Transcatheter pacing system and leadless defibrillator: A solution in a complex case. A case report of a patient with previous device-related infection and persistent left-sided superior vena cava

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Introduction

Persistent superior vena cava is a rare (about 0.3%–0.4% of general population)[1–3] congenital vascular anomaly. Nevertheless, it could cause difficulties in implantation of cardiac devices, preventing in some cases the successful positioning of cardiac leads. New leadless device technologies have been recently introduced to minimize or eliminate the acute and chronic complications related to the leads, the pocket-based generator of traditional transvenous systems, and the access to the superior venous system.[4–7]

We describe the first case of successful implantation of a combination of a transcatheter pacing system (TPS) and a subcutaneous implantable cardioverter-defibrillator (S-ICD) in a patient with previous device-related infection and persistent left-sided superior vena cava (PLSVC).

Case report

We present the case of a 70-year-old man suffering from hypertension, postischemic cardiomyopathy, diabetes, and paroxysmal second-degree atrioventricular block (AVB). The patient was also symptomatic both for heart failure in NYHA class II and reduced left ventricular ejection fraction (LVEF = 25%). In August 2015, a dual-chamber ICD was successfully implanted on the right side because a venography showed a venous anomaly, the PLSVC, on the left side. In April 2018, an echocardiogram showed reduced ventricular function (LVEF = 30%), left ventricular diastolic volume 157 mL, left ventricular diastolic diameter 61 mm, and a left atrium with a diameter equal to 42 mm.

In January 2020, the patient had an unplanned emergency room visit owing to serious device pocket infection and was subsequently admitted to hospital for device and lead removal.

KEY TEACHING POINTS

- The implantation of a transcatheter pacing system (TPS) in a patient with persistent left superior vena cava following explant of a right-sided dual-chamber implantable cardioverter-defibrillator secondary to endocarditis seems to be safe and feasible.
- In a patient with a wide coronary sinus ostium owing to the persistent left superior vena cava, the use of a placeholder such as a temporary pacing lead is suggested to target the right ventricle apex and to avoid an accidental entrance into the coronary sinus ostium.
- In our case report, the coexistence of subcutaneous defibrillator and Micra TPS (Medtronic Inc, Minneapolis, MN) is safe. During the implantation, tests are needed to prove the possible presence of any cross-talk or interference.

After extraction of the leads, in addition to paroxysmal second-degree AVB, the patient presented a system conduction disturbance including symptomatic first-degree AVB, indicating the need for permanent pacing without indication for cardiac resynchronization therapy owing to the low percentage of ventricular pacing (<20%).[8] The patient was started on intravenous vancomycin and gentamicin to treat *Staphylococcus epidermidis*, the bacteria found in the wound cultures.

The computed axial tomography examination confirmed the presence of PLSVC and a very thin right-side superior vena cava (Figure 1). Nevertheless, a left-side implant of traditional dual-chamber ICD was attempted without success 5 days later.

On January 20, 2020, the S-ICD (Emblem; Boston Scientific Corp, St Paul, MN) was successfully implanted

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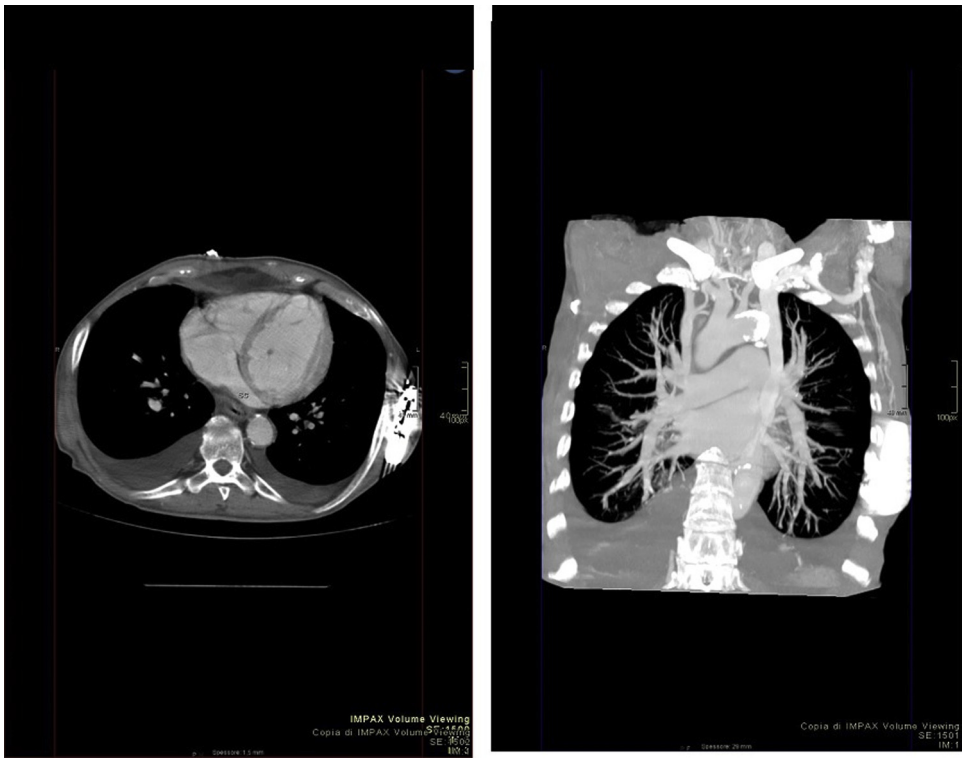

