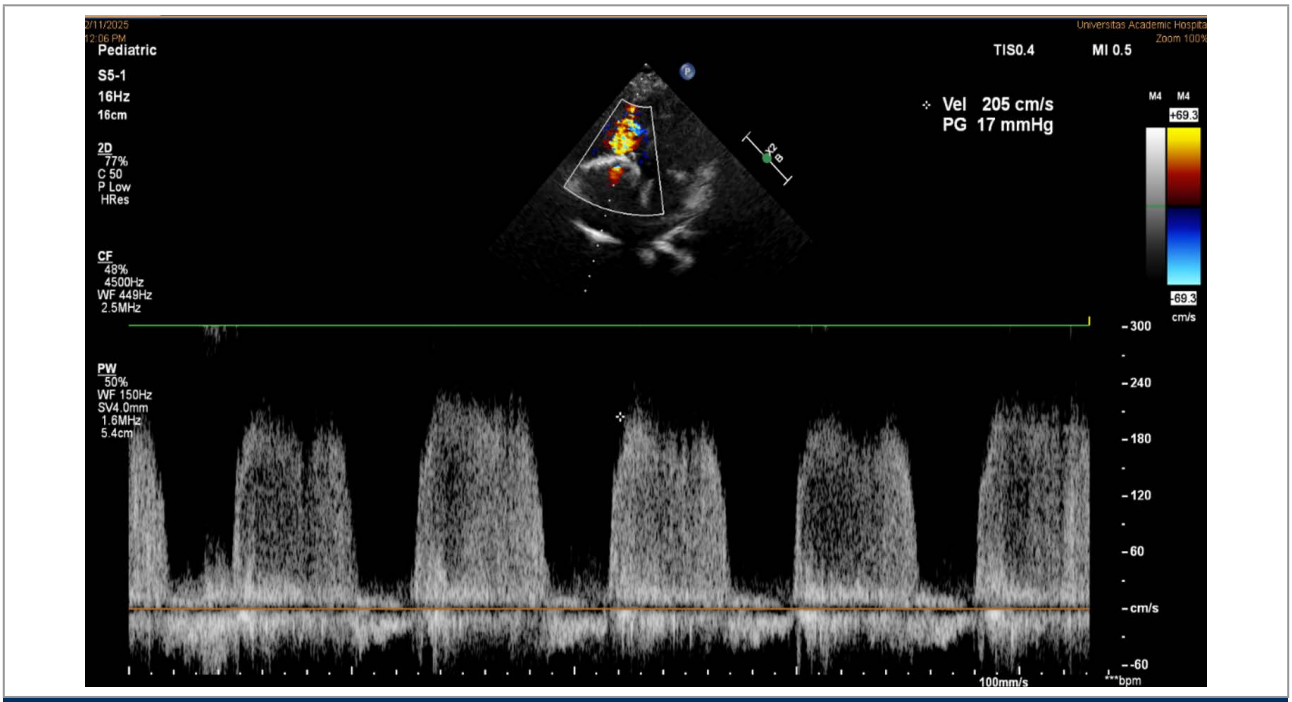

FIGURE 1: Transthoracic echocardiogram showing pulsed wave Doppler tracing of tricuspid stenosis, with loss of E wave and A wave differentiation.

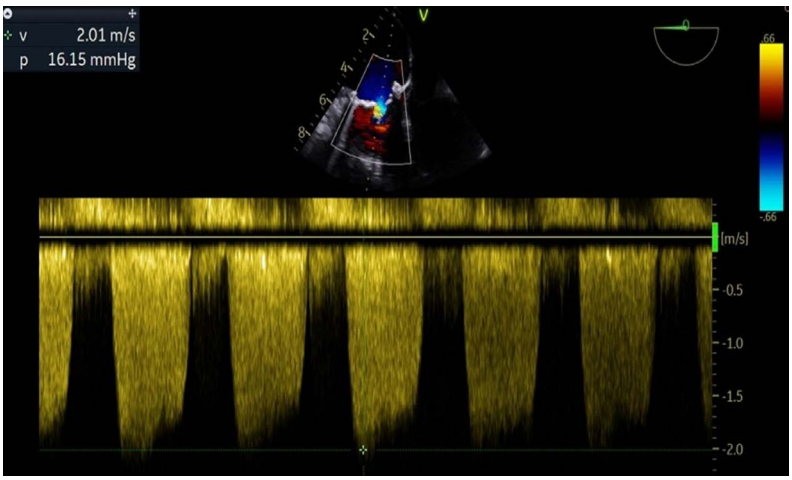

FIGURE 2: Transoesophageal echocardiography showing tricuspid stenosis with Doppler pre-implantation.

