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Timing Matters Most

Delayed Intervention's Impact on Transcatheter Mitral Valve Implantation Strategy

Ion Vasiloi[a]; Thomas Nestelberger[b]; Beat A. Kaufmann[b]; Fabien Praz[c]; Oliver T. Reuthebuch[a]
[a] Department of Cardiac Surgery, University Hospital, Basel, Switzerland; [b] Department of Cardiology, University Hospital, Basel, Switzerland;
[c] Department of Cardiology, Inselspital, University Hospital, University of Bern, Switzerland

Abstract

Transcatheter mitral valve implantation (TMVI) is used for treating severe mitral valve regurgitation in patients deemed unsuitable for open-heart surgery. However, delays between preoperative workup and therapy can lead to changes in the clinical condition and structural valve findings, necessitating a meticulous reevaluation of diagnostic and therapeutic options.

Case Presentation: A 77-year-old woman with severe mitral valve regurgitation and severe comorbidities was referred to our Heart Team and was deemed suitable for TMVI based on the initial evaluation. The echocardiographic finding showed a severe degenerative mitral valve regurgitation with prolapse of the A3 and P3 segments and an eccentric jet directed posteriorly to the atrial roof but without the complete picture of Barlow's disease. Due to delayed approval by the patient, the therapeutic procedure was postponed. Subsequent echocardiographic reevaluation six months later revealed a hypermobile anterior mitral leaflet resulting from chordal elongation in conjunction with a septal bulge, raising the risk for postoperative left ventricular outflow tract (LVOT) obstruction. To mitigate this risk, TMVI combined with the Laceration of the Anterior Mitral Leaflet to Prevent Outflow Obstruction (LAMPOON) was performed. Postimplantation echocardiography revealed a well-functioning mitral valve prosthesis without para- and transvalvular leak, a mean gradient of 3 mm Hg, and no LVOT obstruction.

Conclusion: The diagnostic and therapeutic evaluation of TMVI remains intricate and time-consuming, necessitating thorough planning. Prompt performance of the procedure is crucial to prevent unforeseen structural changes that could jeopardize the patient's outcome. The combination of TMVI with the LAMPOON technique for preventing LVOT obstruction appears feasible and suitable for selected patients.

Keywords: Mitral valve regurgitation; Transcatheter mitral valve implantation; Transcatheter mitral valve replacement; Tendyne™; LAMPOON.

Introduction

Transcatheter mitral valve implantation (TMVI) is a treatment option for mitral valve regurgitation in patients who are too high-risk for open mitral valve surgery. TMVI using the Tendyne™ prosthesis (Abbott Laboratories, Abbott Park, Illinois, USA) has lately gained in interest for high-risk cardiac surgery patients, showing promising results. TMVI can be complicated by left ventricular outflow tract (LVOT) obstruction, which may be influenced by factors such as long hypermobile anterior mitral leaflets, inadequate tethering of the anterior leaflet, septal bulge, aorto-mitral angle, and the size and shape of the mitral prosthesis [1, 2]. Consequently, accurate pre-interventional assessment is crucial to determine the optimal timing for the procedure since delays between diagnosis and treatment can lead to significant clinical and structural changes in the valves, requiring a careful reassessment of treatment options. In cases of high LVOT obstruction risk due to the structural features of the Tendyne™ valve, which lacks open cells in the stent and has the entire stent covered by fabric, the Laceration of the Anterior Mitral Leaflet to Prevent Outflow Obstruction (LAMPOON) technique can be used to address LVOT obstruction by electrosurgically splitting the anterior mitral leaflet just before TMVI. This procedure is intended to prevent systolic anterior motion (SAM) and dynamic LVOT obstruction. As an alternative to LAMPOON, endoscopic scissoring (anterior leaflet cutting with transapical-inserted scissors) can also be considered [3].

Lately, TMVI using transcatheter aortic valve implantation has been used in combination with the LAMPOON technique, showing that the approach is feasible [1, 2]. However, the evidence on the effectiveness of the combination of TMVI using the Tendyne™ prosthesis and the LAMPOON procedure in patients with high risk for LVOT obstruction is limited.