Figure 1 The computed axial tomography showed the left-sided persistent vena cava.

using a 2-incision technique. Device testing revealed adequate sensing of all 3 electrograms in the primary, secondary, and alternate vectors.

After 4 days, implant of a TPS (Micra Transcatheter Pacing System; Medtronic Inc, Minneapolis, MN) via right femoral vein was attempted. At the beginning of the procedure, the interaction of the 2 programmers was tested, and no interference in the telemetry was found. A temporary pacing lead was placed in the apex of the right ventricle, via left femoral vein, and it was a useful landmark for the delivery system of the TPS. In fact, it was necessary, under the guidance of X-rays in the 30° left view, to first gently rotate clockwise the introducer of the TPS to go through the tricuspid valve and then make a counterclockwise rotation to avoid the large coronary sinus ostium. The TPS was successfully fixed in the septum of the right ventricle without any complication (Figure 2). Stability of device tine fixation was tested by gentle traction under fluoroscopic guidance. All electrical device parameters were good and were achieved at initial device placement. No cross-talk between the 2 leadless devices was seen. In particular, no interference was observed on the 3 S-ICD vectors when the TPS was programmed to higher output (Figure 3).

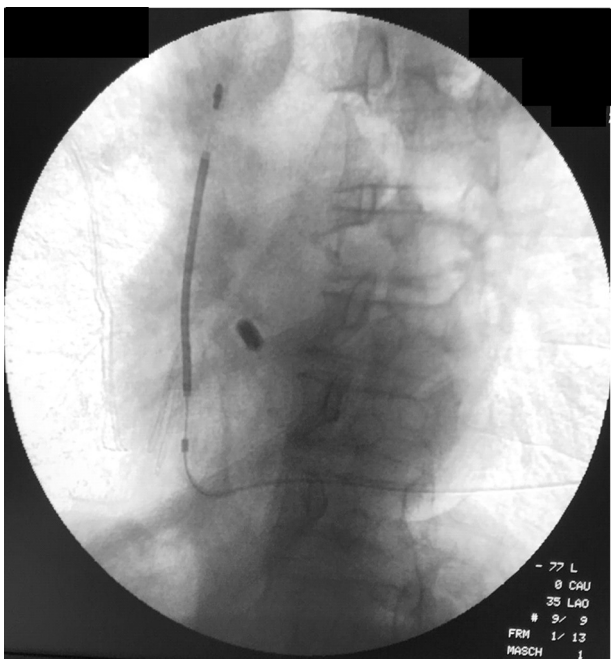

Figure 2 The 35° left anterior oblique view of X-rays radiography shows the placement of subcutaneous defibrillator and transcatheter pacing system.

At 1-month follow up, the patient was asymptomatic, device control confirmed stable electrical parameters, and echocardiogram examination showed an LVEF of 30%.

Discussion

The prior infection of permanent right-sided dual-chamber ICD and simultaneous presence of the PLSVC posed significant limitations on access for another transvenous system. For this reason, we decided for a combination of leadless systems: Micra and S-ICD. Furthermore, results from the Micra Coverage with Evidence Development (CED) Study showed that patients implanted with a leadless Micra TPS

