First case of pacemaker implantation in a patient with previous percutaneous edge-to-edge tricuspid valve repair

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Introduction

High-degree atrioventricular block (AVB) is common in elderly patients and in patients with other cardiac comorbidities and represents the most frequent indication for permanent pacemaker implantation.[1] Conventional cardiac implantable electronic devices (CIED), including pacemakers and defibrillators, are implanted transvenously in the right cardiac chambers, with 1 or more leads crossing the tricuspid valve to reach the right ventricle (RV).[2]

Severe tricuspid valve regurgitation (TR) is a condition leading to poor outcomes, often related to left-side valvular disease or pulmonary hypertension.[3] Transcatheter tricuspid valve repair is an emerging and promising treatment option in symptomatic patients with significant TR with high surgical risk.[4]

CIED implantation in patients previously treated for tricuspid valve disease with transcatheter tricuspid valve repair devices may be challenging because of the presence of the corrective device in the tricuspid valve, potentially compromising the feasibility to reach the RV with the CIED leads. Implantation of permanent pacemaker in a patient treated with a transcatheter tricuspid valve repair device has never been described before.

We report the first case of successful implantation of a standard dual-chamber transvenous pacemaker in a patient previously treated with percutaneous edge-to-edge tricuspid valve repair with TriClip system (Abbott Medical) for severe TR.

KEYWORDS Implantation; Lead; Pacemaker; Percutaneous; Transcatheter; TriClip; Tricuspid; Valve
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Case report

A 61-year-old man with arterial hypertension and diabetes came to our attention for sudden syncope. Previous medical history was positive for 3 prior malignancies, all previously treated, with good long-term follow-up: Hodgkin lymphoma; *lung adenocarcinoma* (undergone pulmonary lobectomy), and prostate cancer. He also suffered from a previous inferior acute myocardial infarction treated with percutaneous coronary angioplasty of the right coronary artery. In 2019 he underwent aortic valve replacement with bioprosthesis for severe aortic stenosis / regurgitation and concomitant dual coronary artery bypass graft (left internal mammary artery for left anterior descending coronary artery and saphenous vein for obtuse marginal branch). During the follow-up he developed a severe TR owing to annular dilatation from adverse right ventricular remodeling and became symptomatic for exertional dyspnea despite incremental medical therapy with diuretics. In May 2021, owing to high cardiac surgery risk, the patient was successfully treated with percutaneous transcatheter implantation of a single TriClip XT device (Abbott Medical) in posteroseptal commissure. The procedure outcome was good, and the degree of TR improved from severe to mild without tricuspid stenosis. During the first months of 2021 the patient suffered 2 further episodes of unexplained syncope *and an implantable loop recorder* was placed (Medtronic LINQ). In July 2021, the patient came to our attention for a further episode of syncope, traumatic, for which he was admitted to our hospital. In the emergency department the patient was asymptomatic. The electrocardiogram showed sinus rhythm with normal heart rate and no conduction block. Blood samples, serum electrolytes, chest and abdominal computed tomography, head computed tomography, and electroencephalogram were normal. A few hours after the admission the patient had another syncope, during which the electrocardiographic monitoring showed third-degree AVB with ventricular escape rhythm at 35 beats per minute. The implantable loop recorder interrogation revealed that a similar episode of paroxysmal AVB occurred during the syncope. A transthoracic echocardiogram (TTE) was performed in the

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KEY TEACHING POINTS

- Transcatheter tricuspid valve repair is an emerging and promising treatment option in symptomatic patients with significant tricuspid valve regurgitation with high surgical risk.
- Good visualization of the TriClip device (which commissure anteroseptal or posteroseptal, is involved?) and tricuspid valve function (degree of stenosis/regurgitation) are key pieces of information to adequately plan the pacemaker implantation. If transthoracic echocardiogram views are poor, intracardiac or transesophageal echo should be used.
- After crossing the tricuspid valve, the ventricular lead has to be placed in a good septal position. To do this, a new preformed stylet (3D curve) is needed.
- Standard transvenous pacemaker implantation in a patient with previous percutaneous edge-to-edge tricuspid valve repair is feasible and safe.

cardiovascular intensive care unit after patient admission. The patient had very good acoustic windows (weight 62 kg; height 162 cm; body mass index 23.6 kg/m^2) and from a modified left parasternal long axis and apical and subcostal windows we were able to identify and confirm the position of the TriClip device at the level of the posteroseptal commissure between posterior and septal tricuspid valve leaflets with mild TR and no stenosis. TTE also showed preserved left ventricular ejection fraction, mild right ventricular dilation, and normal aortic prosthetic valve function.

