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CASE REPORT

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Transseptal mitral valve-in-valve implantation in a degenerated mitral bioprosthesis: A case report and literature review

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Abstract

Transseptal TMViV should be considered for mitral bioprosthesis failure especially when large THV can be implanted. Elevated residual mean gradient and its effect on valve durability and potential valve thrombosis remains an unanswered question.

KEYWORDS

degenerated bioprosthesis, mean gradient, mitral valve-in-valve, SAPEIN S3, transseptal

1 | INTRODUCTION

Reoperation for mitral bioprosthesis failure is associated with increased mortality and morbidity. Over the last decade, transcatheter mitral valve-in-valve has become an attractive alternative for treating bioprosthesis failure. We present the case of a 75-year-old woman with a degenerated mitral bioprosthesis and severely reduced left ventricular ejection fraction who underwent a successful transeptal mitral valve-in-valve procedure. We illustrate, with this case, the advantages of a transeptal access and present a literature review of transcatheter mitral valve-in-valve success.

The increasing number of patients presenting with failed mitral bioprosthesis is the consequence of the shift from mechanical toward bioprosthetic valve implantation in the last decade. Even though redo surgery remains the gold standard, transcatheter mitral valve-in-valve implantation (TMViV) has emerged as a safe and attractive alternative for high-risk patients. However, there are no specific prostheses developed for this indication. Current devices used for TMViV were developed for aortic valve replacement. Since TMViV volume per center remains very low (average center volume of <1 procedure per year in the large Society of Thoracic Surgeons/American College of Cardiology/Transcatheter Valve Therapy Registry),[1] reports describing technical successes as well as tips and tricks are of paramount importance in order to share local experience and increase procedural success worldwide.

2 | CASE REPORT

A 75-year-old woman was admitted for progressive dyspnea and reduced functional capacity. Seven years previously, she had undergone mitral valve replacement with an Edwards Magna 31 mm valve (Edwards Lifesciences) which was complicated by a severe decrease in left ventricle ejection fraction (LVEF) (visually estimated at 25%) and hemicolectomy. Treatments included anticoagulation (vitamin K antagonist) for paroxysmal atrial fibrillation as well as guideline-recommended optimal heart failure medical therapy. Physical examination revealed persistent sinus tachycardia despite maximal tolerated betablocker therapy (100-110 beats per minutes) and mild pulmonary congestion refractory to diuretic therapy. Transthoracic echocardiography (TTE) showed a severely reduced LVEF at 30% and severe mitral stenosis (mean gradient: 25 mm Hg at 108 beats per minute (Figure 1 panel A and Video S1), valve area 0.7 cm^2 by direct planimetry using 3-dimensional transesophageal echocardiography [TEE]) with restricted leaflet mobility (Figure 1 panel B). Of note, the baseline gradient was overestimated due to tachycardia

in relation to the short diastolic time. A coronary angiogram did not reveal any significant obstructive coronary artery disease. After Heart-Team discussion, a second surgical mitral valve replacement was deemed at too high risk considering the LVEF. We decided to perform a transseptal TMViV using a 29 mm Edwards SAPIEN S3 transcatheter heart valve (THV) (FDA approved for TMViV for mitral bioprosthesis since June 2017) mounted on a transfemoral Edwards Commander Delivery System in an antegrade position.