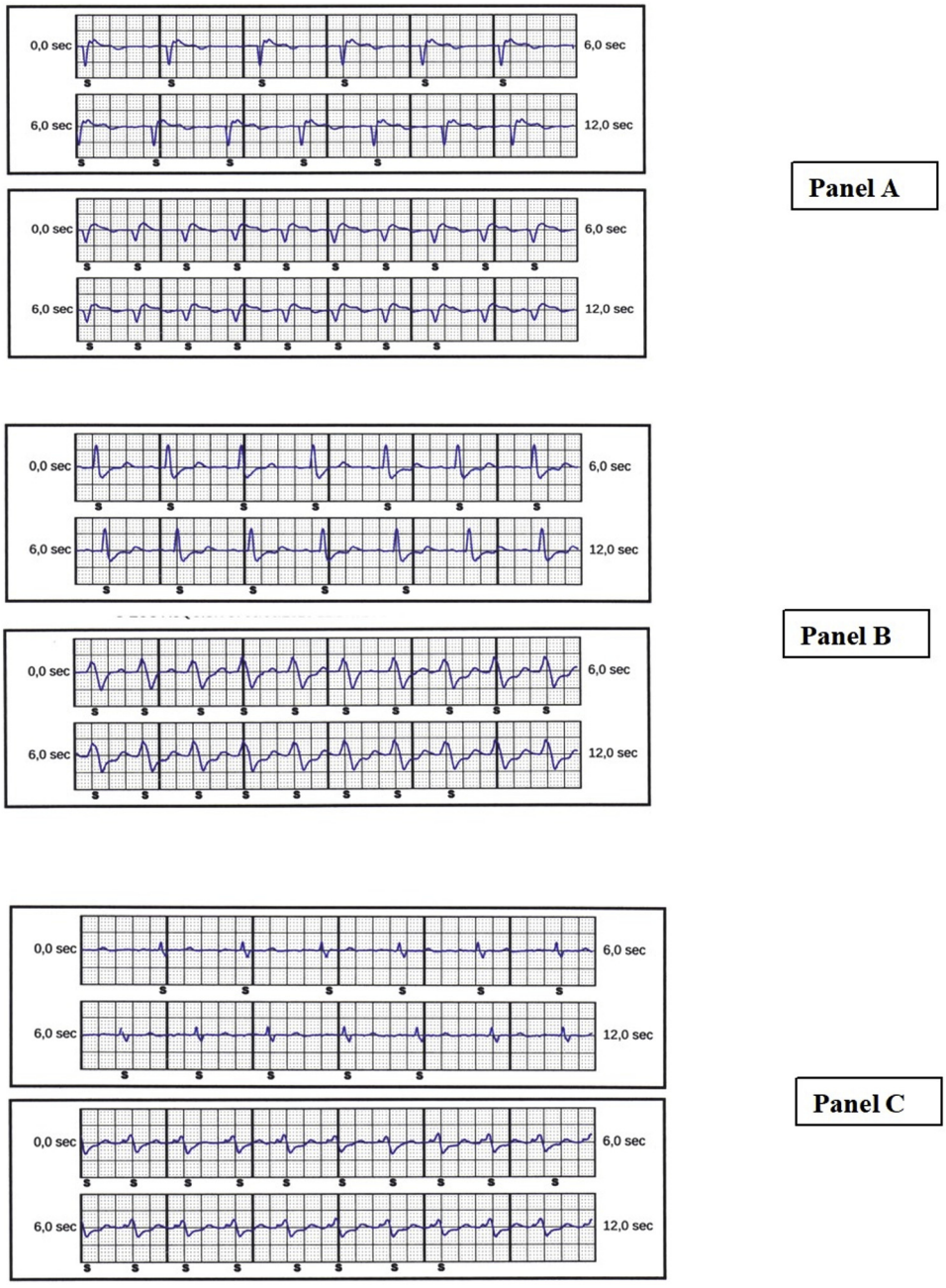

Figure 3 Electrograms of **A:** alternative vector, **B:** primary vector, and **C:** secondary vector of subcutaneous implantable cardioverter-defibrillator during spontaneous rhythm (top row of each panel) and high-voltage output of transcatheter pacing system (100 beats/min) (bottom row of each panel).

experienced a 66% reduction in chronic complications at 6 months compared with patients who received a traditional transvenous pacemaker with leads.[4,9] Micra does not require leads or a surgical "pocket" under the skin, so potential sources of complications related to leads and pockets are eliminated.[4,9]

Recently, a few case reports[10–14] have shown the feasibility and safety of coexistence between the 2 leadless devices. One of the major concerns is the possibility that TPS output can be sensed by the S-ICD, interfering with ventricular tachycardia/ventricular fibrillation detection. Therefore, we tested the presence of cross-talk during the high-voltage stimulation of TPS on the 3 vectors, and we programmed the final TPS voltage as the lowest possible according to the capture threshold. It is important to point out that select patients, including those with recurrent infections, those with vascular access limitations, and those who may be prone to transvenous lead failure, may benefit from the leadless device combination. However, further clinical studies are needed to show the safety and efficacy of this approach in a large number of patients.

The incidence of PLSVC is about 0.3%–0.4% in the general population[3] and it is reported that PLSVC is more frequently connected to the dilated coronary sinus (CS) rather than the left atrium.[2] In our case, we decided to use a temporary pacemaker during the TPS implantation procedure for 2 reasons: (1) to be ready to pace in case of AVB during the

TPS delivery system positioning, and (2) to have a placeholder in the apex of the right ventricle. The presence of PLSVC often implies a large CS ostium; we suggest the use of a temporary pacemaker, especially in the presence of PLSVC and dilated CS, to prevent the delivery system from entering the large CS ostium, with the high risk of damaging it. The temporary pacemaker lead was inserted via the left femoral vein to allow the insertion of the TPS delivery system on the right side, enabling a wider freedom of maneuvering in case of complex or unusual anatomy. Future improvements could include downsizing the size of the delivery sheath and adjustment of the sheath tip curve. In general, even in case of transvenous pacemaker implantation, the presence of PLSVC made the lead implantation more challenging for the operators, increasing the risk of periprocedural complications.[15]

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