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ScienCrown Valve: A Novel Transcatheter Heart Valve for Concurrent Aortic and Mitral Valve-in-Valve Implantation in Bioprosthetic Degeneration

CASE REPORT

INTRODUCTION

Valvular heart disease stems from structural or functional valve abnormalities—most frequently caused by rheumatic complications, degenerative aging processes, infective endocarditis, or traumatic injury—resulting in hemodynamic compromise,[1] which can lead to heart failure or death. Artificial valve replacement restores near-normal cardiac geometry and hemodynamics, promptly relieving symptoms and improving long-term prognosis, though long-term tissue valve deterioration remains a challenge. Perioperative risks escalate significantly with advanced age, comorbidities, and complex reoperations in cases of structural valve deterioration (SVD). Consequently, transcatheter valve-in-valve (ViV) techniques provide a less invasive option for implanting transcatheter heart valves within failed bioprostheses.[2] This document details the first concurrent aortic and mitral ViV procedure using the proprietary ScienCrown valve (Lepu Medtech Inc., Beijing, China). Its unique self-expanding, low-profile design and full retrievability confer exceptional anchoring stability and positional accuracy during deployment, offering crucial technical support for ViV applications in complex anatomical settings.

CASE REPORT

An 83-year-old male with degenerative failure of 11-year-old aortic (St. Jude Medical 21 mm) and mitral (St. Jude Medical 27 mm) bioprostheses developed congestive heart failure alongside severe aortic stenosis/insufficiency and severe mitral insufficiency. Left ventricular ejection fraction (LVEF) was 40%. Symptoms comprised unexplained chest tightness, wheezing, orthopnea, and persistent nocturnal paroxysmal dyspnea. Examination noted arrhythmia with frequent ectopic beats and grade 4/6 systolic murmurs over mitral/aortic areas. Transthoracic/transesophageal echocardiography (TTE/TEE) confirmed mitral prosthesis severe regurgitation [vena contracta width (VCW) 8 mm, mean gradient 8 mm Hg] and severe aortic prosthesis stenosis/regurgitation (mean gradient 44 mm Hg; peak velocity 5.7 m/s, VCW 8 mm) (Figure 1). Additional findings: severe left atrial enlargement, LVEF 40%, and moderate pulmonary hypertension (estimated systolic pressure 57 mm Hg). Coronary angiography was unremarkable. Preoperative cardiac computed tomography quantified aortic annulus dimensions (circumference 58.6 mm, area 252.9 mm^2, diameter 18.1 mm) with a low right coronary height (6.4 mm). Mitral annulus diameter measured 24 mm, aorto-mitral angle 61.8°, with calculated neo-left ventricular outflow tract (LVOT) of 999.9 mm^2, indicating low LVOT obstruction risk post-TMViV. N-terminal pro-B-type natriuretic peptide (NT-proBNP) was severely elevated (11363.03 pg/mL). Due to advanced age, prior sternotomy, and comorbidities, conventional redo AVR or MVR was deemed excessively hazardous. A multidisciplinary consensus opted for concurrent transapical transcatheter aortic mitral valve-in-valve (TAViV) and transcatheter mitral valve-in-valve (TMViV) using the ScienCrown self-expanding valve, after obtaining informed consent.

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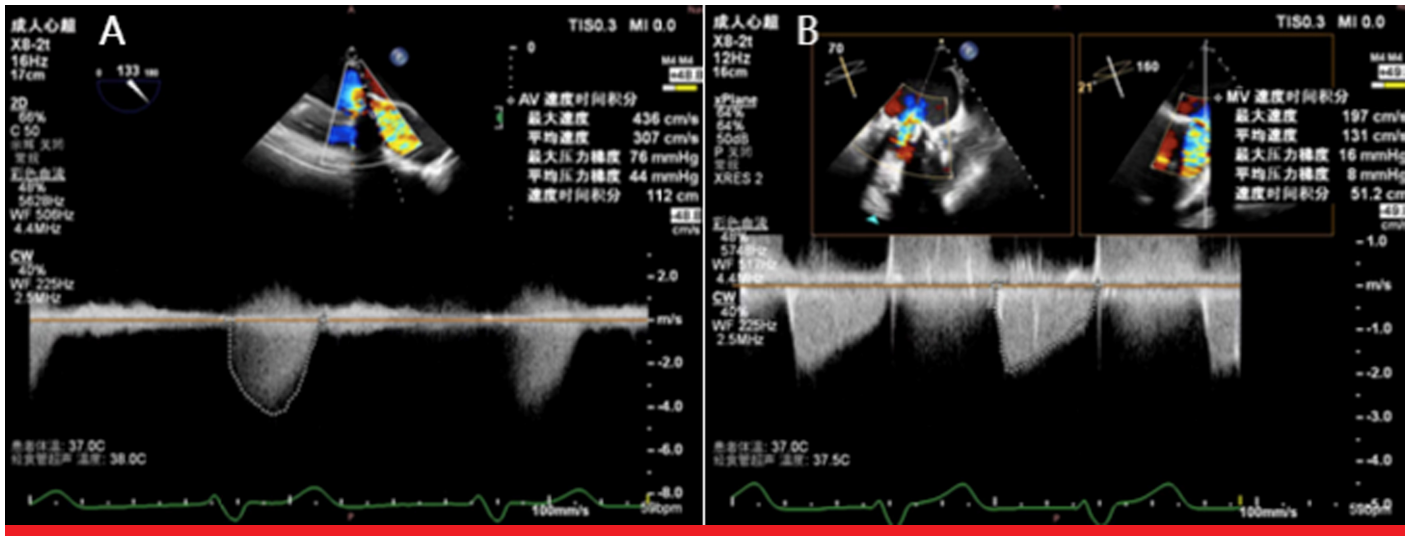