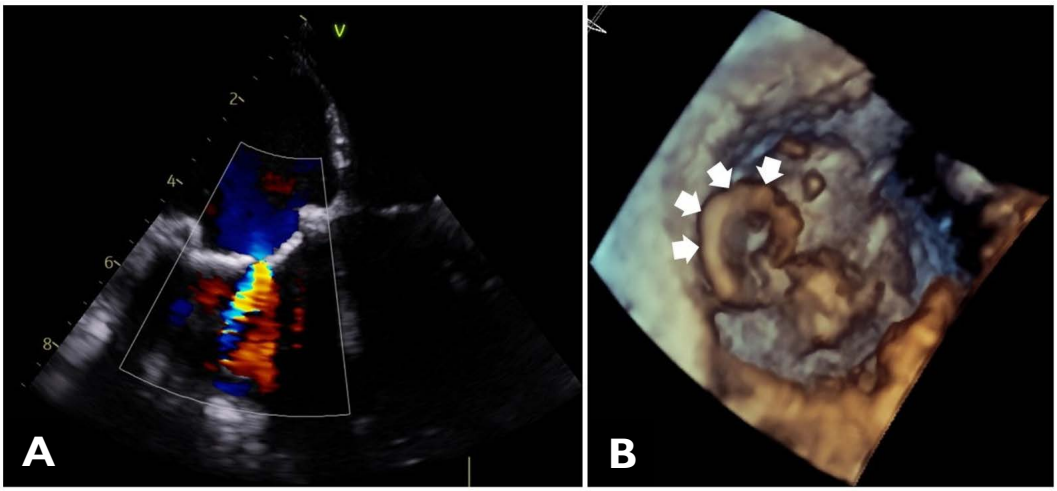

FIGURE 3: Transoesophageal echocardiography showing tricuspid stenosis with colour Doppler (A) and a 3-dimensional rendering of the bioprosthetic tricuspid valve (B) showing the thickened leaflets with a stenotic orifice (white arrows).

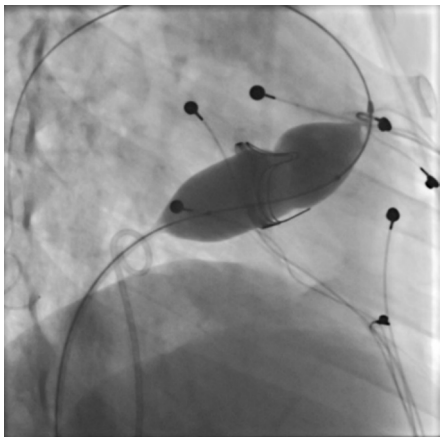

FIGURE 4: Balloon interrogation of the bioprosthetic tricuspid valve showing severe stenosis with a prominent waist.

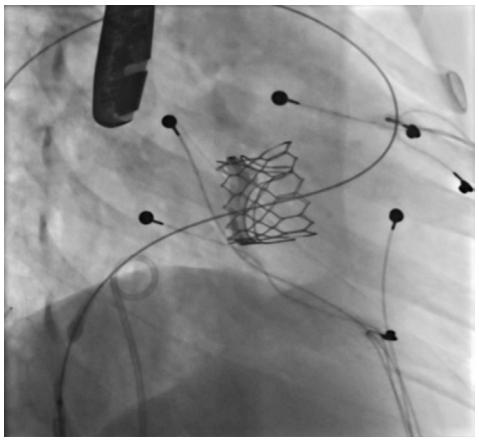

FIGURE 5: The Edwards valve is implanted with a good apposition to the walls of the bioprosthetic valve.