Permanent pacemaker implantation was indicated. We decided to implant a conventional pacemaker mainly for 2 reasons: (1) the ventricular lead was maneuverable and flexible (without the stylet); and (2) the stylet could be shaped with a 3D curve as we needed/decided. According to international recommendations and under appropriate antibiotic therapy,[2,5] surgical incision of the deltoidopectoral groove was performed to gain access to the cephalic vein (direct cut-down) and axillary vein (eco-guided puncture) as our usual practice. A ventricular lead was inserted via the cephalic vein to the heart. In order to cross the valve, the lead stylet was manually curved (Figure 1). TTE showed the anterior tricuspid leaflet was free to move, so we planned to cross the valve anteriorly. The ventricular lead was advanced to the superior vena cava–right atrium junction and then the first stylet (soft and straight) was removed and shaped. A smooth, single plain large curve was manually obtained to cross the tricuspid valve at anterior leaflet level. First, posteroanterior and left anterior oblique views confirmed the anterior position of the lead tip. Then, in right anterior oblique fluoroscopic view the ventricular lead was advanced into the RV. Despite our concerns, after 2 attempts the lead crossed the tricuspid valve and was advanced to the right ventricular outflow tract. The TriClip device was still in the correct position. After that, a new stiff straight stylet was molded: the shape was similar to the first stylet used but with an additional distal 90° posterior curve in the last 2 cm to reach a good septal position. The second stylet was advanced. The ventricular lead was withdrawn from the right ventricular outflow tract with counterclockwise rotation and after a "jump" the lead was advanced to the inferior midapical ventricular septum (Figure 1, left side). The septal position of the tip was confirmed with a 40° left anterior oblique view as per our standard practice.

The lead tip was screwed to the midapical septum, showing optimal parameters of sensing, impedance, and pacing thresholds. No noise artifacts were detected during

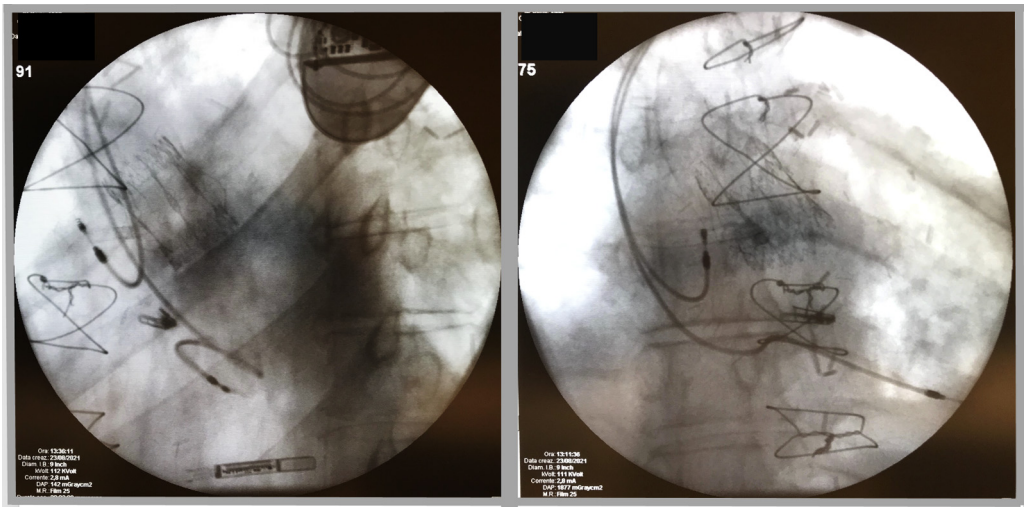

Figure 1 Fluoroscopic images showing no contact between ventricular lead and TriClip device.