Figure 1. Echocardiographic evaluation of bioprosthetic valve dysfunction. A: Aortic prosthesis severe stenosis with regurgitation (mean gradient 44 mm Hg; peak velocity 5.7 m/s, VCW 8 mm). B: Severe mitral bioprosthetic regurgitation (VCW 8 mm, mean gradient 8 mm Hg).

PROCEDURE

On June 4, 2025, integrated TEE and fluoroscopy guided the procedure under general anesthesia. Temporary pacing was established via the right internal jugular vein. A limited left anterolateral incision exposed the fifth intercostal space. Dual purse-string sutures were secured at the apex; heparin achieved Activated Clotting Time (ACT) > 250 s. After apical puncture, guidewire crossing utilized initially a soft wire, then an Amplatz Super Stiff™ Guidewire (Boston Scientific). Rapid pacing (180 bpm) facilitated pre-dilation of the aortic bioprosthesis with an 18 mm balloon (Figure 2A). A 21-mm ScienCrown valve was selected. Rotation of the unlock knob gradually released the valve from its delivery system (Video 1). Deployment was successful without malposition or paravalvular leak (PVL) (Figure 2B and Video 2). Post-deployment TEE indicated a mean aortic gradient of 6 mmHg with no PVL (Figure 2C and D). Subsequently, the stiff guidewire traversed the mitral prosthesis into the left atrium (Video 3). The ScienCrown delivery system was reloaded in a reverse configuration. A 25-mm ScienCrown valve was implanted within the mitral position under rapid pacing (180 bpm) (Figure 2E and Video 4). Transesophageal echocardiography confirmed a mean mitral gradient of 5 mmHg with normal leaflet motion and no PVL (Figure 2F). Post-procedural fluoroscopy documented both valves in situ (Figure 2G). Post-implant day 1 bedside TTE showed mild gradients (mitral: 2.52 mm Hg, velocity 0.76 m/s; aortic: 13.39 mm Hg, velocity 1.7 m/s) indicating mild aortic stenosis (AS) and normal mitral function (Figure 3). The patient advanced to New York Heart Association class II and was discharged on postoperative day 5.

DISCUSSION

Aging and the persistent presence of rheumatic heart disease contribute to the prevalence of combined valve disease. For several decades, the therapeutic mainstay has been surgical valve replacement utilizing either mechanical or bioprosthetic prostheses,[3] with their application expanding significantly over the past 20 years, notably among patients under 65 years of age.[4] These devices offer distinct advantages over mechanical alternatives by eliminating mandatory lifelong anticoagulation and substantially reducing thromboembolic event rates. However, their principal limitation remains SVD, which frequently necessitates high-risk reoperative surgery for aortic or mitral valve replacement in elderly individuals.[3] The inaugural transcatheter aortic ViV implantation via CoreValve in an octogenarian, documented by Wenaweser et al[5] in 2007, established a foundation for novel interventions. Subsequently, ViV therapy has evolved into a viable alternative for high-risk patients with degenerated bioprosthetic aortic valves, effectively minimizing perioperative morbidity. The pioneering transapical mitral ViV procedure, performed by Cheung's group in 2009,[6] further expanded this paradigm. Contemporary TAViV/TMViV procedures demonstrate consistent outcomes with greater than 90% procedural success rates and highly reproducible results.[7]

