Cardiology in the Young

cambridge.org/cty

First report of a percutaneous valve-in-Valve implantation of tricuspid valve in a systemic right ventricle

Zeeshan Ahmed Mumtaz, Sreeja Pavithran and Kothandam Sivakumar

Department of Pediatric Cardiology, Institute of Cardio Vascular Diseases, Madras Medical Mission, Chennai 600037, India

Brief Report

Cite this article: Mumtaz ZA, Pavithran S, and Sivakumar K (2022) First report of a percutaneous valve-in-Valve implantation of tricuspid valve in a systemic right ventricle. *Cardiology in the Young* **32**: 1357–1359. doi: 10.1017/S1047951121005059

Received: 16 November 2021
Accepted: 27 November 2021
First published online: 31 January 2022

Keywords:
Corrected transposition of great arteries; First-in-man; Tricuspid valve replacement; Bioprosthetic degeneration; Atrioventricular discordance

Address for correspondence:
Dr K. Sivakumar MD DM, Head of Department of Pediatric Cardiology, Institute of Cardio Vascular Diseases, Madras Medical Mission, 4A, Dr J J Nagar, Mogappair, Chennai, 600037, India. Phone +91 944444 49966;
Fax +914426565859.
Email drkumarsiva@hotmail.com

Abstract

Severe tricuspid regurgitation in corrected transposition of great arteries is treated with early bioprosthetic replacement to prevent right ventricular failure. When bioprosthesis degenerates, surgery on cardioplegic arrest further complicates right ventricular function. We report the first transcatheter valve-in-valve implantation of tricuspid valve in a systemic right ventricle in corrected transposition describing the modifications due to anatomical differences in these patients.

In corrected transposition of great arteries, a suboptimal non-crescentic right ventricle and structural abnormalities cause tricuspid regurgitation.[1] Right ventricle is preserved after tricuspid interventions in even asymptomatic patients.[2] Unlike mitral valve, complex tricuspid abnormalities necessitate replacement often with a bioprosthesis rather than repair.[3] Tricuspid replacement provides a 5-year freedom from death and reintervention only in 65% of patients.[3] Surgical replacement of degenerating bioprosthesis under ischaemic arrest further complicates right ventricular function.[3] Parasternal location of right ventricle in corrected transposition with a vertical trajectory from the aneurysmal left atrium pose anatomical challenges for a transcatheter valve-in-valve implantation within a degenerated tricuspid bioprosthesis in systemic right ventricle, reported for the first time.

Case report

A 31-year-old lady with corrected transposition became symptomatic after second decade from progressive tricuspid regurgitation. Left atrium measured 9 cm, and redundant tricuspid leaflets from a 43 mm annulus were non-coapting. The right ventricular ejection fraction was 34%. Tricuspid replacement with a 31 mm Perimount (Edwards Lifesciences, Irvine, CA) bioprosthesis was done at 24 years through combined left atrial and septal approach. Paroxysmal atrial fibrillation on follow-up needed electrical cardioversion thrice and antiarrhythmic drugs. Echocardiography after a recent cardioembolic brain infarction revealed a degenerated severely stenotic bioprosthesis with a mean gradient of 13 mmHg and moderate regurgitation. Heart team recommended a valve-in-valve implantation considering the risks of repeat sternotomy, ischaemic arrest, and recent stroke after informed consent from patient.

Trans-septal puncture and vertical guidewire course from aneurysmal left atrium to parasternal right ventricle were planned on CT. The distance from bioprosthesis to the right ventricular apex was short (Supplemental Figure). Bapat's mobile application predicted an internal diameter of 28.5 mm for this bioprosthesis.[4]

Under general anaesthesia and ultrasound guidance, groin and jugular venous access were obtained. A right anterior oblique projection profiling the bioprosthesis was chosen as the working fluoroscopic plane. Posteroinferior transseptal puncture guided by transesophageal echocardiography was confirmed on fluoroscopy to avoid a puncture superior to the level of the bioprosthesis. Prior surgical atrial septal scars did not permit passage of the 8F transseptal sheath even after the needle penetration. After protecting the left atrium from needle injury by a long coronary wire through the needle, force was used to advance the sheath. Left atrium recorded tall v waves measuring 38 mmHg and a mean pressure of 26 mmHg as well as a transtricuspid gradient of 13 mmHg.

