

# Two ‘firsts’ in a patient with tricuspid valve infective endocarditis following edge-to-edge repair: a case report

Alexandru Patrascu <sup>1,2\*</sup>, Donat Binder<sup>1</sup>, Feraas Al Farwan<sup>1</sup>, Kai Weinmann<sup>1</sup>, and Ilka Ott<sup>1</sup>

<sup>1</sup>Department of Cardiology, Helios Hospital Pforzheim, Kanzlerstrasse 2-6, Pforzheim 75175, Germany; and <sup>2</sup>Private University in the Principality of Liechtenstein (UFL), Triesen, Principality of Liechtenstein

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## Background

Tricuspid regurgitation (TR) is associated with increased morbidity and mortality. As many elderly TR patients are deemed inoperable, transcatheter edge-to-edge repair (T-TEER) is arising as a viable treatment option. Though procedural safety aspects seem excellent, long-term risks cannot be ignored, including the feasibility of cardiac pacing by endovascular lead implantation at a later time, as well as T-TEER device-related infective endocarditis (IE), in the context of systemic infection.

## Case summary

We present the case of an 80-year-old man with recurrent admissions for right heart failure due to massive TR, despite successful percutaneous mitral valve repair. The patient was turned down for surgery and eventually underwent T-TEER, with successful TR reduction to mild-to-moderate and improvement in quality of life. Five months later, the patient was admitted for symptomatic bradycardia and the first reported pacemaker implantation after T-TEER with a specific tricuspid valve device was performed. Lead implantation was guided by transoesophageal echocardiography, and did not worsen residual TR. Two years later, the patient presented with device-related tricuspid valve IE, again a ‘first’ following T-TEER. Despite antimicrobial therapy, the vegetation embolized through the atrial septal defect caused by prior mitral-TEER and triggered an ischaemic stroke. Furthermore, sepsis led to multiorgan failure and eventually death.

## Discussion

Tricuspid regurgitation is an individual predictor of morbidity and mortality, frequently found in elderly, and should be addressed in symptomatic inoperable patients. With the rise of interventional treatment, new challenges face long-term follow-up and treatment after percutaneous repair. This case report underscores the feasibility of endovascular pacemaker lead implantation after T-TEER, while it points to the risk of device-related tricuspid valve IE.

## Keywords

Tricuspid valve • Infective endocarditis • Transcatheter edge-to-edge repair • Pacemaker lead implantation • Case report

## ESC curriculum

5.7 Bradycardia • 4.5 Tricuspid regurgitation • 2.2 Echocardiography • 4.11 Endocarditis

## Learning points

- Endovascular pacemaker lead implantation after transcatheter edge-to-edge repair for tricuspid regurgitation is feasible and should be guided by transoesophageal echocardiography.
- Device-related tricuspid valve infective endocarditis after interventional treatment should be ruled out in the case of systemic infection with no clear focus. A thorough diagnostic workup, including imaging studies and blood cultures, is essential.

\* Corresponding author. Tel: +49 7231 969 3436, Email: [ionut.patrascu@helios-gesundheit.de](mailto:ionut.patrascu@helios-gesundheit.de)

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## Introduction

Tricuspid transcatheter edge-to-edge repair (T-TEER) is an emerging treatment option<sup>1</sup> in symptomatic inoperable patients with high-grade tricuspid regurgitation (TR). Since the first procedures with off-label mitral valve devices in 2016, and CE-marking of the first tricuspid valve (TV) specific device in 2020,<sup>2</sup> T-TEER has shown safety and efficacy in reducing TR, while improving quality of life (QoL).<sup>3</sup> Nonetheless, as with any novel procedure, many questions remain unanswered, whether regarding patient selection or procedural aspects. Among the unsolved puzzles, this case report addresses two important

