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CASE REPORT
Other

One-shot transcatheter double valve replacement: six-month follow-up—a case report

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Background Transcatheter aortic valve replacement (TAVR) in combination with a valve-in-valve (V-i-V) transcatheter mitral valve replacement (TMVR) is a rare procedure in comparison to surgical therapy especially in young patients. We report on a young patient at high surgical risk, receiving a double valve implantation with two S3 transcatheter heart valves.

Case summary A 59-year-old female patient with two previous mitral valve replacements due to endocarditis and re-endocarditis experienced a new onset of severe mitral valve stenosis in combination with progredient aortic stenosis. She was admitted to the hospital with severe dyspnoea and intermittent non-invasive ventilation [New York Heart Association (NYHA) III–IV]. An interventional transapical transcatheter double valve implantation was planned and carried out due to cardiac decompensation and high comorbidity preoperatively (STS score of 6.92). At 6-month follow-up, the patient presented herself in an improved condition with reduced symptoms (NYHA I–II), a good functional status of both valves and an advanced right and left ventricular function in the echocardiogram.

Discussion Even in younger patients at high risk, a combined native TAVR and V-i-V TMVR procedure can be performed. In this case, a transcatheter SAPIEN 3 valve was transapically implanted with good clinical mid-term outcome at 6 months.

Keywords Transcatheter aortic valve implantation • TAVR • Transcatheter mitral valve implantation • TMVR • Minimally invasive valve surgery • Case report

Learning points

- A stenosis of the degenerated redo mitral prosthesis in combination with onset of new aortic stenosis leads to progredient heart failure.
- Transcatheter double valve implantation is a good bailout option especially in high-risk and even younger patients with prior redo mitral valve replacement.

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Introduction

Transcatheter aortic valve replacement (TAVR) as a treatment option for patients suffering from severe aortic valve stenosis is a nowadays widely accepted procedure, even in degenerated bioprosthetic aortic valves as a valve-in-valve (V-i-V) procedure.[1,2] Recently, transcatheter mitral valve replacement (TMVR) was introduced as a treatment option for patients who are not eligible for redo mitral valve surgery. Meanwhile, a considerable number of single reports using TMVR in the treatment of native mitral valve stenosis, failed mitral valve bioprostheses, or mitral rings have been published.[3–5] To the best of our knowledge, this is the first case report on implantation of two valved stents into the native aortic as well as the V-i-V mitral position as a one-step transapical transcatheter double valve replacement.

Timeline

2000 and 2010	Mitral valve and re-mitral valve replacement (both 31 mm Hancock II bioprosthesis) due to endocarditis
Admission to hospital, initial evaluation	Patient suffering from severe dyspnoea, New York Heart Association (NYHA) III, beginning acute renal failure
Hospital Day 1	Worsening of dyspnoea and renal function, admission to intensive care unit (ICU), intermittent ventilation, haemodialysis, and inotropes
Days 2–7	Transoesophageal echo: High-grade mitral and aortic valve stenosis, severe tricuspid valve insufficiency, severe impaired left and right ventricular function Heart team: high-risk transcatheter aortic valve replacement (TAVR) and valve-in-valve (V-i-V) transcatheter mitral valve replacement (TMVR) (STS 6.92%) Cardiac catheterization Computed tomography scan for procedural planning
Day 9	Transapical TAVR (Edwards 23 mm S3) and simultaneous V-i-V TMVR (Edwards 29 mm S3) in hybrid operation room under general anaesthesia, extubating in the operation room and admission to ICU
Days 10–15	Discharge to general ward at postoperative Day 1 and further mobilization
Day 16	Discharge from hospital to local cardiac rehabilitation
6-Month follow-up	Echocardiogram with recovered systolic left (ejection fraction 35%) and right ventricular (TAPSE 17 mm) function, good valvular function, and 6-min walk test, patient at NYHA I–II

Case presentation

A female patient (59 years) with end-stage heart disease [New York Heart Association (NYHA) IV] suffered from severe biological mitral valve prosthetic stenosis (mean gradient of 22 mmHg, peak pressure gradient 34 mmHg) (*Figure 1A*) and combined severe aortic stenosis (valvular orifice area 0.8 cm^2, mean gradient 25 mmHg). In 2000 and 2009, she received 31 mm large Hancock II mitral valve bioprostheses due to endocarditis. Additionally, she suffered from obesity (29.8 body mass index), chronic renal disease type IV, pulmonary hypertension, chronic obstructive pulmonary disease type GOLD IV, and atrial fibrillation. Her echocardiogram indicated a severely reduced ejection fraction (EF) of 25%. She suffered from cerebral amyloid angiopathy with multiple haemorrhages at a high risk of bleeding using a heart-lung-machine. The clinical condition of the patient was reduced: she suffered actual from severe dyspnoea and physical examination showed peripheral oedema, pleural effusion, and signs of peripheral hypoxia, she was therefore dependent on permanent oxygen support. Patients serum creatinine values were elevated with 140 µmol/L. Furthermore, her Troponin T was elevated with 107 ng/L. The NTproBNP, indicating heart insufficiency, was elevated with 2300 ng/L.