The phenomenon of concurrent aortic and mitral bioprosthetic degeneration has become progressively more prevalent in aging populations.[8] Dual-valve deterioration exacerbates hemodynamic load; consequently, the majority of patients are now considered too high-risk for repeat open surgery.[8] Multiple contraindications—such as advanced age, NYHA Class IV heart failure, previous sternotomy, a thin chest wall, and dense adhesions—render repeat surgery exceedingly risky. Transcatheter ViV alternatives offer substantially reduced procedural invasiveness, occasionally mandating simultaneous dual-valve intervention. Although prior investigators have documented simultaneous TAViV and TMViV utilizing differing access routes (transapical and transfemoral) with balloon-expandable prostheses,[8,9] this report describes the world's first single-session transapical implantation for dual bioprosthetic degeneration using the innovative ScienCrown valve via an entirely transapical

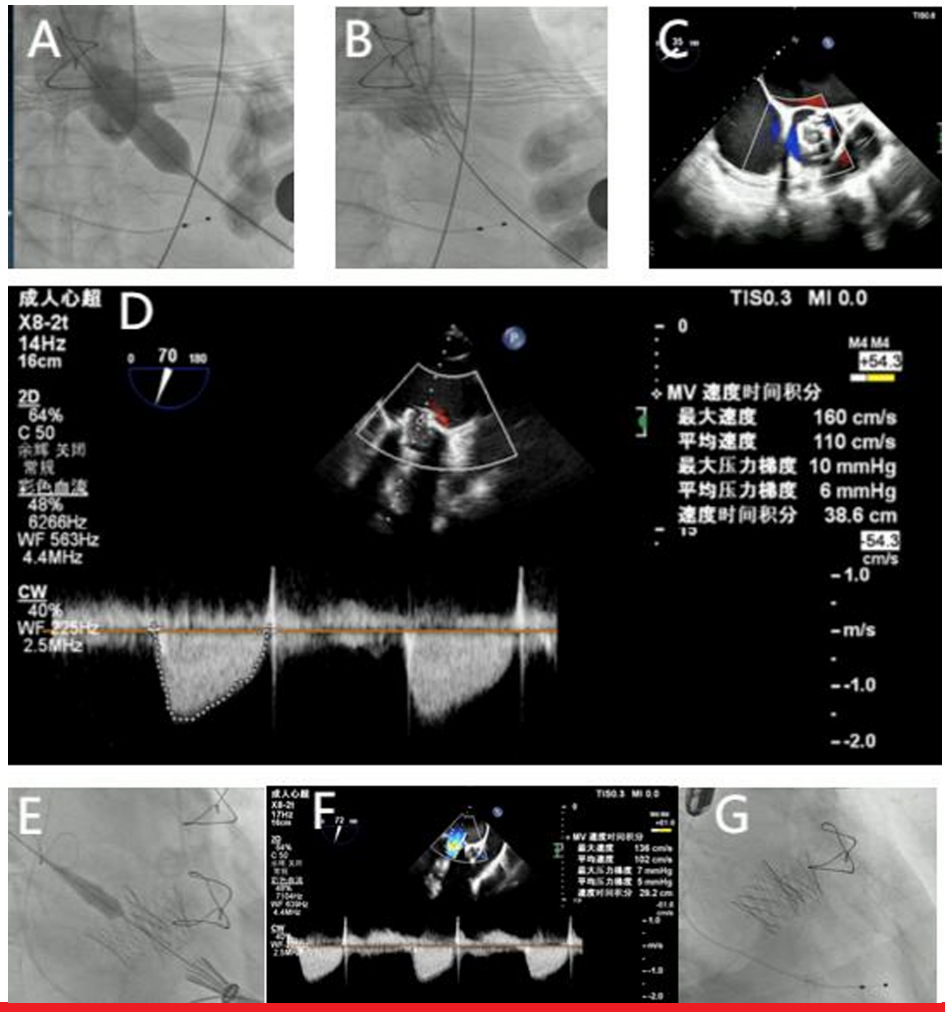

Figure 2. Transapical aortic and mitral ViV procedure using ScienCrown. A: An 18-mm balloon aortic valvuloplasty pre-dilation. B: Successful 21 mm ScienCrown deployment demonstrating absence of paravalvular leak. C: Post-implantation transesophageal echocardiography (TEE) confirming no perivalvular leakage. D: Post-procedural TEE documenting mean aortic gradient of 6 mmHg. E: Optimal 25 mm ScienCrown placement in mitral position. F: Post-deployment TEE assessment showing a mean mitral gradient of 5 mm Hg. G: Postoperative imaging demonstrating appropriate spatial orientation and stent expansion for both implanted valves.

