IHJ Cardiovascular Reports 8 (2024) 66–69

Contents lists available at ScienceDirect

IHJ Cardiovascular Reports

journal homepage: www.sciencedirect.com/journal/ihj-cardiovascular-reports

Case Report

Single stage transcatheter mitral valve in valve implantation and paravalvular leak closure following failure of bioprosthetic valve and cardiogenic shock

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ARTICLE INFO

Handling editor: Dr Yadav Rakesh

Keywords:
Mitral stenosis
Mitral regurgitation
Transcatheter mitral valve in valve implantation
Percutaneous paravalvular leak closure
Cardiogenic shock

ABSTRACT

The simultaneous occurrence of structural degeneration of a bioprosthetic mitral valve with a paravalvular leak is extremely unusual and results in cardiac failure. Management of such a clinical scenario is challenging. We report a case of concomitant transcatheter mitral valve in valve implantation and paravalvular leak closure in an elderly frail patient with degenerated mitral bio prosthesis and paravalvular leak.

1. Introduction

Bioprosthetic valves carry the risk of reduced durability and structural degeneration at the expense of reduced thrombosis and freedom from anticoagulation. Paravalvular regurgitation is a rare yet serious complication that may occur in both biological and mechanical prosthetic valves. Late PVLs occur because of suture dehiscence, which in turn is caused mostly by slow resorption of poorly debrided annular calcification or bacterial endocarditis.[1] Surgical PVL repair has a failure rate of ≈35 %, which increases with each re-intervention.[2] Percutaneous PVL device closure is associated with high success rates and lower operative mortality.[3–5] Transcatheter mitral valve-in-valve (ViV) implantation combined with percutaneous PVL closure is gaining popularity for the management of prosthesis failure with PVL in high-risk patients.

2. Case report

A 82-year-old woman with past history of surgical mitral valve replacement (25mm Medtronic Hancock II) for rheumatic valvular heart disease, chronic obstructive pulmonary disease and cerebrovascular accident presented with complaints of breathlessness at rest (class IV dyspnea), orthopnea and poor exercise tolerance. On physical examination, she was cachectic (Body Mass Index = 14.4) and dyspneic at rest with heart rate of 160 beats/min, had bilateral pedal edema, elevated jugular venous pressure, bilateral crepitations and hepatomegaly. A pansystolic murmur was heard in the mitral and tricuspid areas. Laboratory investigations revealed hemoglobin of 8.8 mg/dL, and increased renal parameters suggestive of acute kidney injury (urea-58 mg/dL, serum creatine-1.8 mg/dL, and eGFR of 25ml/mt/1.73m^2).

Electrocardiogram was suggestive of atrial fibrillation with fast ventricular rate. Transthoracic echocardiography revealed severe valvular regurgitation (mitral bio-prosthetic valve dysfunction) and PVL, moderate tricuspid and pulmonary hypertension, right ventricular dysfunction, and adequate left ventricular function. *Trans*-esophageal echocardiography (TEE) demonstrated severe mitral regurgitation with paravalvular leak (8 × 4 mm) at anteromedian location (Fig. 1). Risk scores such as the Society of Thoracic Surgery score [12.66 %], and Euro

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https://doi.org/10.1016/j.ihjcvr.2024.06.007
Received 28 August 2023; Received in revised form 11 June 2024; Accepted 27 June 2024
Available online 2 July 2024

SCORE 34 indicated high surgical risk. The patient was initially managed with anti-failure measures, anticoagulation and rate controlling medications for 2 weeks. During the hospital stay, patient developed worsening heart failure with severe hypotension, metabolic acidosis with elevated lactate (2.4 mmol/L) requiring inotropes and ventilator support. After stabilization, options of surgery *vs trans*-catheter valve replacement were discussed by the heart team. The risk and benefits of each procedure were clearly explained to the patient and her relatives. A *trans*-catheter valve deployment with PVL closure was planned. Computed tomography (CT) was used to determine the angle of deployment, risk of left ventricular outflow tract (LVOT) obstruction, and the size of the valve (Fig. 2). The commissure to commissure distance was 25.2 mm, area derived diameter was 22.7 mm, and total area was 405.9 mm^2. Dr.Vinayak Bapat's mitral app was used for valve size estimation (Fig. 3). A 23 mm Edwards S3 valve or 23 mm MYVAL was considered. If 23 mm MYVAL was considered, then predicted neo LVOT area was 270.3 mm^2. A pre-procedural plan was put in place to deploy 23 mm MYVAL (see Fig. 4).

