

Transcatheter Tricuspid Valve-In-Ring and Aortic Valve-In-Valve Implantation

Daniel Reichart¹ Niklas Schofer² Florian Deuschl² Andreas Schaefer¹ Stefan Blankenberg²
 Hermann Reichenspurner¹ Ulrich Schaefer² Lenard Conradi¹

¹Department of Cardiovascular Surgery, Universitätsklinikum Hamburg–Eppendorf, Universitäres Herzzentrum Hamburg GmbH, Hamburg, Germany

²Department of General and Interventional Cardiology, Universitätsklinikum Hamburg–Eppendorf, Universitäres Herzzentrum Hamburg GmbH, Hamburg, Germany

Address for correspondence Daniel Reichart, MD, Universitätsklinikum Hamburg–Eppendorf, Universitäres Herzzentrum Hamburg GmbH, Martinistr. 52, 20246 Hamburg, Germany (e-mail: d.reichart@uke.de).

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Abstract

Background Transcatheter heart valve (THV) therapies have shown to be an alternative to surgical valve replacement, especially in high-risk patients requiring redo surgery. However, reports of transcatheter-based interventions in tricuspid valve position are scarce.

Case Description Here, we report a case of successful concomitant transcatheter aortic valve-in-valve (ViV) and tricuspid valve-in-ring (ViR) procedures using a 23-mm CoreValve Evolut R THV (Medtronic, Inc., Minneapolis, Minnesota, United States) in aortic position and a 29-mm SAPIEN3 (Edwards Lifesciences, Inc., Irvine, California, United States) THV in tricuspid position.

Conclusion This case demonstrates feasibility of concomitant transcatheter aortic ViV and tricuspid ViR procedures.

Keywords

- ▶ aortic valve
- ▶ tricuspid valve
- ▶ heart valve

Introduction

Reports on transcatheter tricuspid valve interventions are scarce, even more when combined with other valve procedures. However, potential candidates are abundant and thus, this case report faces the clinical need and reports on an alternative therapeutic option of concomitant transcatheter aortic valve-in-valve (ViV) and off-label tricuspid valve-in-ring (ViR) implantation.^{1,2}

Case Description

A 77-year-old female patient was referred with dyspnea according to New York Heart Association (NYHA) functional class, III–IV, 22 months after aortic valve replacement (Hancock II Ultra 21 mm, Medtronic, Inc., Minneapolis, Minnesota, United States). During this initial procedure, right coronary obstruction occurred with subsequent surgical revascularization on day 1. Nonetheless, right heart dysfunction and severe tricuspid regurgitation (TR) developed requiring tricuspid

valve repair 3 months later using a 34-mm Contour 3D ring (Medtronic, Inc.). Nine months later, the patient was admitted with infective aortic valve endocarditis, which was treated with antibiotics. Subsequent early deterioration of the aortic bioprosthesis was possibly triggered by this event. Upon readmission another 13 months later, severe aortic valve regurgitation without any sign of active endocarditis was seen. The peak/mean transprosthetic gradients were 59/33 mm Hg. Left ventricular ejection fraction was 43% and right ventricular function was severely reduced (tricuspid annular plane systolic excursion, 6 mm) with a recurrence of severe TR and mild chronic renal failure. The ventricular pacemaker (PM) lead was located at the interrupted portion of the annuloplasty ring. Formal risk stratification revealed logistic European System for Cardiac Operative Risk Evaluation (logEuroSCORE) I of 34.4% and Society of Thoracic Surgeons (STS) score of 10.5%. The patient was allocated to a combined interventional treatment due to prohibitive surgical risk. Use of a 23-mm CoreValve Evolut R THV (Medtronic, Inc.) as an aortic ViV procedure and a 29-mm SAPIEN3 (Edwards Lifesciences, Inc., Irvine, California,

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United States) THV as a tricuspid ViR procedure was planned. The dimensions provided by the manufacturer of the Medtronic Hancock II Ultra 21 mm were: internal diameter (ID), 18.5 mm and true stent ID, 16.5 mm. The 34-mm Contour 3D ring had a min/max diameter of 22/32 mm. The orifice area was 588.6 cm² resulting in an area-derived inner diameter of 27.4 mm. By CT, inner ring perimeter of 87.6 mm and perimeter-derived diameter of 27.9 mm were measured.