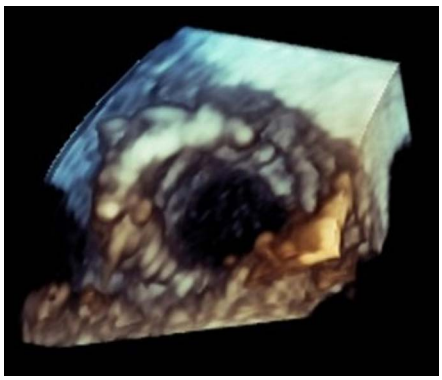

FIGURE 6: Transoesophageal echocardiography with 3-dimensional rendering post-implantation showing a functional valve and no orifice stenosis.

the Melody (Medtronic, Minneapolis, United States) and the Edwards SAPIEN XT and S3 valves.

Prosthetic tricuspid valves have been reported to have shorter longevity than their systemic counterparts, leading to TS, TI, or mixed tricuspid valve disease, all of which may necessitate valve replacement.[2,3] However, surgical replacement of dysfunctional tricuspid prostheses has been noted to confer a higher risk, especially in the setting of concomitant RV dysfunction.[2,6] Due to the off-label use of percutaneous valves in the tricuspid position, there are currently no formal indications for TVIV. Through the Valve-in-Valve International Data (VIVID) registry, McElhinney, et al. described indications for reintervention with TVIV as significant TI, which is moderate or greater in severity according to standard definitions, or TI warranting reintervention. TS for reintervention was deemed significant if there was a mean Doppler gradient ≥ 10 mmHg or if the degree of TS warranted reintervention. However, in both studies using the VIVID registry, the indication was determined by the treating physician.[3,7]

Valve selection is determined by the size of the previously surgically implanted valve. Consequently, the internal and external diameters are needed for device selection.[2] The surgical notes serve as a crucial starting point to identify the true internal diameter of the prosthesis. However, detailed computed tomography (CT) imaging may be needed in cases with uncommon or unknown rings or valves.[6] Valve-in-valve apps may be a useful adjunct, but ultimately, the decision would be informed by a review of the CT images.[6,8] The current recommendation in the literature is to use a Melody or SAPIEN valve if the bioprosthesis' outer diameter is ≤ 25 mm or ≥ 29 mm, respectively.[6] The current comparative data show no difference in the short- and medium-term between the two valve types.[7,9] Due to the pathophysiological mechanisms causing bioprosthetic TS, the inner diameter may be irregularly distorted.[2] Thus, use of a sizing balloon helps to identify the constrictive points within the prosthesis that will serve as a landing zone, and provide information on how the prosthesis may deform during deployment of the percutaneous valve.[2,9]

The youngest reported patient to receive a TVIV was 5 years old, weighing 17.1 kg.[9] Tzifa, et al. previously reported on a successful TVIV in a 6-year-old patient, weighing 13 kg, in addition to successful implantation in an 11- and 12-year-old during their early experience.[2] To the authors' knowledge, our case is the youngest TVIV in South Africa.

Safety considerations

Similar to percutaneous pulmonary valve implantation (PPVI), establishing a safe landing zone is paramount for a stable valve implantation and a lower risk of embolisation. Previous case reports described the use of pre-stenting bioprosthetic valves that have a short landing zone, especially when implanting the Edwards valve due to its short stent length.[2] However, Eicken, et al. suggested that pre-stenting may lead to a smaller orifice area, which could lead to long-term complications.[9] It is also advised that if pre-stenting is not performed, rapid pacing may assist with the accurate positioning of the valve. Rapid pacing may be performed via the coronary sinus, LV, or pericardial approach. In our case, we utilised the patient's pacemaker.