Valve dimensions were calculated based on computed tomography. The mitral prosthesis annulus appeared to be suitable for a 29 mm SAPIEN 3 and the aortic annulus for a 23 mm SAPIEN 3 valve. However, there are various valved stents available for the transapical approach. After extensive consideration, a simultaneous transapical TAVR in the native aortic valve and TMVR in the mitral bioprosthesis (V-i-V) were carried out using two SAPIEN 3-valved stents via a left-sided mini-thoracotomy in a hybrid operation room (OR) under fluoroscopic and echocardiographic control [transoesophageal echo (TOE)]. Rapid pacing was done using an intracardiac pacemaker electrode in the right ventricle. After apex puncture, a conventional TAVR with a SAPIEN 3-valve (23 mm) was performed without prior valvuloplasty (*Figure 1B* and Supplementary material online, *Video S1*). This was done first to facilitate good positioning of the aortic valved stent into the annulus without interfering with the mitral valved stent and its neo-left ventricular outflow tract (LVOT). The angiogram proved no paravalvular leakage (PVL) (Supplementary material online, *Video S2*). By using the same access site and port system, a TMVR with a SAPIEN 3 (29 mm) was undertaken. A pre-shaped extra-stiff wire was secured into the left atrium during implantation (Supplementary material online, *Video S3*). The additional S3 prosthesis was expanded during rapid pacing in the mitral prosthesis (*Figure 1C* and Supplementary material online, *Video S4*). Post-implant TOE demonstrated neither valvular nor paravalvular nor mitral leakage. The aortic (pmean 8 mmHg) and mitral gradient (pmean 5 mmHg) were low. No LVOT-obstruction or signs of heart blockage were revealed. The patient was discharged 16 days after the intervention in a good mobilized condition.

A follow-up echo demonstrated a mildly enlarged, concentrically hypertrophied left ventricle with moderately impaired left ventricular function (EF 35%) of ubiquitous hypokinesia 6 months after discharge. Right ventricular function with a tricuspid annular plane systolic excursion (TAPSE) of 17 mm was impaired, too. The implanted aortic valve demonstrated no paravalvular or valvular insufficiency, mean pressure gradient