2.1. Procedure

The intervention was performed under general anaesthesia and TEE-guidance. A 8.5-Fr *trans*-septal sheath and were introduced into the right femoral vein and advanced over a guide wire into the right atrium. *Trans*-septal puncture was performed at the postero-superior part of the fossa ovalis under TEE-guidance. An AgilisTM NxT Steerable Introducer was used to orient a multipurpose catheter towards the degenerated bio prosthesis. Subsequently, the prosthesis was crossed and a pre-shaped stiff wire (SAFARI2 Guidewire small curve; Boston Scientific, Marlborough, MA, USA) was positioned in the apex of the left ventricle. The sheath was exchanged for a 14-Fr Python expandable introducer sheath (Meril's Life Sciences Pvt. Ltd.). Atrial septostomy was performed using a 40 × 14 mm balloon (XXL Balloon Dilatation Catheter; Boston Scientific). The 23 mm MYVAL transcatheter heart valve (THV) was advanced into the degenerated mitral bioprosthesis using both fluoroscopy- and TEE-guidance to facilitate crossing of the septum. The THV was navigated across the previous surgical prosthesis and placed in 80:20 position within the stent frame. It was then deployed slowly under rapid pacing (160/min) taking care to align both valve inflows. Mean trans mitral gradient decreased to 3 mm Hg after valve deployment. A 0.35″ straight guidewire supported by a 4 Fr straight catheter (Heartrail II straight; Terumo, Leuven, Belgium) was used to cross the PVL at the anteromedial location. After exchange for an 8 French AmplatzerTM TorqvueTM 45 delivery system (Abbott/St. Jude Medical, Plymouth, MN, USA), a 10/5 mm Amplatzer Vascular Plug II (AVP II; Abbott/St. Jude Medical, Plymouth, MN, USA) was implanted reducing PVL to trace (Fig. 3). At the end of the intervention, both valvular and paravalvular regurgitation was reduced significantly. Post-procedural period was uneventful, and her heart failure symptoms improved markedly. She was discharged on post-operative day 6 after optimizing medications and is doing well at 4 year follow up.

3. Discussion

3.1. Decision making

Our patient had progressively worsening heart failure because of bioprosthetic valve dysfunction. She presented to us with acute decompensation resulting in cardiogenic shock requiring multiple inotropes and mechanical ventilation. Considering her advanced age, extreme frailty, multiple comorbidities, and current critical clinical scenario she had prohibitively high risk for surgery. Following a heart team discussion, *trans*-catheter approach was planned.

3.2. Pre-procedural planning

3-D TEE is useful in distinguishing valvular and paravalvular regurgitation jets and estimating the stability of the dehiscent surgical implant. TEE was used to determine the size of the plug required for PVL closure. In our case, CT was used to determine the diameter of the surgical valve and the outflow tract of the left ventricle. Valve size estimation was performed using the Dr.Vinayak Bapat's mitral sizing software. It helped to minimize neo LVOT obstruction during Transcatheter Mitral Valve Implatation (TMVI) by providing near precise estimations.[6]

3.3. Transcatheter mitral valve implantation

TMVR was found to be a safe and effective treatment option for patients with failed mitral bioprosthesis in a retrospective multi-center analysis of 248 patients.[6] LVOT obstruction or valve embolization are the notable yet rare complications (3.2 and 1.6 %, respectively). Key point to note is the importance of eliminating parallax during positioning of the bevel in relation to the previous valve within the frame. The valve must be positioned at an 80:20 ratio on the valve frame and deployed slowly.

3.4. Percutaneous paravalvular leak closure

Percutaneous PVL closure emerged as an alternate technique to surgical repair because of the high mortality risk associated with redo procedures for surgical PVL closure. Echocardiographic and fluoroscopic fusion imaging are useful to aid navigation in the left atrium and identification of the defect.[7] Successful percutaneous PVL closure, was