## Summary figure

Date	Events
Past medical history	<ul style="list-style-type: none"> <li>• Recurrent hospitalizations for acute heart failure between July 2017 and July 2019</li> <li>• Continuous progression of mitral (MR) and tricuspid regurgitation (TR) despite optimal medical therapy</li> <li>• Transcatheter mitral valve edge-to-edge repair (M-TEER) December 2019 with reduction to moderate MR</li> <li>• Repeat M-TEER December 2019 with MR reduction to trivial</li> </ul>
Day 0 (December 2020)	<ul style="list-style-type: none"> <li>• Transcatheter tricuspid valve edge-to-edge repair (T-TEER) due to persisting NYHA II shortness of breath and peripheral oedema, in spite of 2x M-TEER</li> <li>• TR reduction from massive [effective regurgitant orifice area (EROA) 108 mm<sup>2</sup>, regurgitant volume 97 mL, vena contracta 19 mm] to mild-to-moderate (EROA 20 mm<sup>2</sup>, vena contracta 4 mm)</li> </ul>
30-Day follow-up	<ul style="list-style-type: none"> <li>• Trivial MR, mild-to-moderate TR</li> <li>• Improvement in quality of life (QoL), NYHA I, no more peripheral oedema</li> </ul>
6-Month follow-up	<ul style="list-style-type: none"> <li>• Symptomatic bradycardia</li> <li>• Pacemaker lead implantation with TOE guidance</li> </ul>
12-Month follow-up	<ul style="list-style-type: none"> <li>• No change in MR and TR, good pacemaker parameters, good QoL</li> </ul>
30 months after T-TEER	<ul style="list-style-type: none"> <li>• Hospitalization for sepsis/<i>Staphylococcus aureus</i> bacteraemia with unclear focus</li> <li>• T-TEER device-related tricuspid valve infective endocarditis</li> <li>• Cerebral vegetation embolization through previous atrial septal defect (after 2x M-TEER)</li> <li>• Fulminant sepsis with multiorgan failure and death</li> </ul>

## Case presentation

An 80-year-old man with known massive functional TR (grade IV°/V°)<sup>7</sup> was referred for T-TEER, based on shortness of breath New York Heart Association (NYHA) functional class III, multiple hospitalizations for right-sided acute heart failure, poor response to optimal medical therapy, and prohibitive surgical risk (EUROSCORE II 14.5%, STS-Score 8.3%), as assessed by the Heart Team. The patient had undergone M-TEER twice, 6 and 12 months prior, which eventually successfully treated mitral regurgitation, but had little to no effect on the massive TR ([Figure 1](#), [Supplementary material online, Video S1](#)). His medical history included also permanent atrial fibrillation, stage 3B chronic kidney disease, arterial hypertension, and peripheral artery disease.

Upon admission, physical examination showed marked peripheral oedema despite high-dose diuretics, jugular vein distension, and an irregular heart beat. The patient had low QoL (Kansas City Cardiomyopathy Questionnaire, KCCQ-12 Score, 57.2 points), impaired 6 min walk distance (6MWD) of 250 m, and high NTproBNP of 2354 pg/mL. Echocardiography confirmed massive TR ([Figure 1](#)), as measured by biplane vena contracta of 19 mm, proximal isovelocity surface area (PISA) of 11 mm, effective regurgitant orifice area (EROA) of 108 mm<sup>2</sup>, and regurgitation volume of 97 mL. Furthermore, signs