The procedure was performed under general anesthesia using ProStar (right common femoral artery; Abbott Laboratories, Chicago, Illinois, United States) and ProGlide systems (right femoral vein; Abbott Laboratories). A transradial cerebral protection system (Claret Medical, Santa Rosa, California, United States) was introduced. Due to low left coronary takeoff (distance, 6 mm), prewiring of the left coronary system using a balance middle weight (BMW) wire (Abbott Laboratories) and 3.0 × 20 mm percutaneous coronary intervention (PCI) balloon (Boston Scientific, Inc., Marlborough, Massachusetts, United States) was performed.

First, the deteriorated aortic bioprosthesis was passed retrogradely, and a 260-cm Safari wire (Boston Scientific, Inc.) was introduced into the left ventricle. Due to the small caliber peripheral vasculature, the 23-mm CoreValve Evolut R THV (Medtronic, Inc.) was inserted using the 14Fr equivalent InLine sheath (Medtronic, Inc.). Aortic ViV procedure was performed without rapid ventricular pacing (RVP) or reshathing. Fluoroscopy, echocardiography (peak/mean gradient: 17/8 mm Hg), and invasive hemodynamic (peak/mean gradient: 12/2 mm Hg) assessment confirmed adequate THV position without any paravalvular leakage (PVL).

In a second step, tricuspid ViR was performed. A 29-mm SAPIEN3 THV (Edwards Lifesciences, Inc.) was introduced using a 300-cm Safari wire (Boston Scientific, Inc.), 16Fr-Sheath, and Commander delivery catheter (both from Edwards Lifesciences, Inc.) with reverse crimping to account for the antegrade approach (→ Fig. 1). Loading of the THV onto the balloon was performed in the right atrium with balloon overfilling by 2 mL due to marginal landing zone dimensions. THV deployment resulted in an implantation height of 80% ventricular (→ Fig. 2). Procedure was performed under fast pacing of 150

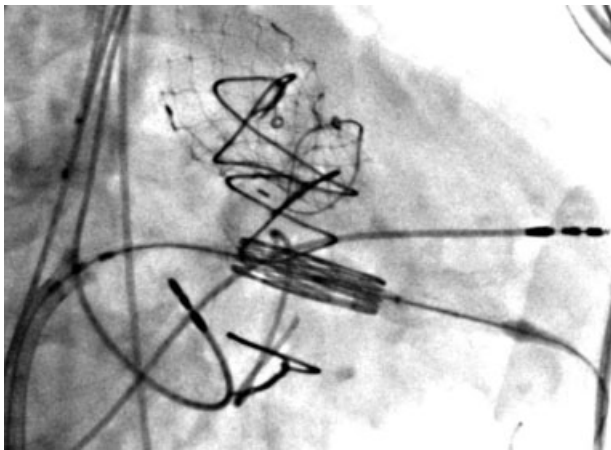


Fig. 1 The CoreValve Evolut R THV (Medtronic, Inc.) was implanted in aortic position. The 29-mm SAPIEN3 THV (Edwards Lifesciences, Inc.) was introduced with reverse crimping to account for the antegrade approach.