After positioning a Sentinel cerebral protection device (Boston Scientific) in the brachiocephalic trunk and the left carotid artery, we punctured the right femoral vein, performed a transseptal puncture followed by a dilatation of the septum by an inflation of a 12 × 40 mm Powerflex Pro 0.035 balloon (Cardinal Health TM). Subsequently, a medium Agilis steerable transseptal sheath (Abbott Vasc) was advanced to facilitate the advancement of an extra-small 0.035 Safari guidewire (Boston Scientific) into the left ventricular apex through a 6 French pigtail catheter. After optimal positioning under fluoroscopic and TEE guidance, the balloon-expandable valve was deployed under rapid pacing at 180 bpm (Figure 1 panel C) with a significant reduction in mean gradient from 25 to 3.6 mm Hg postprocedure (Figure 1 panel D) and no residual regurgitation. Panel E, Figure 1 (and Video S2) shows fully opened leaflets at 3-dimensional echocardiography. After retrieval, the Sentinel device showed multiple micro debris (Figure 1, panel F). At 1 year, the patient was in a functional class New York Heart Association I with a transprosthetic mean mitral gradient of 7 mm Hg. Despite optimal heart failure treatment, LVEF remained severely reduced (30%) and the patient underwent insertion of an implantable cardioverter defibrillator for primary prevention.

3 | DISCUSSION

Reoperation for mitral bioprosthesis failure is associated with increased mortality and morbidity.[1] According to the recent data from the Society of Thoracic Surgeons, American College of Cardiology and Transcatheter Valve Therapy Registry including 1529 patients with a mean STS score of 11.1% and a mean age of 73 years, TMViV for