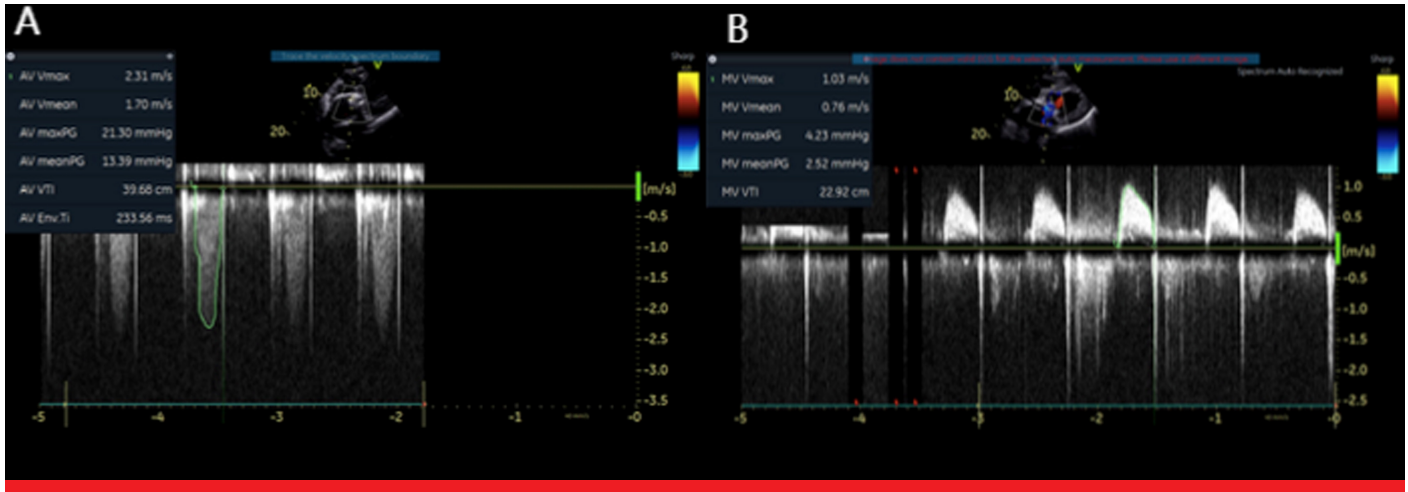

Figure 3. Postoperative transthoracic echocardiographic findings.

approach. In this case, TAViV was done first. The rationale for this strategy is that the aortic and mitral annuli are contiguous, connected by the aorto-mitral fibrous curtain. Therefore, treating the mitral valve first may cause some degree of obstruction during subsequent aortic valve deployment.

The ScienCrown transcatheter heart valve incorporates a fully retrievable and repositionable self-expanding bioprosthetic design. Its abbreviated nitinol stent architecture mitigates coronary obstruction risk, while triple bovine pericardial leaflets maintain exemplary hemodynamic performance.[10] Compatible with transfemoral (18-21 Fr) and transapical (27 Fr) delivery systems, the device features a pre-curved flexible catheter to augment navigational precision and positional accuracy. A dependable locking/unlocking mechanism with a full-hanging connection ensures complete retrievability and controlled deployment. Paravalvular leakage is minimized through dual-layer inner-outer skirt sealing, while 3 radiopaque markers at the stent base optimize implantation visualization.[10] In the present case, the team achieved technically successful concurrent transapical TAViV and TMViV with absent residual gradients and no significant paravalvular leakage. This procedural outcome translated directly to substantial symptomatic improvement in the patient's clinical status postoperatively.

The limitation of this study is that it is based on single-center case reports. Further validation through multicenter registry studies is needed.

CONCLUSION

This report substantiates the safe and reproducible use of concurrent dual ViV therapy for bioprosthetic failure, capitalizing on the ScienCrown valve's self-expanding low-frame profile and full retrievability. Artificial intelligence (AI)-assisted technologies (such as Large Language Models [LLM], chatbots, or image creators) were not utilized in the production of this case report.

Informed Consent: Written informed consent was obtained from the patient.

Declaration of Interests: The authors have no conflicts of interest to declare.

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Video 1: Rotation of the unlock knob gradually released the valve from its delivery system.

Video 2: Deployment was successful without malposition or paravalvular leak (PVL).

Video 3: The Amplatz Super Stiff™ Guidewire traversed the mitral prosthesis into the left atrium.

Video 4: A 25-mm ScienCrown valve was implanted within the mitral position under rapid pacing (180 bpm).

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