Case Description

A 77-year-old woman with severe mitral valve regurgitation and comorbidities (European System for Cardiac Operative Risk Evaluation [EuroScore] II, 8.99%; Society of Thoracic Surgeons [STS] Score, 6.36%) was referred to our Heart Team. Upon initial evaluation, she was deemed suitable for TMVI with Tendyne™. The cardiological assessment was made in the context of cardiac decompensation (New York Heart Association Functional Classification [NYHA] III-IV) due to atrial fibrillation. The echocardio-

graphic findings revealed severe degenerative mitral valve regurgitation with prolapse of the A3 and P3 segments and an eccentric jet directed posteriorly reaching the atrial roof, but without a definitive image of Barlow's disease (fig. 1, video 1). Additionally, the echocardiogram showed the following measurements: left ventricular internal diameter in diastole 6.21 cm, Left Atrium Longitudinal Reservoir Strain (LALs) 7.32 cm, Right Atrium Longitudinal Reservoir Strain (RALs) 5.36 cm, systolic pulmonary artery pressure (sPAP) 27 mm Hg, proximal isovelocity surface area 12 mm, and effective regurgitation orifice area 0.75 cm^2. In addition to the mitral valve disease, the patient exhibited aortic valve stenosis of mild to moderate severity, a history of type 2 myocardial infarction, peripheral artery disease with prior interventions, chronic venous insufficiency, factor V Leiden mutation, suspected obstructive pneumopathy (with nicotine consumption and chronic hypoxia) with partial respiratory insufficiency of unclear etiology, as well as limited mobility with a rollator. The coronary angiogram showed a triple vessel coronary artery disease with hemodynamically nonsignificant stenoses in the proximal and mid-left anterior descending artery (fractional flow reserve = 0.86), coronary sclerosis in the Ramus circumflex artery, with a significant long-segment stenosis proximally in the right coronary artery, and a focal, high-grade stenosis that distally extending to the ostial posterolateral artery (healed dissection, differential diagnosis: fibromuscular dysplasia). After recompensation, the patient reversed her decision to undergo the intervention, which postponed the therapeutic procedure for approximately six months. New complaints of exercise-independent angina pectoris led to a repeated echocardiographic evaluation of the mitral valve and revealed a prolapse of both leaflets with a hypermobile anterior mitral leaflet (AML) caused by chordal elongation (fig. 2, Video 2). The preexisting systolic dynamic bulge (fig. 1–3) in the LVOT (velocity time integral (VTI) 30 cm) along with the hypermobile AML increased the risk of postoperative LVOT obstruction. Additionally, the then-constricted LVOT generates Bernoulli forces pulling the AML towards the septum during systole resulting in SAM. Considering these aspects, the Heart Team decided on a combined intervention: TMVI implantation with prior LAMPOON modification. We opted primarily for the LAMPOON technique rather than endoscopic scissoring [3]. We considered endoscopic scissoring to split the AML as a bail-out strategy in case LAMPOON fails. In the case of hemodynamic instability or post-im-

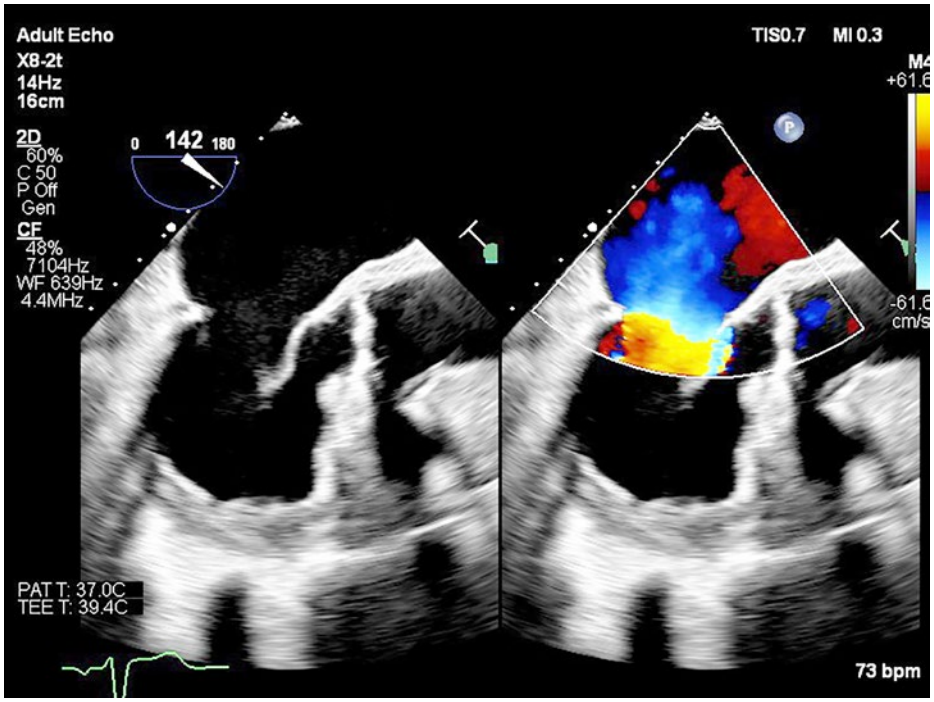

Figure 1: First echocardiographic evaluation of the mitral valve showing a septal bulge in the left ventricular outflow tract.

