Hybrid subcutaneous and transvenous approach for cardiac resynchronization defibrillator implant in a patient with congenital heart disease and tricuspid bioprosthetic

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Introduction

Patients with congenital heart disease and/or tricuspid valve (TV) replacement pose a challenge for device implantation owing to issues with vascular access, abnormal anatomy, and potential for valve dysfunction and infection.[1]

Transvenous implantable cardioverter-defibrillator (ICD) insertion in such patients poses particular issues owing to the larger size of the lead and presence of coil material. On the other hand, subcutaneous ICD (S-ICD) lacks pacing and resynchronization ability at this time.

Case report

A 44-year-old woman with history of ventricular septal defect and TV repair in 1972 subsequently had bioprosthetic TV replacements owing to endocarditis in 1975, 1980, and 2001 and was referred for cardiac resynchronization therapy defibrillator (CRT-D) implant based on left ventricular (LV) ejection fraction of 20%, NYHA class III, and right bundle branch block with QRS duration of 145 ms. We decided to avoid putting a defibrillator lead across the TV owing to history of recurrent infections and transvalvular mean gradient of 8 mm Hg. A Medtronic (Minneapolis, MN) CRT-D system (including leads and device) was implanted with a Select-Secure 4 French lead for right ventricle (RV) pacing, a 40396 lead in an available posterolateral vein for LV pacing, a 6937A coil for innominate coil (connected to superior vena cava port), and a 6996SQ lead in subcutaneous posterior location with the tip of the lead at the spine and connected to the RV coil port of a DF-1 CRT-D device (Model D314TRG) (Figure). The innominate coil was inserted for managing a potential high defibrillation threshold (DFT). DFT was 25 joules with and without innominate coil inclusion. LV ejection fraction improved to 45% and NYHA class to II.

KEY TEACHING POINTS

- Transvenous leads can cause tricuspid valve dysfunction.
- It may be challenging to implant a transvenous implantable cardioverter-defibrillator system in patients with tricuspid valve replacement and/or congenital heart disease.
- A subcutaneous system using an anteroposterior configuration with a lower can location with either a 4F right ventricle lead or only left ventricular coronary sinus lead can be a reasonable option.

Discussion

Patients with TV disease or prosthesis present challenges for lead implantation, including damage to valve and potential for tricuspid regurgitation or infection. Although an S-ICD avoids these problems, the current technology lacks capability for pacing (until leadless pacemaker communication is available) and particularly for CRT.[2] Different subcutaneous shock pathways other than the currently available technology have been previously explored. An anteroposterior pathway with a single posterior subcutaneous coil and inframammary can location was 93% successful in achieving defibrillation.[3] An infraclavicular can location was feasible if a left parasternal coil was added. Our novel approach allows for CRT combined with an S-ICD configuration using a standard transvenous system without transvalvular defibrillator lead insertion and with minimal interference with valve function. Use of an RV lead can be completely avoided if necessary by only using the LV lead for sensing and pacing.

KEYWORDS Resynchronization therapy; Defibrillator; Tricuspid prosthesis; Subcutaneous defibrillator; Adult congenital heart disease
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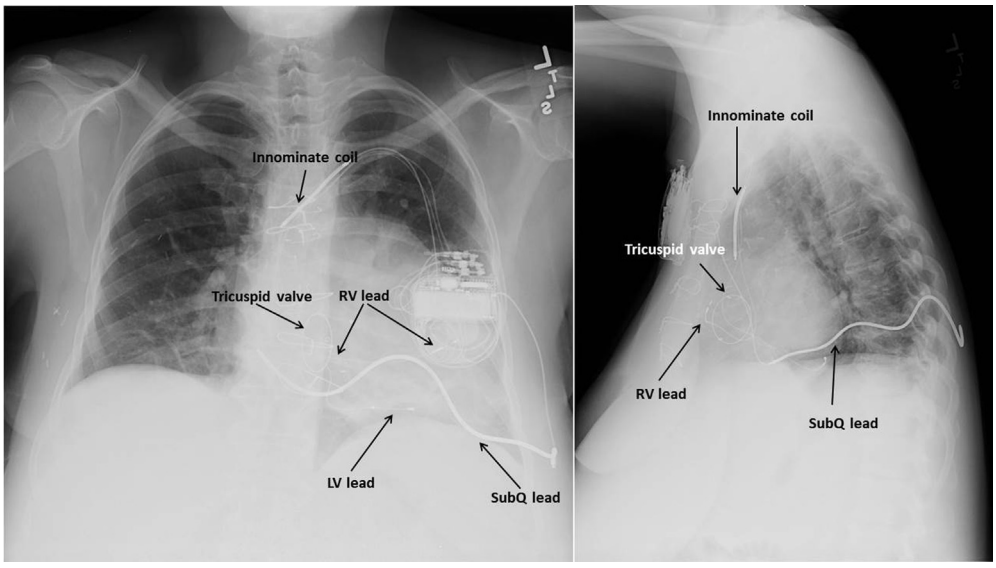

Figure **Left:** Posteroanterior radiograph view of cardiac resynchronization therapy defibrillator (CRT-D) system. **Right:** Lateral radiograph view of CRT-D system. Right ventricle (RV), left ventricle (LV) and subcutaneous (SubQ) leads are shown with *arrows*. Note the lower location of the device position.

The standard S-ICD does not have the ability to pace the RV and provide antitachycardia pacing or the ability to provide resynchronization therapy.[4] It is prone to T-wave oversensing. The size of the device is significantly bigger than transvenous devices and the postprocedure pain is an issue. It does not have capability for recording, identifying, and treating atrial arrhythmias.[4,5] Also, at this time, it is only available from 1 vendor.

Our approach can be used with any vendor's currently available devices and leads, with smaller device footprint and capability for pain-free termination of ventricular and some atrial tachycardias via antitachycardia pacing.[6] It allows for resynchronization therapy, too.

The limitations include reliability of consistent posterior coil location, dependence on patient body habitus, and long-term stability of the lead and DFT.[3]

There is a potential for higher DFT, and therefore when using this approach the DFT should be tested.[3] Addition of an innominate, azygos, or coronary sinus coil may be needed when anatomically possible if DFT is high.

In conclusion, our approach provides an alternative to transvenous-only and S-ICD systems with more flexibility of configurations. This system, without the transvenous component, can potentially be an alternative to current S-ICDs if a proper sensing and detection algorithm for the can to coil is developed.

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