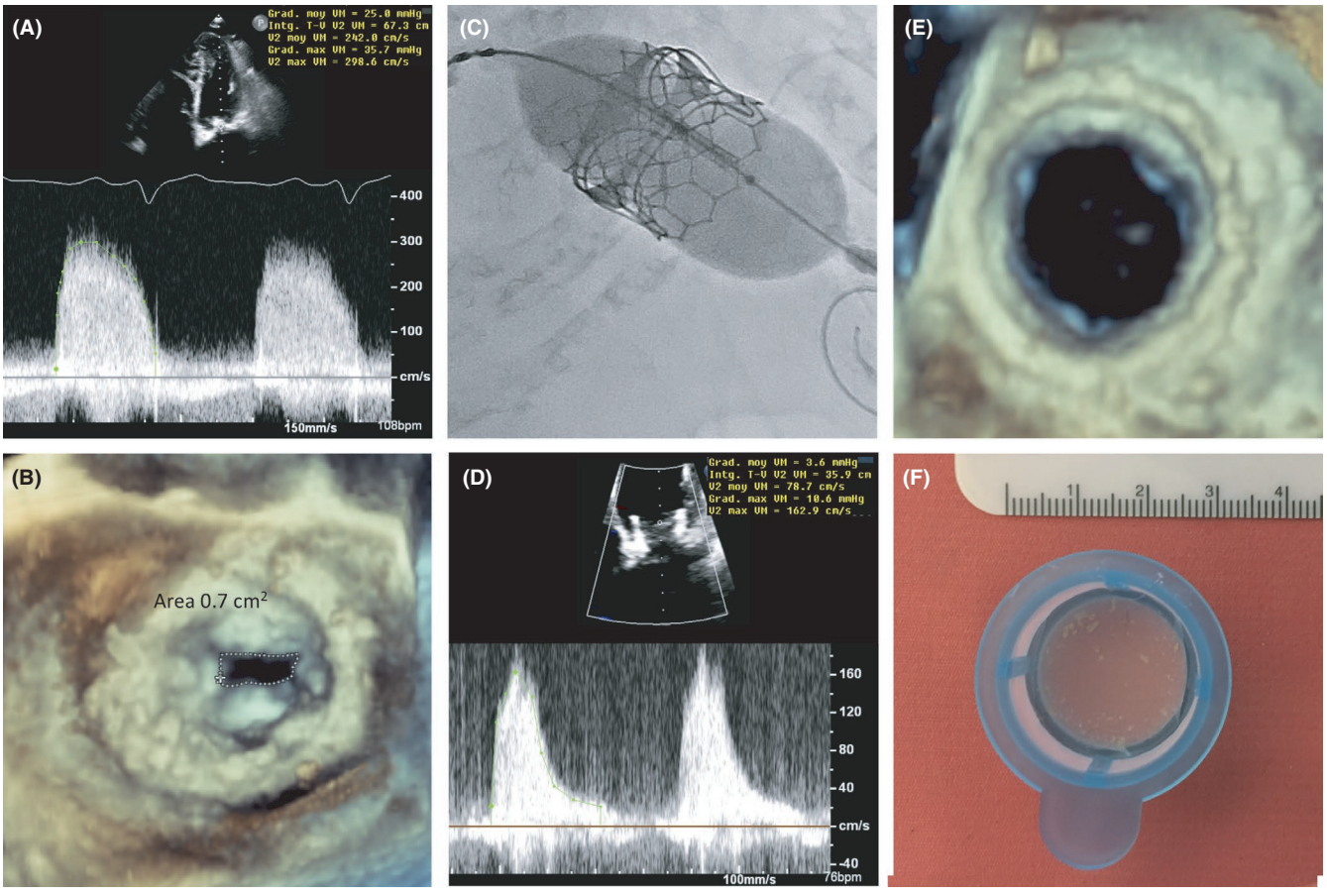

FIGURE 1 Panel A: Continuous doppler through the mitral valve showing severe mitral stenosis (mean gradient: 25 mm Hg at 108 beats per minute). Panel B: Valve area at 0.7 cm^2 as measured by direct planimetry using 3-dimensional transesophageal echocardiography. Panel C: Balloon-expandable valve deployment under rapid pacing at 180 bpm. Panel D: Significant mean gradient reduction from 25 to 3.6 mm Hg postprocedure. Panel E: Fully opened leaflets at 3-dimensional echocardiography. Panel F: Multiple micro debris captured by the Sentinel device

TABLE 1 Largest series reporting mitral valve-in-valve for degenerated bioprosthesis

Study	No of patients	Date of inclusion	Procedural success rate	Transseptal access rate	Edwards valve size	Postprocedural mean gradient (mm Hg)	LVOT obstruction (% of patient)	All-cause mortality
Whisenant et al, 2020[4] (STS/ACC/TVT registry)	1529	06.2015-07.2019	96.8%	Transseptal: 86.7% Transapical: 13.3%	20:0.2% 23:7.8% 26:41.4% 29:50.6%	7.3 ± 2.73 at 30 d 7.0 ± 2.89 at 1 y	0.9%	4% in-hospital 5.4% at 30 d 16.7% at 1 y
Guerrero et al, 2020[1] (STS/ACC/TVT registry)	680	03.2013-06.2017	90.9%	Transseptal: 41.8% Transapical: 46.8% Transatrial: 0.1% Other or unknown: 11.3%	23:9.2% 26:37.6% 29:53.2%	4 in-hospital 7 at 30 d	0.7%	6.3% in-hospital 8.1% at 30 d
Keenan et al, 2020[8] (Single center Australia)	7	12.2017 −11.2018	86%	Transseptal: 100%	26:43% 29:57%	5.5 (4-7)	14%	14% at 30 d
Okoh et al, 2020[5] (Single center Israel)	15	07.2013-09.2016	100%	Transseptal: 7% Transapical: 80% Sternotomy: 13%	-	-	0	0 at 30 d 27% at 1 y
Yoon et al, 2019[6] (40 US and European centers)	322	02.2009-04.2018	73.6%	Transseptal: 38.8% Transapical: 59.9%, Transatrial: 1.2%	-[a]	5.9 ± 2.8 in-hospital	2.2%	6.2% at 30 d 12.6% at 1 y
Yamashita et al, 2019[2] (Multicentric Japan)	4	05.2017-03.2020	100%	Transapical: 100%	23:75% 29:25%	5 (5.0-9.5) at 7 d 6.2 (4.0-11.0) at 30 d	0	0 at 30 d 0 at 1 y
Eleid et al, 2017[7] (Multicentric US)	60	01.2014-03.2017	97%	Transseptal: 100%	-	6.3 ± 2.9 in-hospital 6.9 ± 1.8 at 30 d	5%	95% at 30 d
Webb et al, 2010[9] (Multicentric Canada and UK)	7	NA	100%	Transseptal: 14% Transapical: 72% Transatrial: 14%	23:29% 26:71%	8.0 ± 1.3	-	14% at 30 d