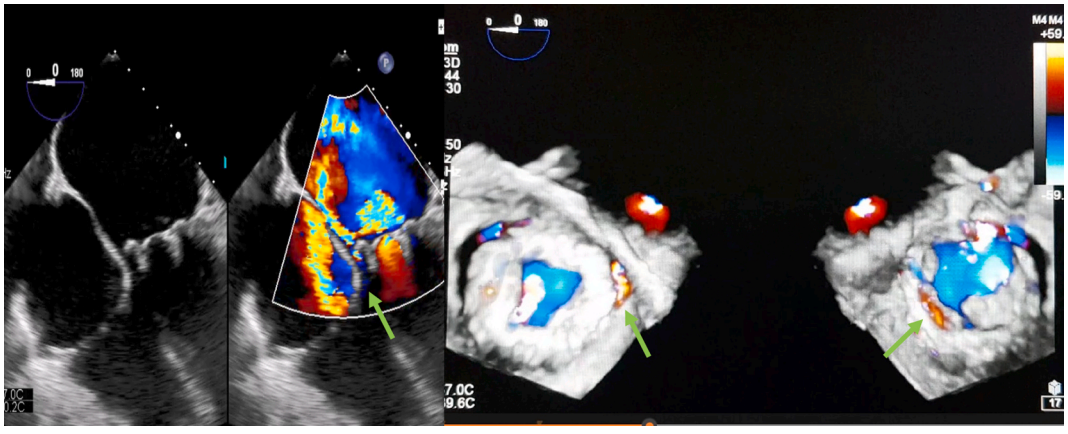

Fig. 1. Preoperative transesophageal echocardiography showing severe valvular regurgitation and paravalvular leak (indicated by arrows).

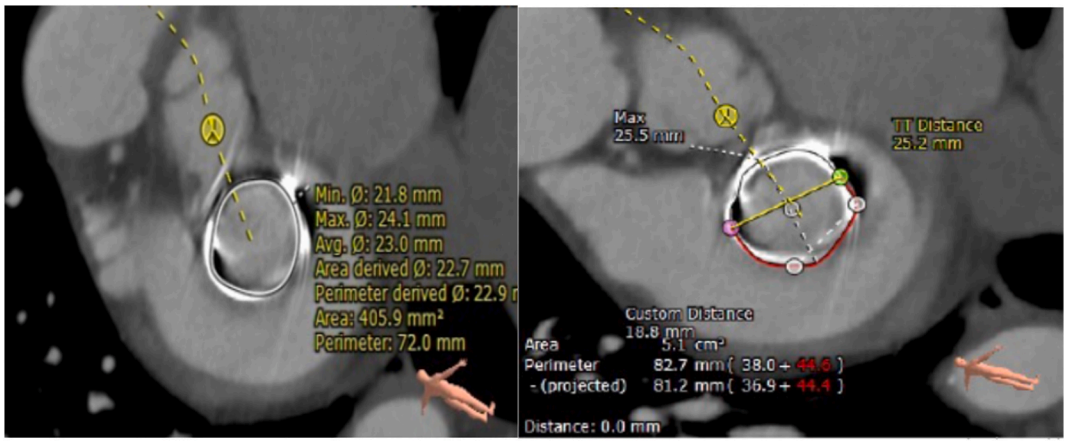

Fig. 2. Preoperative computed tomography used for pre-procedural planning.

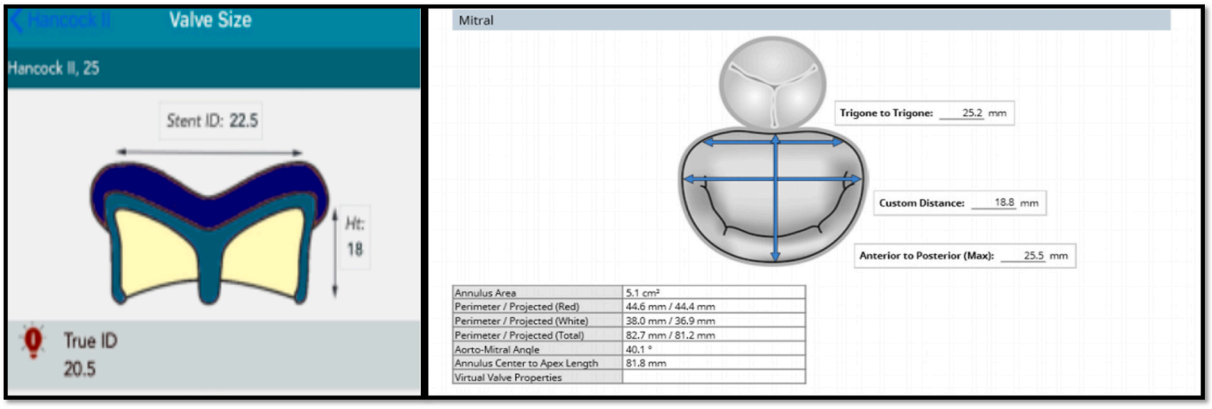

Fig. 3. Dr.Vinayak Bapat's mitral app was used for valve size estimation.