Long-term outcomes

The clinical and haemodynamic outcomes for TVIV have been promising thus far. Most studies report improvement in New York Heart Association functional classification from class III or IV to class I or II post-TVIV.[2,3,7,9] Reported complications include third-degree heart block, mild-to-moderate TI due to over-dilation of the implanted valve, and endocarditis.[2] However, due to the limited case reports, incidence rates for these complications are not widely available. Presently, long-term outcomes for TVIV are unavailable, while the largest medium-term outcome data set is by McElhinney, et al., reporting on the VIVID registry. Key findings reported from this study included a 3-year incidence of death (17%), reintervention (12%), and valve-related adverse outcomes (8%).[7] The annualised incidence rate of endocarditis in TVIV was 1.5% per patient-year, similar to that reported for PPVI in a systematic review.[10] It is also suspected that there may be no significant difference in endocarditis incidence between surgical tricuspid valve replacement and TVIV.[7] The time to diagnosis of endocarditis post-TVIV ranged between 2 and 29 months.[7] Valve thrombosis was noted to occur with a cumulative incidence of 3.3% over the 3 years. A higher post-TVIV inflow gradient was associated with a higher risk of valve thrombosis and need for reintervention.

CONCLUSION

Transcatheter TVIV replacement is a safe alternative approach for patients who may be at higher risk for surgical revalvulation. The current case adds to the growing literature, demonstrating procedural safety and good efficacy in young patients with post-operative tricuspid pathology.

Conflict of interest: none declared.

ETHICAL CONSIDERATIONS

This article followed all ethical standards for research. The patient provided signed informed consent to the publication of a personal medical report in an impersonal form. Ethics approval was obtained from the University of the Free State Health Sciences Research Ethics Committee (UFS-HSD2025/1225/3009).

REFERENCES

1. Öztürk M, Aykan HH, Karagöz T. Transcatheter tricuspid valve-in-valve implantation in a paediatric patient: A case report. Cardiol Young 2025;35(2):436-8. https://doi.org/10.1017/S1047951125000186.
2. Tzifa A, Momenah T, Al Sahari A, et al. Transcatheter valve-in-valve implantation in the tricuspid position. EuroIntervention 2014;10(8):995-9. https://doi.org/10.4244/EIJV10I8A168.
3. McElhinney DB, Cabalka AK, Aboulhosn JA, et al. Transcatheter tricuspid valve-in-valve implantation for the treatment of dysfunctional surgical bioprosthetic valves: An international, multicenter registry study. Circulation 2016;133(16):1582-93. https://doi.org/10.1161/CIRCULATIONAHA.115.019353.
4. Van Garsse LAFM, Ter Bekke RMA, Van Ommen VGVA. Percutaneous transcatheter valve-in-valve implantation in stenosed tricuspid valve bioprosthesis. Circulation 2011;123(5). https://doi.org/10.1161/CIRCULATIONAHA.110.972836.
5. Calvert PA, Himbert D, Brochet E, et al. Transfemoral implantation of an Edwards SAPIEN valve in a tricuspid bioprosthesis without fluoroscopic landmarks. EuroIntervention 2012;7(11):1336-9. https://doi.org/10.4244/EIJV7I11A209.
6. Sanon S, Cabalka AK, Babaliaros V, et al. Transcatheter tricuspid valve-in-valve and valve-in-ring implantation for degenerated surgical prosthesis. JACC Cardiovasc Interv 2019;12(15):1403-12. https://doi.org/10.1016/j.jcin.2019.05.029.
7. McElhinney DB, Aboulhosn JA, Dvir D, et al. Mid-term valve-related outcomes after transcatheter tricuspid valve-in-valve or valve-in-ring replacement. J Am Coll Cardiol 2019;73(2):148-57. https://doi.org/10.1016/j.jacc.2018.10.051.
8. Bapat V. Valve-in-valve apps: Why and how they were developed and how to use them. EuroIntervention 2014;(10 Suppl U):U44-U51. https://doi.org/10.4244/EIJV10SUA7.
9. Eicken A, Schubert S, Hager A, et al. Percutaneous tricuspid valve implantation: Two center experience with midterm results. Circ Cardiovasc Interv 2015;8(4):e002155. https://doi.org/10.1161/CIRCINTERVENTIONS.114.002155.
10. Abdelghani M, Nassif M, Blom NA, et al. Infective endocarditis after Melody valve implantation in the pulmonary position: A systematic review. J Am Heart Assoc 2018;7(13):e008163. https://doi.org/10.1161/JAHA.117.008163.