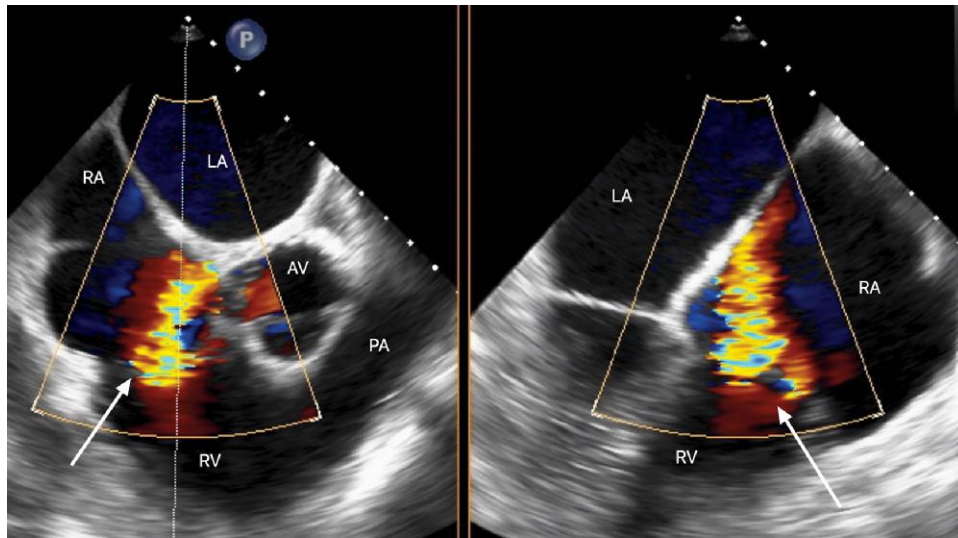
T-TEER issues. First, the impact of pacemaker leads (PL) on TR and different strategies to deal with them are currently the subject of intensive discussions, especially whether PL should first be extracted or if TEER is even the best approach for such cases.<sup>4</sup> However, the opposite appears equally important, that is, whether PL implantation after T-TEER is even possible considering the reduced TV area, and if so, how should it best be performed. Second, as with any valve procedure, the risk of developing infective endocarditis (IE) is not negligible. We know that IE following M-TEER (mitral) is a rare occurrence,<sup>5</sup> and that right-sided IE, in general, only accounts for 5–10% of all IE cases,<sup>6</sup> but data and case reports for T-TEER are lacking.

of right heart cardiac remodelling were present, with enlarged right atrium (RA) of 101.5 mL/m<sup>2</sup> indexed volume, increased right ven-

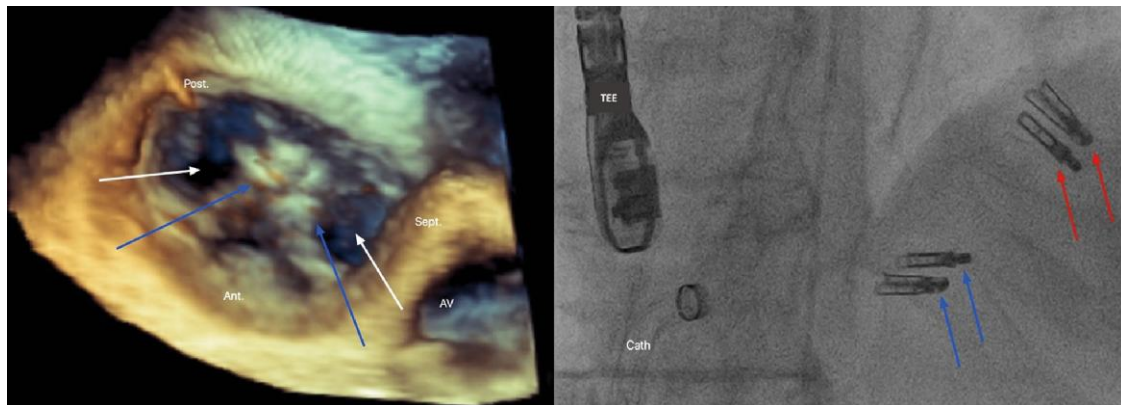
tricular (RV) basal diameter (50 mm) and dilated TV annulus (47 mm). Moreover, RV function was impaired [tricuspid annular plane systolic excursion (TAPSE) 10 mm, fractional area change (FAC) 30%] and RV systolic pressure increased (32 mmHg).

Transcatheter edge-to-edge repair addressed both the gap of 10 mm and the main jet arising from the antero-septal commissure, which was the site of implantation of 2 XT TriClips™ (Abbott Medical), the thickest and widest CE approved clips available in December 2020. This created two orifices by bicuspidalization of the TV ([Figure 2](#), [Supplementary material online, Video S2](#)), with TR reduction from massive (IV°/V°) to mild to moderate (I–II°/V°), while the transvalvular gradient only rose to 1.5 mmHg ([Figure 3](#), [Supplementary material online, Video S3](#)). The procedure and hospital stay were uneventful, with third post-operative day discharge.