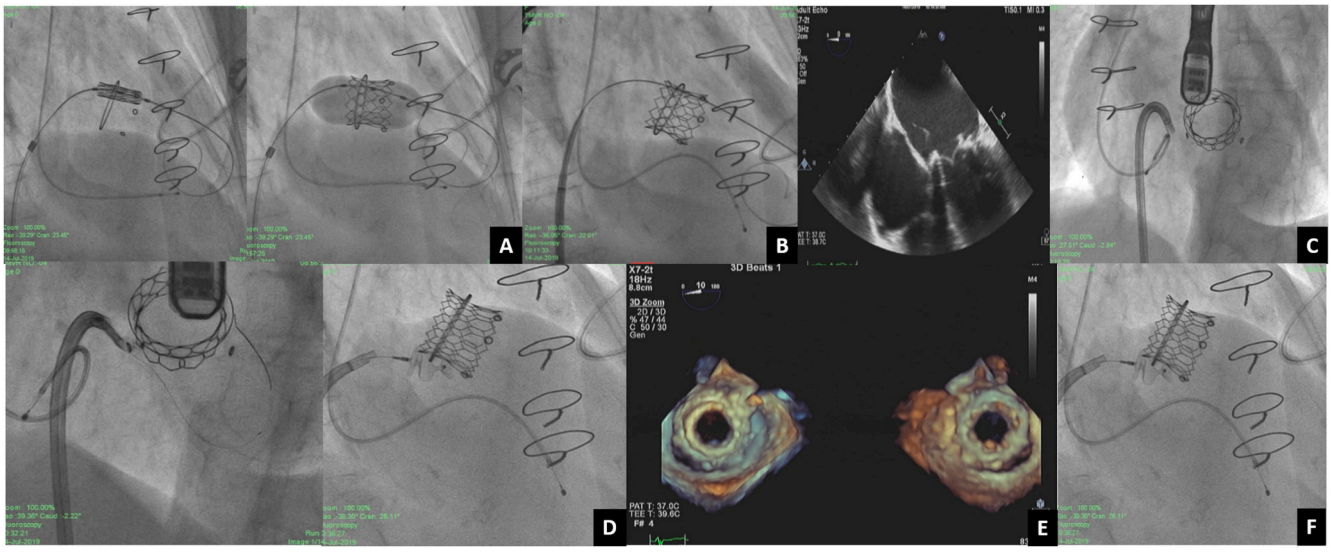

Fig. 4. Single stage procedure combining transcatheter valve in valve placement, and closure of paravalvular leak: A: Valve deployment, B: Post deployment, C: ECHO Guided wire placement, D: post PVL closure with AVP II device, E: Post procedure TEE, F: Final result.

defined as a residual PVL of mild severity or less, and is associated with improved 1-year survival.[8]

3.5. *Concomitant transcatheter mitral valve implantation and percutaneous paravalvular leak closure*

Kliger et al. (2015) first reported successful simultaneous closure of mitral PVL and TMVI.[9] The unique challenge in this patient subset is to

avoid interactions between the many implanted devices to ensure optimal function of the valve leaflets. Precise assessment of the valve size, and intra-procedural guidance are required for successful procedure completion.

4. Conclusions

We report the successful management of an elderly frail patient with late failure of mitral bio-prosthesis using combined transcatheter mitral valve in valve implantation, and PVL closure. Meticulous pre procedural planning and post-procedural care improves patient outcomes.

Institutional review board approval

The study was a case report, hence does not require institutional ethical clearance.

Statement of human and animal rights

The study was conducted according to the guidelines of the Declaration of Helsinki.

Informed consent

Individual patient consent was obtained for use of patient data and images for the purpose of publication.

Consent for publication

The authors give the publisher the permission to publish the work.

Funding

None.

Author's contributions

Conceptualization, D.K; methodology, D.K, N.B.S, M.K, A.K; validation, D.K, and N.B.S.; data curation, A.K; writing—original draft preparation, D.K, N.B.S, A.K, A.M.K; writing—review and editing, A.M.K, A.K.; All authors have read and agreed to the published version of the manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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