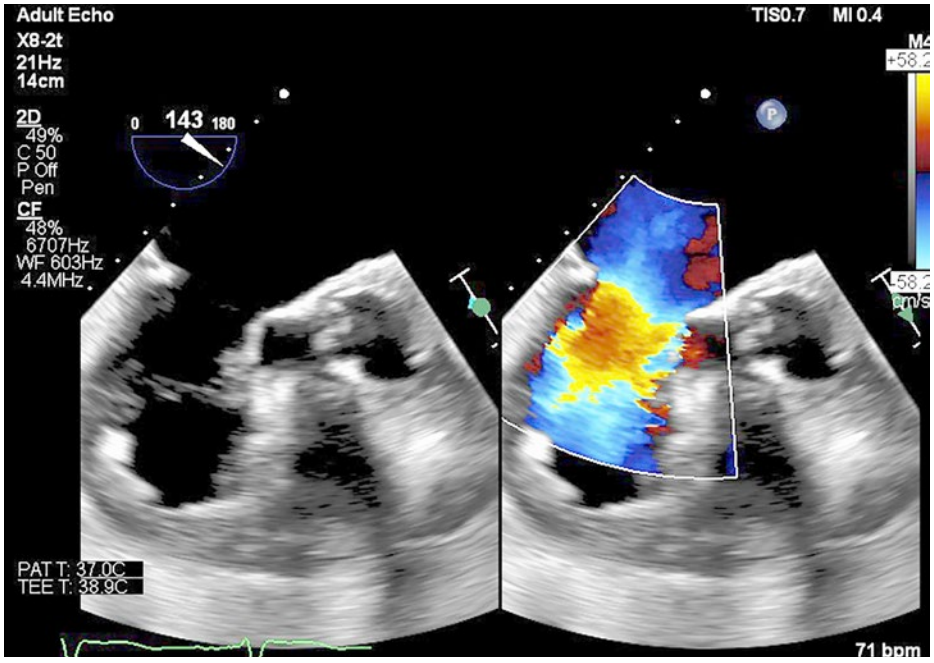

Figure 2: Second echocardiographic evaluation of the mitral valve showing anterior mitral leaflet elongation and hypermobility.

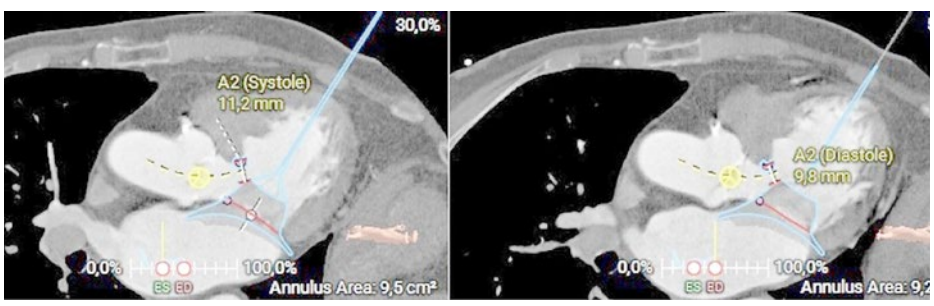

Figure 3: Preoperative computed tomography scan: Analysis of the prosthesis position and left ventricular outflow tract dimensions in systole and diastole.

plantation LVOT obstruction, the implantation of an intra-aortic balloon pump and even sternotomy with consequent extracorporeal circulation and surgical valve replacement were considered.

Operative procedure

The procedure was performed in a hybrid operating room under general anesthesia. After exposing the apex in the fifth intercostal space, the purse-string sutures were placed. Via the right femoral vein, the interatrial septum was punctured under echocardiographic and angiographic guidance. Sequentially, the AML was punctured three millimeters below the aortomitral junction in the A2 segment using electrosurgical wires, and the site was flushed with 5% dextrose to prevent current dispersion and blood coagulation. This was followed by laceration of the AML using the externalization wire shaped as a "flying V" (fig. 4). As expected, this resulted in acute severe mitral valve regurgitation with an increase of the sPAP to 57 mm Hg, a decrease in systolic pressure to 90/50 mm Hg, and the need for inotropic support with adrenalin 10 µg and phenylephrine up to 500 µg. Without delay, the Tendyne™ mitral prosthesis was implanted following the routine steps. The procedure was finalized by adjusting the tether tension and placing the extracardiac apical pad. Postimplantation echocardiography revealed a well-functioning mitral valve prosthesis without paravalvular leakage, a mean gradient of 3 mm Hg, and no LVOT obstruction (VTI 22 cm). Postoperatively, the fast-track extubated patient was transferred to the intensive care unit (ICU) in a hemodynamically stable condition.