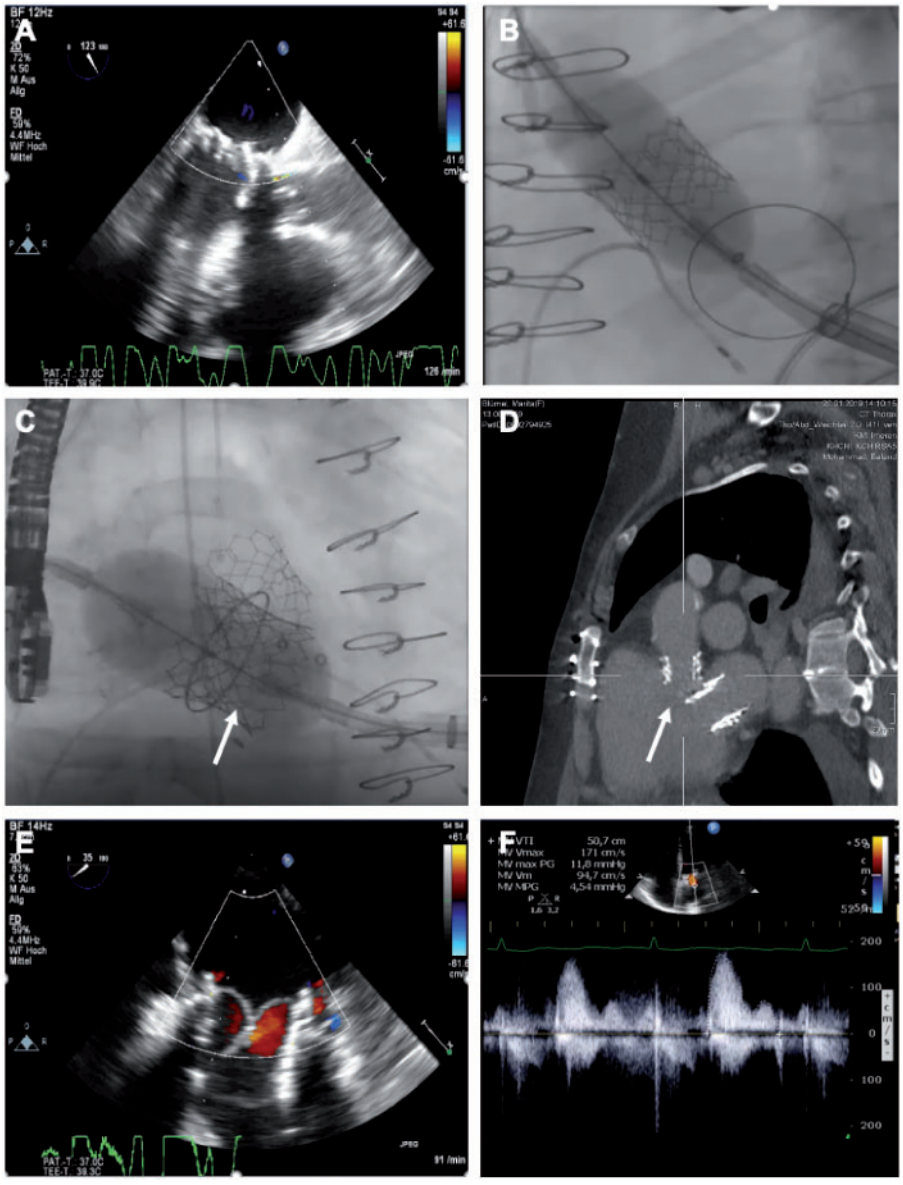

Figure 1 (*A*) Bioprosthetic mitral stenosis and native aortic stenosis on echocardiography preoperatively. (*B*) Deployment of S3 transcatheter aortic valve replacement valve in aortic position. (*C*) Valve-in-valve mitral procedure; note: the new stent (white arrow) is not deeper in left ventricle compared to bioprosthetic struts. (*D*) Postoperative computed tomography scan revealing two well-positioned prostheses. The white arrow indicates the new LVOT. (*E* and *F*) Mitral valve assessment with competent valve after 6 months.

(MPG) 12 mmHg, area 1.9 cm^2. The biological mitral valved stent indicated no mitral regurgitation (MPG 5 mmHg), the tricuspid valve showed again severe regurgitation with a decreased systolic pulmonary artery pressure of 45 mmHg (*Figure 1E and F*). The patient improved to NYHA II.

Discussion

The term V-i-V referred to transcatheter heart valve implantation in a degenerated implanted bioprosthesis.[1] The first aortic V-i-V implantation using a CoreValve system in an 80-year-old patient was reported by Wenaweser *et al.*[2]

Walther *et al.* initiated the concept of mitral V-i-V implantation in 2007. He carried out his trials in seven pigs.[1] Cheung *et al.*[3] carried out the first transapical transcatheter mitral V-i-V implantation in humans with a 26 mm Cribier-Edwards transcatheter valve in a mitral xenograft in 2009.

The trials mentioned above led to a huge and rapid evolution of transcatheter implantation with V-i-V procedures.[4] In 2010, Roberts *et al.* carried out the first trial of transatrial transcatheter tricuspid V-i-V implantation.[5] Patients with high risk of redo-surgery could benefit

from these procedures. Only a few case reports exist for a one-step double-valved stent implantation technique. Bauernschmitt *et al.*[6] already described a case of a double-valved stent implantation via a transapical access in 2017. The TMVR was conducted in a native, highly calcified mitral valve prior to TAVR. After initially good valve function the mitral valved stent migrated to the left atrium and the patient received a conventional mitral valve replacement afterwards. A different access site was reported in a case report by Bashir *et al.*[7] They performed a trans-femoral TAVR and a consecutively transseptal TMVR. Post-implant TOE showed trace paravalvular mitral and aortic regurgitation with a small remaining atrio-septal shunt without long-term follow-up.

To the best of our knowledge, our case report represents the first implantation of a double-valved stent in an aortic native valve and V-i-V redo mitral valve in a patient at high risk of redo-operation, especially with a previous history of multiple re-operations of the mitral valve due to endocarditis associated with a high risk of cerebral bleeding. The postoperative follow-up and results were satisfactory and represent a potential to increase such interventions.

Conclusions

After careful selection of high surgical risk patients and evaluation by experienced heart teams, combined native stenotic aortic and redo mitral valve can be replaced by transcatheter valves using transapical access.

Lead author biography

Georg Lutter has a surgical professorship at the University Medical Center Schleswig-Holstein, Campus Kiel, Germany. He is Chair for Experimental Cardiac Surgery and Heart Valve Technologies at the Christian-Albrechts-University of Kiel, Germany. His main interests are innovative transcatheter mitral, tricuspid, aortic, and tissue engineered pulmonary valved stent technologies. He and Dr Lucian Lozonschi invented the TMVR Tendyne technology.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

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Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: D.F. is a consultant of Medtronic and Edwards Lifesciences and G.L. of Abbott and Medtronic. All other authors declared no conflict of interest.

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