Thirty-day follow-up showed persistent good result, while the patient reported symptom relief, increased QoL (NYHA III to II, KCCQ-Score 57.2–77.5 points) and functional capacity (6MWD from 250 to 350 m). Both RV systolic function (TAPSE 10–18 mm, FAC 30–45%) and glomerular filtration rate improved (50.4–67.5 mL/min/1.73 m<sup>2</sup>), while RA indexed volume decreased (101.5–84.7 mL/m<sup>2</sup>). Unfortunately, five months later, he was readmitted with recurrent syncope and was found to have bradycardia below 40 beats per minute, on the basis of longstanding atrial fibrillation. He had no antiarrhythmic drugs



**Figure 1** Biplane transoesophageal orthogonal images show massive functional tricuspid regurgitation (white arrow) before transcatheter repair. RA, right atrium; LA, left atrium; AV, aortic valve; PA, pulmonary artery; RV, right ventricle.

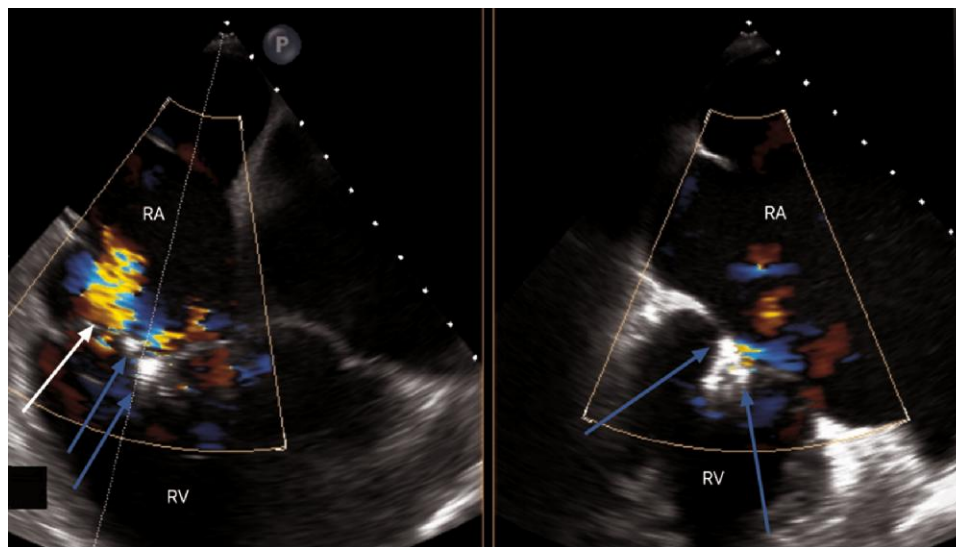


**Figure 2** Position of clips at procedure end. Left image: 3D view of tricuspid valve with central position of both devices (blue arrows) and remaining valve orifices after 'bicuspidalization' (white arrows). Right image: fluoroscopy view after deployment of both tricuspid devices (blue arrows), also showing previous implanted mitral clips (red arrows). TEE, transoesophageal echocardiography; AV, aortic valve.