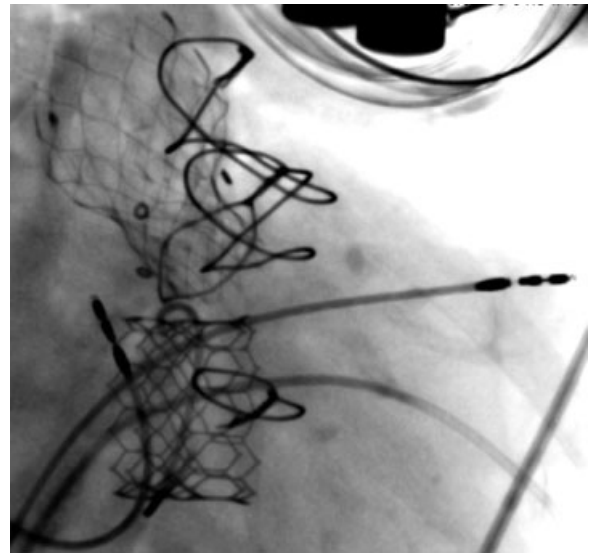


Fig. 2 Postimplantation fluoroscopy depicting the SAPIEN3 (Edwards Lifesciences, Inc.) THV in tricuspid position and a CoreValve Evolut R THV (Medtronic, Inc.) in aortic position. The SAPIEN3 (Edwards Lifesciences, Inc.) was implanted with an implantation height of 80% into the ventricle.

beats per minute via external programmer and internal PM. Balloon postdilatation was performed using a 30-mm Z-MED II balloon (NuMED; Hopkinton, New York, United States).

Procedural/fluoroscopy times were 163/56 minutes and duration of intensive care unit/overall hospital stay was 2/10 days. At discharge, trace PVL, a peak/mean gradient of 34/20 mm Hg, and an effective opening area of 1.4 cm² were documented in the aortic position. Regarding tricuspid ViR, mild residual TR at the annuloplasty ring interruption was observed where the ventricular PM lead was still located with adequate lead function. At 30 days, the patient reported improvement in NYHA class II.

Discussion and Conclusion

Surgical redooperations for TR carry substantial perioperative risk, which is even higher in patients with previous bypass surgery and impaired right ventricular function.³⁻⁵ Conservative treatments failed and to avoid re sternotomy or cardiopulmonary bypass—despite the knowledge of the asymmetric and partial landing zone provided by the open annuloplasty ring—decision was made to allocate this patient to a ViV/ViR intervention. An alternative strategy could be tricuspid valve clipping. However, tricuspid valve clipping was not an option due to anatomical reasons. Other alternative approaches such as annuloplasty devices were not applicable due to prior surgery.⁶

Despite technical success with substantial clinical benefit of this particular patient, some technical challenges should be briefly discussed. Abdoulhosn et al recently described an experience in 22 tricuspid ViR procedures with implantation success of 91% and significantly reduced degrees of TR (excluding PVLs). As in the present case, almost all tricuspid annuloplasty rings had an interrupted portion to respect the patients' conduction system anatomy. Abdoulhosn et al described significant residual PVLs at the open aspect of the

ring in a subset of patients. As a solution, Amplatzer occluders were implanted into the residual paravalvular space.⁷

A further challenge lies in the patient's history of a two-chamber PM implantation. The ventricular lead posed a risk of lead damage during the ViR procedure. In this case, the lead position was at the interrupted ring portion. For RVP, an external programmer was used. In case of any lead dysfunction, the placement of a temporary coronary sinus PM wire might have been an option.⁸

When using the 29-mm SAPIEN3 THV (Edwards Lifesciences, Inc.), it seemed advisable to perform loading of the THV onto the deployment balloon outside the eSheath to avoid friction of THV stent against the balloon, which might have led to balloon damage or disengagement of THV and balloon when advancing the system further through the eSheath.

This patient presented with only mild chronic renal failure. Thus, combined valvular intervention seemed feasible, especially since ViV/ViR procedures rarely require increased amounts of contrast agent due to the radioopacity of prosthetic landing zones. In case of severe renal failure, a staged approach may be considered.

In conclusion, this case demonstrated the feasibility of concomitant transcatheter aortic ViV and tricuspid ViR procedures. Careful consideration of the above-mentioned technical challenges and anticipation of the high degree of procedural complexity are mandatory for such combined transcatheter valve interventions.

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