[a]3.7% of the patients underwent valve-in-valve with a Lotus prosthesis.

mitral bioprosthesis failure is an attractive alternative to surgery.[2] Indeed, procedural success (96.8%) was high, and all-cause mortality at 30 days was 5.4%. The transseptal approach became more and more dominant during the inclusion period compared to transapical approach (overall 86.7% of transseptal approach) and is associated with a lower 1-year mortality rate (15.8% vs 21.7%, P =.03). Although it has been postulated that valve positioning might be easier through the transapical approach due to the proximity of the apex to the mitral apparatus, excellent procedural success was reported among series including only patients who underwent transseptal TMViV. The risk of complications (including mainly apical pseudo-aneurysm and apical bleeding) related to the transapical approach favored the transseptal approach over time with good clinical results. Table 1 summarizes the largest series reporting TMViV for degenerated bioprosthesis[2-9] describing procedural success, rate of transeptal approach, Edwards THV sizes, postprocedural mean gradient, rate of left ventricular outflow tract obstruction, and all-cause mortality.

With respect to our case, we clearly favored the transeptal over transapical approach considering the reduced LVEF. Technically, the use of the Agilis steerable transseptal sheath is recommended to provide enough support to advance the stiff guidewire into the left ventricle. When using the usual SL0 transeptal sheath (Abbott Vasc), the pigtail repeatedly moved out from the left ventricle while advancing the stiff Safari guidewire.

In the largest registry from Whisenant et al, a mean gradient of 6.9 mm Hg was found at 1 year for valve sizes of 26 and 29 mm, which is similar to our patient, but higher to what we can expect after conventional surgery.[4] As expected, patients who benefited from smaller transcatheter bioprosthesis (20 and 23 mm) had higher transvalvular gradient following TMViV in comparison with patients with larger bioprosthesis (26 and 29 mm). Importantly, implantation of a smaller prosthesis was found to be associated with a higher mortality at 1 year (28.9% vs 15.6%, P =.003). Since unanswered questions remain with respect to the elevated residual mean gradient and its effect on valve durability and potential valve thrombosis, additional studies are required to define long-term outcomes and optimal anticoagulant therapy in the absence of atrial fibrillation after TMViV.[10]

4 | CONCLUSIONS

In conclusion, our case illustrates a favorable outcome at 1 year post transseptal TMViV for mitral bioprosthesis failure in a patient at high risk for surgical reintervention. Transseptal TMViV should be considered as an alternative to conventional surgery especially when a large THV could be implanted.

4.1 | Novel teaching points

- Reoperation for mitral bioprosthesis failure is associated with increased mortality and morbidity.
- Transcatheter mitral valve-in-valve is an attractive alternative for bioprosthesis failure with good procedural results, in particular when large prosthesis can be implanted (26 and 29mm Edwards SAPIEN valve).
- The transseptal over transapical approach should be favored with respect to the lower 1-year mortality rate.
- Elevated residual mean gradient at 1 year and its effect on valve durability and potential valve thrombosis remains an unanswered question.

CONFLICT OF INTEREST

S Noble received institutional grants from Edwards Life Sciences. The other authors have no potential conflict of interest.

AUTHOR CONTRIBUTION

NP: analyzed the data and wrote the manuscript. HM: provided critical feedback. SN: helped shaped the research and provided critical feedback.

ETHICAL APPROVAL

The research reported has adhered to the Helsinki ethical principles for medical research involving human beings.

INFORMED PATIENT CONTENT

The patient gave written informed consent to use of related anonymous data for research and publication.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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