Although no cardiovascular adverse events occurred, the hospital stay was prolonged to 35 days, with an ICU stay of 22 days. The main postoperative complications included recurrent acute respiratory distress syndrome with pleural effusions due to the chronic pulmonary disease, secondary pulmonary edema due to tachycardic atrial fibrillation exacerbated by pulmonary embolism and pneumonia, as well as a delirium requiring pharmacological treatment. The echocardiographic findings at the 8-month follow-up revealed a well-functioning prosthesis with a mean gradient of 2 mm Hg and an effective orifice area of 3.1 cm^2. The patient remains clinically well 14 months post-surgery.

Discussion

TMVI is a novel therapeutic option for treating mitral valve pathologies [4, 5]. We report a case with a significant delay between the initial workup and the procedure, with possible changes in anatomy in between. Reevaluation after a period of six months demonstrated a hypermobile AML that, in conjunction with the preexisting septal bulge, was at risk of causing severe LVOT obstruction. To potentially overcome this detrimental risk, we opted for splitting the AML using the LAMPOON technique [1]. Clinical case series have shown promising results regarding the safety and efficacy of such a complex procedure, despite the theoretical risk of aortic valve injury, chordal rupture, or embolization of leaflet fragments [1].

Endoscopic scissoring represents an alternative but is still investigational [3]. However, splitting the AML under echocardiographic guidance with endoscopic scissors transapically inserted via a sheath might be a promising technique. Post-procedural follow-up showed an improvement of clinical symptoms with the mitral valve prosthesis in the correct position and with a normal function (no transvalvular or paravalvular leakage) and a mean gradient of 3 mm Hg.

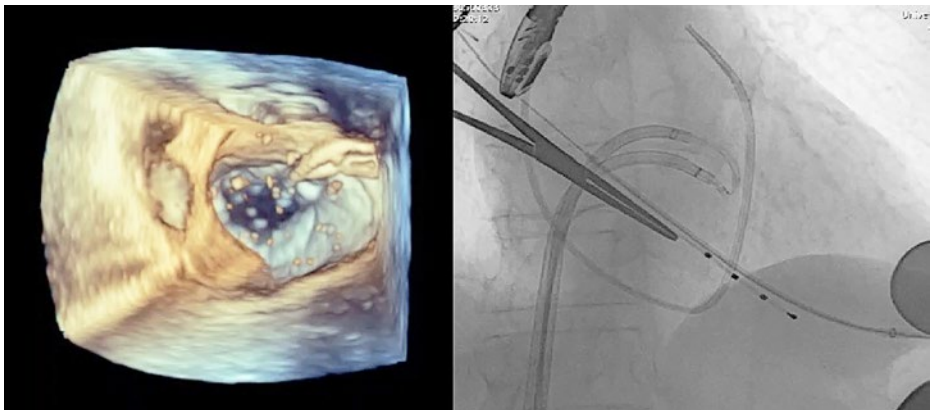

Figure 4: Intra-procedural echocardiographic (left) and fluoroscopic (right) assessment of the setup for the laceration of the anterior mitral leaflet to prevent left ventricular outflow tract obstruction.

Conclusion

TMVI with the Tendyne™ prosthesis along with electrosurgical AML modification is feasible and effective. Delay between the initial workup and the actual intervention should motivate a thorough anatomical reevaluation to detect changes in valve and ventricular pathology and discuss further interventional strategies.

Correspondence

Prof. Dr. Oliver T. Reuthebuch
Department of Cardiac Surgery
University Hospital Basel
Spitalstrasse 21
CH-4031 Basel
oliver.reuthebuch[at]usb.ch

Ethics Statement

Written Informed consent was obtained.

Conflict of Interest Statement

I. Vasiloi has no potential conflicts of interest to declare.
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Author Contributions

IV was the major contributor in writing. TN was second operator. BK was the cardiac sonographer. OR was first operator, contributor in writing and approved the final manuscript. All authors read and approved the final manuscript.

References

You will find the full list of references online at https://cvm.swisshealthweb.ch/en/article/doi/cvm.2024.1514206641/.