The rigid septal puncture site was predilated using 16 mm Atlas gold balloon (Bard endovascular, Tempe, AZ) before advancing a 8.5F Agilis sheath(Abbott, Chicago, IL) to advance a pigtail catheter into the RV. As the extra-small curve 0.035 Safari wire (Boston Scientific, Marlborough, MA) was not supported in the short right ventricular inflow, it was flipped into the ascending aorta despite losing its coaxiality. The groin venous sheath was upgraded to 14F expandable Python sheath (Meril Lifesciences, Vapi, India) to advance a 30.5 mm MyVal THV(Meril Lifesciences, Vapi, India) into the bioprosthesis. The valve was slowly balloon

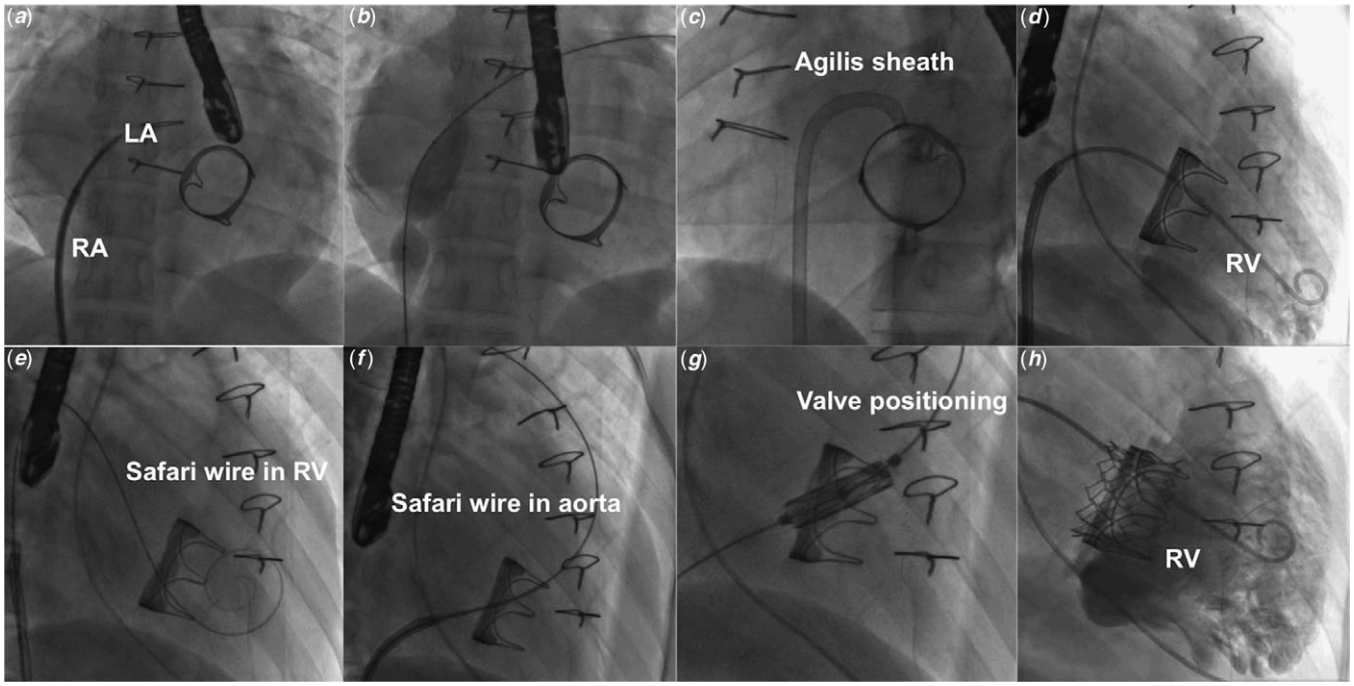

Figure 1. Septal puncture was made below the level of tissue valve(A) and dilated with 16 mm large balloon(B) before advancing a steerable sheath into the left atrium(LA) towards the valve orifice(C). Angiogram(D) in right ventricle(RV) shows small inflow dimension compared to outflow and severe tricuspid regurgitation. The small RV inflow provided inadequate support for the guidewire loop(E) which was flipped into the aorta(F) thereby losing coaxiality with the valve(G) that got autocorrected during valve expansion(H).