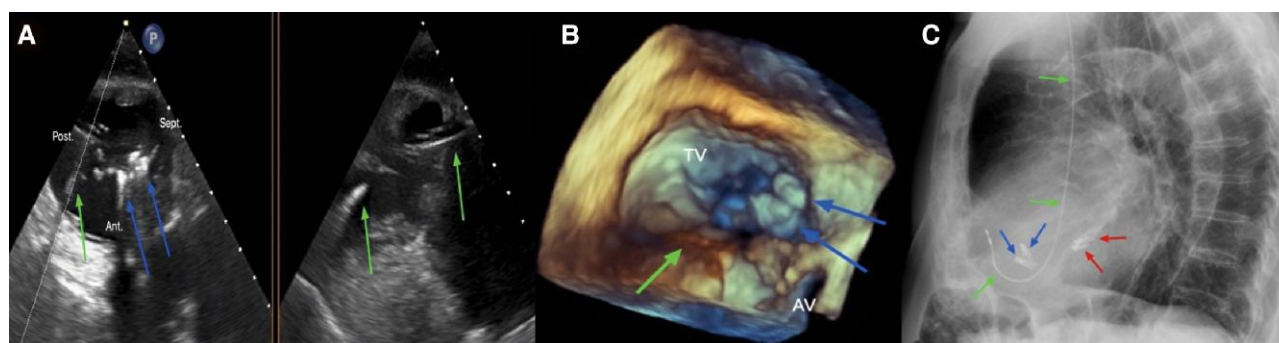
or any other plausible explanation for his slow heart rhythm. The indication for implantation of single chamber pacemaker was obvious, but concerns were raised due to the previous implanted TriClips™, both not to dislodge them, nor to increase the transvalvular gradient. For this reason, PL insertion was performed under transoesophageal echocardiography (TOE) guidance and a lateral course between the anterior and posterior leaflets was chosen (Figure 4, Supplementary material online, Video S4). Fortunately, the lead did not interfere with the clips or residual TR, which in turn remained unchanged. No further increase in transvalvular gradient was seen, and regular lead values were recorded. At that time, June 2021, this was the first reported case of PL implantation after T-TEER with the TriClip™ system.<sup>8</sup>

The patient remained oligosymptomatic for the following two years, until September 2023 he was readmitted with fever, productive cough,

and confusion, under the presumption of community-acquired pneumonia. Head-CT was negative, while chest X-ray showed no clear infiltrates. Three days into the hospital stay, his condition got worse under anti-infective therapy with piperacillin-tazobactam (3 × 4.5 g daily). Transoesophageal echocardiography was ordered, which showed very good long-term result after 2× M-TEER, but worsened residual TR (III°/V°) with jets coming from both orifices. More importantly, a mobile mass was present on the posterior TV leaflet on the atrial side, closer to the commissure than the centrally implanted clips (Figure 5, Supplementary material online, Video S5). This irregular inhomogeneous structure of ~1.6 cm length protruded through the TV and made contact with the more posterior placed clip, but not the PL. The IE suspicion was reinforced by positive blood cultures for *Staphylococcus aureus*.



**Figure 3** Modified midesophageal biplane view shows final procedural result, with reduction of massive tricuspid regurgitation to mild-to-moderate (white arrow) after implantation of two clips (blue arrows). RA, right atrium; RV, right ventricle.



**Figure 4** Multimodality imaging by transgastric biplane view (A), 3D tricuspid valve view (B), and fluoroscopy (C) shows lateral commissural course of pacemaker lead (green arrows), with considerable distance to both tricuspid clips (blue arrows). Also notice both mitral clips (red arrows). TV, tricuspid valve; AV, aortic valve.