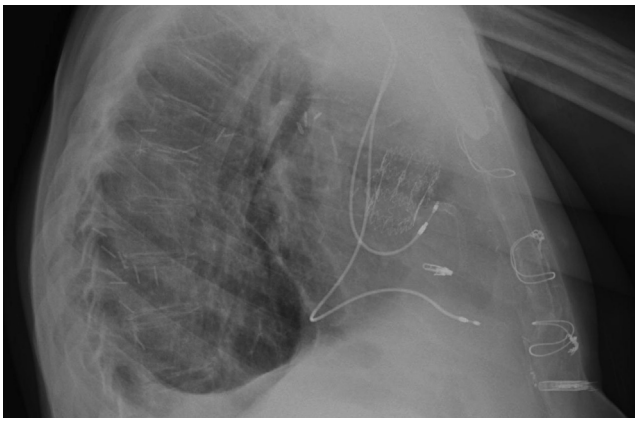

Figure 2 Postoperative chest radiograph showed the final position of the leads and the relationship of ventricular lead with the TriClip device.

ventricular lead placement and at the follow-up, even with low sensitivity. The atrial lead was inserted via the axillary vein in the right atrial appendage by a conventional way. The device, connected to the 2 leads, was implanted in the subcutaneous pocket.

Postoperative chest radiographs showed the final position of the leads and no contact between ventricular lead and the TriClip device (Figure 2).

An echocardiographic examination after the procedure confirmed the correct position of both leads and confirmed only a mild residual TR (Figure 3).

Electronic control of pacemaker after 24 hours confirmed optimal sensing, impedance, and pacing threshold parameters. The patient was then discharged 2 days later, asymptomatic, and is doing well since. At the 1-month visit the patient did very well. We performed a new TTE and the TR was the same. After 2 months, clinical status of the patient was stable and unchanged.

Discussion

Significant TR is an uncommon but serious problem with few effective treatment options. Prognosis in patients with untreated severe TR remains poor, and conventional surgery carries significant mortality and morbidity risk despite different etiologies.[6] Within the different etiologies, the prevalence of secondary (functional) TR is