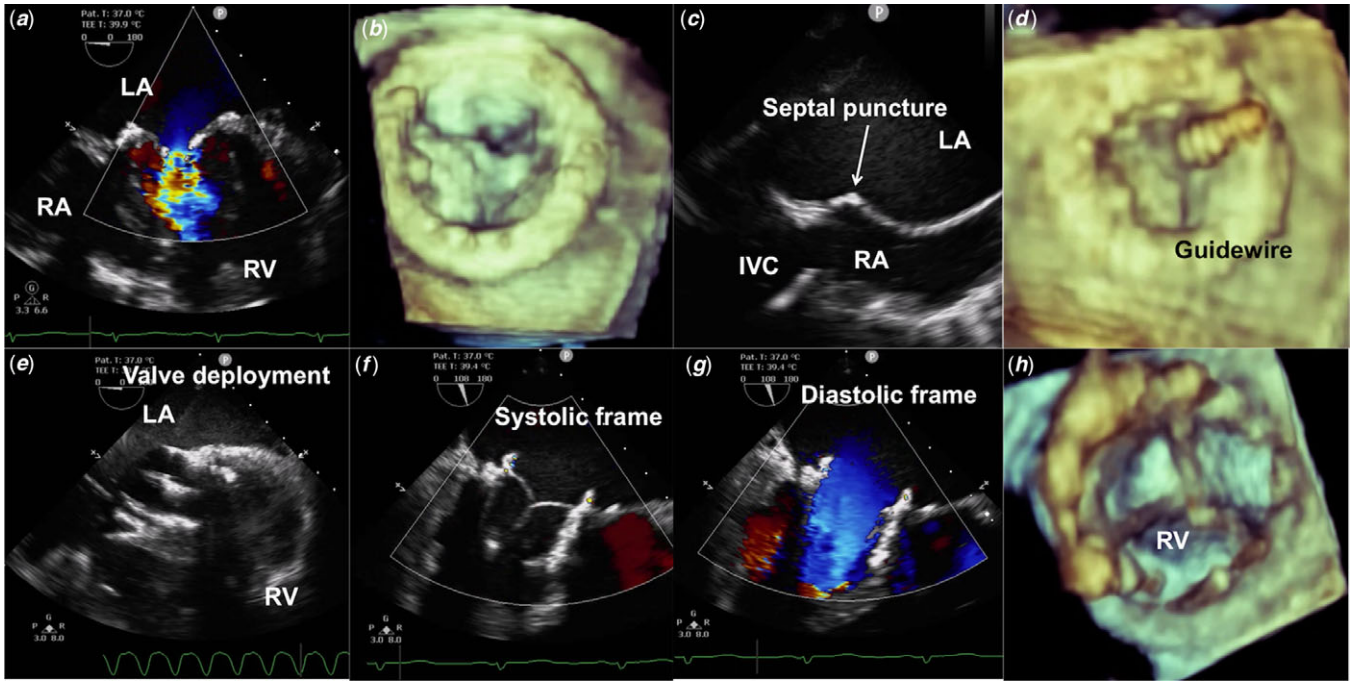

Figure 2. Transesophageal echocardiogram(A) showed severe bioprosthesis stenosis and degeneration on three dimensional volume rendering(B). Echocardiographically guided posteroinferior transseptal puncture(C) assisted passage of guidewire through the tissue valve(D). After deployment of the balloon expandable valve(E), systolic(F) and diastolic(G) frames as well as volume rendered ventricular view(H) of the transcatheter valve demonstrate normal valve function.

expanded while adjusting the Navigator delivery system (Meril Lifesciences, Vapi, India) to autocorrect the lack of alignment and recreate its coaxiality in the final stages of deployment. Rapid pacing, slow inflation, and apnoea induced on ventilator allowed control during valve positioning with 20% of the stent protruding on the atrial side (Fig 1).