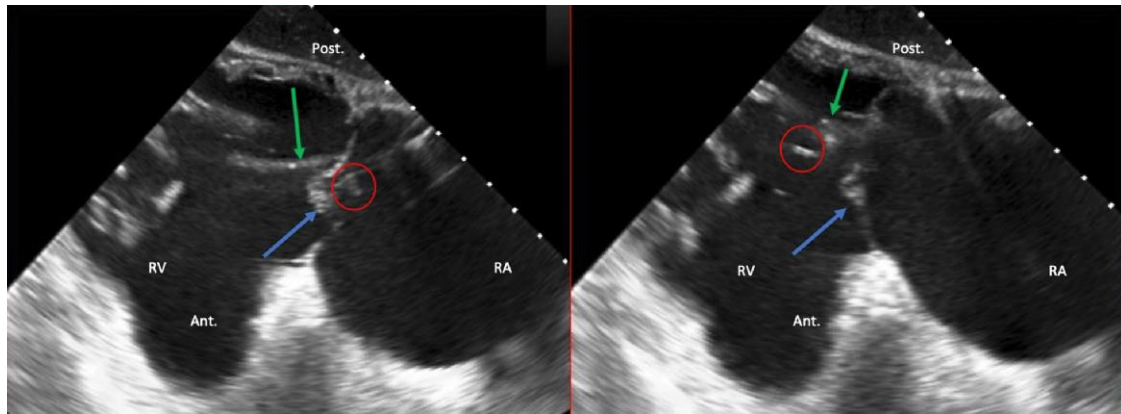
Initial empiric antimicrobial therapy was subsequently switched to intravenous flucloxacillin ( $6 \times 2$  g daily) and rifampicin (900 mg daily), considering the antibiogram and renal function decline. The patient and his legal guardian decided against surgery. Within the following week, he went from slight initial confusion to severe mental impairment. A follow-up head-CT showed cerebellar ischaemia, while on repeat-TOE, the vegetation was not present any more, which raised the suspicion of cardioembolic stroke in the presence of TV endocarditis and residual atrial septal defect after 2x M-TEER. Despite our best efforts, the patient's condition deteriorated and he eventually succumbed to the disease.

## Discussion

We report the case of T-TEER in a symptomatic patient with high-grade TR, turned down for surgery by the Heart Team, that improved his QoL after successful TR reduction. Despite implantation of two rather 'bulky' devices (XT TriClip™), RV PL implantation was possible

and did not affect TR or TV mean gradient. We did however cross the TV and position the PL TOE-guided, which we highly recommend. Since our first report on pacemaker implantation after T-TEER with the TriClip system,<sup>8</sup> other case reports<sup>9</sup> confirmed the feasibility of endovascular PL placement. Therefore, we see no reason why T-TEER patients with pacemaker indications should receive an epicardial PL. Moreover, considering the large TV annulus, usually further enlarged in TR patients, the remaining orifices after percutaneous therapy are large enough to let even thicker devices through e.g. a leadless pacemaker.<sup>10</sup>

This case report also highlights the danger of IE in these multimorbid very sick inoperable patients with high-grade TR. Though very seldom,<sup>11,12</sup> right heart IE should be ruled out in all patients with systemic infection unresponsive to antibiotics, in the presence of foreign material e.g. central catheters, PL, TV prosthesis, or implanted devices. Currently, there are no reports on how to approach T-TEER associated IE. Data on the timing of endocarditis, common pathogens, and treatment outcomes are needed.



**Figure 5** Transgastric long axis right ventricular view depicts right atrial mobile mass (red circle) protruding during diastole into the right ventricle. The suspected vegetation comes in contact with one of the clips (blue arrow), but apparently not with the pacemaker lead (green arrow). RA, right atrium; RV, right ventricle.

In conclusion, endovascular PL implantation after T-TEER is feasible and should be guided by TEE, while IE is possible and should be thought off in the presence of systemic infection.

## Lead author biography



Alexandru Patrascu is a young interventional cardiologist working as an attending doctor at the Helios Hospital in Pforzheim, Germany. After completing his training in general cardiology in Robert Bosch Hospital, Stuttgart, Germany, he was awarded the EAPCI grant and started his interventional career in Georges Pompidou, Paris, France. After a second fellowship in interventional and structural cardiology at the Andreas Gruentzig Heart Cath Laboratories, Zurich, Switzerland, he joined the interventional team of the academic hospital in Pforzheim. His research interests include the percutaneous treatment of valvular heart disease, in particular tricuspid transcatheter edge-to-edge repair.

## Supplementary material

[Supplementary material](#) is available at *European Heart Journal – Case Reports* online.

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**Consent:** The authors confirm that written consent for submission and publication of this case report including images and associated

text has been obtained from the patient before his death, and that his consent was in line with COPE guidance.

**Conflict of interest:** None declared.

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## Data availability

Data available on request: the data underlying this article will be shared on reasonable request to the corresponding author.

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