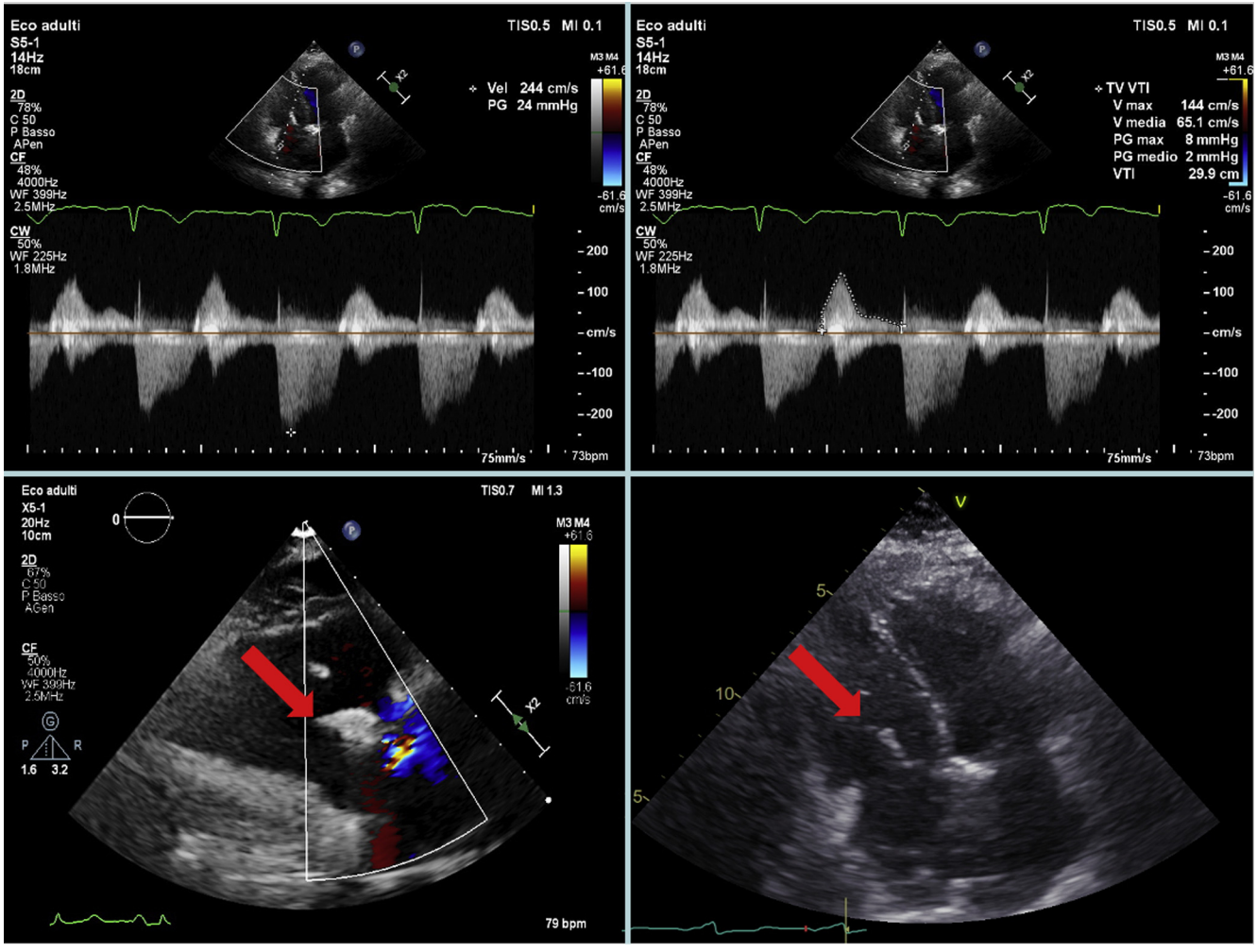

Figure 3 Postoperative transthoracic echocardiogram showing a mild residual tricuspid valve regurgitation. The 2 red arrows show the correct position of the TriClip device after the procedure.

increasing, mainly owing to mitral valve disease or ischemic left heart failure that causes strain on the left ventricle and secondary effects on the tricuspid valve. Owing to unsatisfactory results of isolated tricuspid valve surgery with a perioperative mortality rate of 8%–10%,[7,8] surgical treatment is often withheld from patients, leading to an increasingly underserved population of patients with relevant TR. Transcatheter tricuspid repair has recently emerged as a feasible treatment option in patients with significant TR deemed at high risk for surgery. More than 300 procedures have been performed worldwide until now, and preliminary results are promising.[9,10] After a cardiac operation, 0.4%–28% of patients need to be treated with a permanent pacemaker. The incidence is less than 1% after coronary artery bypass graft and 3%–6% after valve interventions and increases with age.[11] The implantation of CIED, mostly pacemakers, after tricuspid valve treatment involves technical difficulties that must be known to the implanters in order to select the best technical option. Several approaches have been reported—epicardial leads, standard endocardial leads, or coronary sinus leads[12]—but no one of these techniques has proven to be a better solution. In patients with previous tricuspid valve surgery, permanent pacemaker or implantable cardioverter-defibrillator implant are still a huge challenge. Echocardiography-guided insertion of ventricular and atrial leads was previously described in different case reports.[13,14] Transesophageal and intracardiac echocardiography are capable to describe cardiac anatomy and to identify in real time lead position, so echo-guidance could represent a useful tool in difficult cases.

Our case report represents, to the best of our knowledge, the first description of CIED implantation in a patient previously treated with nonconventional tricuspid intervention and in particular with transcatheter valve repair by means of a device left in site. The description of our case could be helpful for clinicians facing CIED implantation in this kind of patients. We found that the procedure was successful and safe, but this is a single case and more data are needed to assess safety during longer follow-up.

Conclusion

Conventional transvenous pacemaker implantation in a patient with previous transcatheter tricuspid valve repair was feasible and safe. Our experience could be useful for physicians treating patients after percutaneous tricuspid interventions.

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