Transoesophageal echocardiogram(Fig 2) and simultaenous haemodynamic pressure traces confirmed normal function of

https://doi.org/10.1017/S1047951121005059 Published online by Cambridge University Press

the transcatheter valve. There was no significant interatrial shunt. Uneventful post-procedural course led to discharge after two days while receiving aspirin, rivaroxaban, amiodarone, and metoprolol.

Discussion

This is the first reported case of transcatheter valve-in-valve implantation within a tricuspid bioprosthesis in corrected transposition after a detailed literature search. Unlike mitral valve, tricuspid valve in systemic right ventricle warrant modifications during edge-to-edge tricuspid repair.[5,6] High surgical risks of tricuspid replacement in right ventricular dysfunction may force a heart transplantation.[5,6] Unlike mitral valve, the following procedural modifications may be needed.[7]

When atrial septal surgical scars hinder transseptal puncture, needle is electrified with a bougie of an electrocautery and a coronary wire advanced through it to avoid inadvertent left atrial injury. Predilating rigid atrial septum with a large 16 mm facilitates to advance transcatheter heart valves larger than 26 mm and reduce the procedural time. But advancing this balloon through the degenerated prosthesis is not advised to prevent embolisation of fractured leaflets. Small left atrial appendage thrombus or clots from degenerating bioprosthesis are excluded by transoesophageal echocardiography in patients with recent cardioembolic strokes. Unfavourable angulated trajectory from left atrium to a parasternally located right ventricle in corrected transposition is further worsened by a superior transseptal puncture that is avoided by fluoroscopic selection of the puncture site below the plane of the prosthetic ring. Unlike equal inflow and outflow dimensions of left ventricle that allow a deep positioning of the Safari wire for support, short right ventricular inflow dimension in corrected transposition denies any wire support. This may necessitate the wire loop to be flipped into the ascending aorta. The generous subaortic conus in corrected transposition prevents any possibility of neo-subaortic narrowing, unlike in mitral procedure. Finally, unlike Sapien S3 valve mounted and crimped proximal to the balloon on the delivery system that needs alignment with the balloon markers within the inferior caval vein, the MyVal is crimped directly on the balloon easing this step.[8]

Supplementary material. For supplementary material accompanying this paper visit https://doi.org/10.1017/S1047951121005059

Acknowledgements. Pramod Sagar compiled computed tomographic and echocardiographic images.

Financial support. None.

Conflicts of interest. None.

Ethical standards. The procedure complied with ethical standards of Madras Medical Mission ethical committee and Indian council of medical research.

References

1. Prieto L, Hordof A, Secic M, Rosenbaum M, Gersony W. Progressive tricuspid valve disease in patients with congenitally corrected transposition of the great arteries. Circulation 1998; 98: 997–1005.
2. Baumgartner H, De Backer J, Babu-Narayan S, et al. ESC guidelines for the management of adult congenital heart disease. Eur Heart J 2021; 42: 563–645.
3. Koolbergen D, Ahmed Y, Bouma B, et al. Follow-up after tricuspid valve surgery in adult patients with systemic right ventricles. Eur J Cardiothorac Surg 2016; 50: 456–463.
4. Bapat V. Valve-in-valve apps: why and how they were developed and how to use them. EuroIntervention 2014; 10 Suppl U: U44–51.
5. Picard F, Tadros V, Asgar A. From tricuspid to double orifice morphology: percutaneous tricuspid regurgitation repair with the MitraClip device in congenitally corrected-transposition of great arteries. Catheter Cardiovasc Interv 2016; 90: 432–436.
6. Luedike P, Riebisch M, Weymann A, Ruhparwar A, Rassaf T, Mahabadi A. Feasibility of a novel transcatheter valve repair system to treat tricuspid regurgitation in ccTGA. J Am Coll Cardiol Case Rep 2021; 3: 893–896.
7. Guerrero M, Salinger M, Pursnani A, et al. Transseptal transcatheter mitral valve-in-valve: a step by step guide from preprocedural planning to postprocedural care. Catheter Cardiovasc Interv 2017; 92: E185–E196.
8. Sivaprakasam MC, Reddy RV, Sengottuvelu G, Sivakumar K, et al. Early multicentre experience of a new balloon expandable MyVal transcatheter heart valve in dysfunctional stenosed right ventricular outflow tract conduits. Ann Pediatr Cardiol 2021; 14: 293–301.