IMAGES

Implantation of a subcutaneous implantable cardioverter-defibrillator in a patient with epicardial defibrillation patches

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Introduction

The subcutaneous implantable cardioverter-defibrillator (S-ICD) was developed to provide an alternative to the transvenous implantable cardioverter-defibrillator (TV-ICD), because it is implanted without any transvenous or epicardial leads. Studies demonstrating the safety and effectiveness of the S-ICD have been published, indicating that it is a good alternative for a variety of patients eligible for a TV-ICD system.[1] However, the implantation of an S-ICD in patients with epicardial defibrillation patches is not well documented and remains unclear. Herein, we describe the implantation of S-ICD in a patient with epicardial defibrillation patches and a conductor breakage in the ICD shock circuit.

Case report

A 73-year-old man with prior ventricular fibrillation and chronic atrial fibrillation underwent implantation of a TV-ICD in 2006. He was complicated by device-related infection requiring system extraction. Surgical implantation of an abdominal ICD (Maximo^{TM} DR 7278; Medtronic, Minneapolis, MN) with an epicardial right ventricular pace/sense lead (4968®; Medtronic) and epicardial defibrillation patches (6721®; Medtronic) to the lateral wall of the right and left ventricles was performed. Postoperative ICD check (14 years) demonstrated electrical noise on the patch-generator electrogram, suggesting a conductor breakage in the ICD shock circuit. Considering the previous endocardial device infection and absence of a pacing indication,[1] implantation of an S-ICD was selected. This device has 3 available sensing vectors: primary (proximal parasternal sensing electrode to device); secondary (distal parasternal sensing electrode to device); and alternate vectors (distal to proximal parasternal electrode). Preprocedural sensing check using the electrocardiogram screening tool was satisfactory in more vectors on the right parasternal area than on the left parasternal area. The patient underwent implantation of an S-ICD system on the left side of the chest. The pulse generator (EMBLEM^{TM} MRI; Boston Scientific, Marlborough, MA) was placed at the left posterior axillary line between the fifth and sixth intercostal spaces. The subcutaneous defibrillation lead (EMBLEM^{TM} 3501; Boston Scientific) was placed on the right parasternal area utilizing the intermuscular 2-incision technique while avoiding the sternal wire (Figure 1A and 1B). In defibrillation

KEY TEACHING POINTS

- Subcutaneous implantable cardioverter-defibrillator (S-ICD) may be ideal as a reimplantation device in endocarditis-related ICD patients without a pacing indication because of infection; these patients are not at higher risk of developing subsequent reinfection or requiring a subsequent lead or system extraction.
- Epicardial defibrillation patches may develop electrical problems (significant increase in defibrillation threshold owing to insulating effects and disturbance of the potential gradient field under the patches).
- Conventional optimal implantation of an S-ICD may be effective in patients with epicardial defibrillation patches.

KEYWORDS Cardiac implantable electronic devices; Epicardial defibrillation patch; Infection; Subcutaneous implantable cardioverter-defibrillator; Transvenous implantable cardioverter-defibrillator; Ventricular fibrillation
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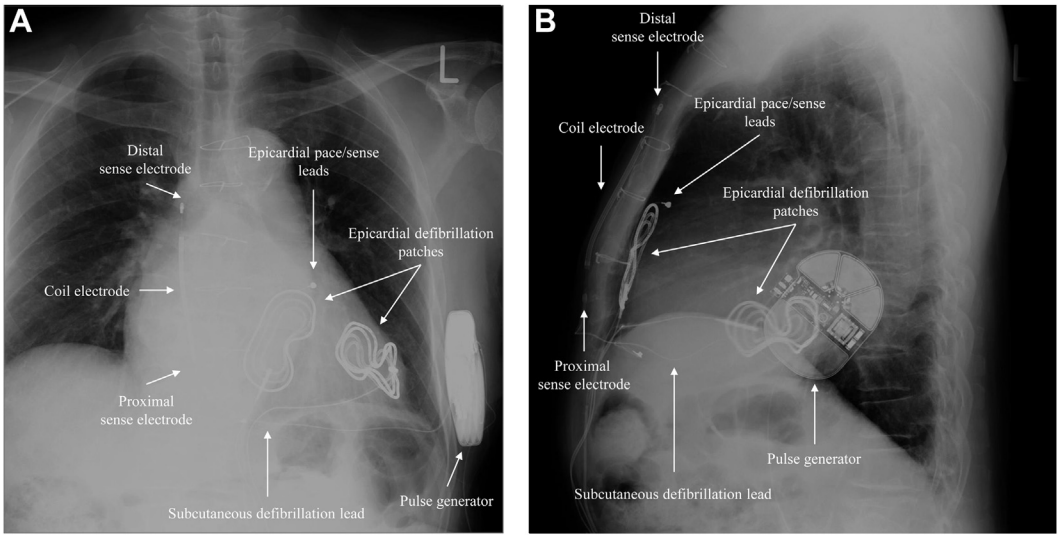

Figure 1 Posteroanterior (**A**) and lateral (**B**) chest radiographs showing the subcutaneous implantable cardioverter-defibrillator system in place.

threshold (DFT) testing, the alternate vector was automatically selected as a sensing vector. Ventricular fibrillation, induced using 50 Hz burst pacing, was terminated with a single 65 J ICD shock with 50 Ω of shock impedance after 12.6 seconds (Figure 2A). Postoperatively, S-ICD analysis revealed 3 sensing vectors with gain setting to 2× (Figure 2B). The primary vector and the secondary vectors had a larger R wave, larger T waves, and myopotential noise detected by exercise stress tests (ie, isometric chest press, provocative maneuver). The alternate vector had acceptable R-wave amplitude with smaller T waves and less myopotential noise. Therefore, the alternate vector associated with the lowest risk of inappropriate ICD shocks was finally selected. The patient exhibited an uneventful course without evidence of inappropriate ICD shocks.

Optimal S-ICD device configuration includes a parasternal position electrode and a left lateral chest pulse generator.[2] Previously, investigators attempted to overcome the risk of electrical shielding of the S-ICD shock vector in a patient with an epicardial defibrillation patch by placing the generator at a lower position.[3] However, this approach was limited by sensing problems and difficulty in placing the generator in patients with small stature (ie, Japanese patients). In addition, the previous case report showed that the distal tip of the S-ICD lead was intermittently in contact with the sternal wire, causing sensing failure.[4] Therefore, the generator was placed at the conventionally optimal position in the left chest, while the defibrillation lead was placed to avoid the sternal wire. Despite the risk of electrical problems in the epicardial defibrillation patches (ie, insulating effect and disturbance of the potential gradient field under the patches),[5] defibrillation was possible under normal shock impedance even with conventional optimal S-ICD implantation. A limitation of this case report is that the present findings did not suggest that epicardial patches do not impact the DFT for S-ICD, and this threshold may change over time; hence, repeat DFT testing may be necessary. This report may assist in future cases involving implantation of a new ICD in patients with epicardial defibrillation patches.

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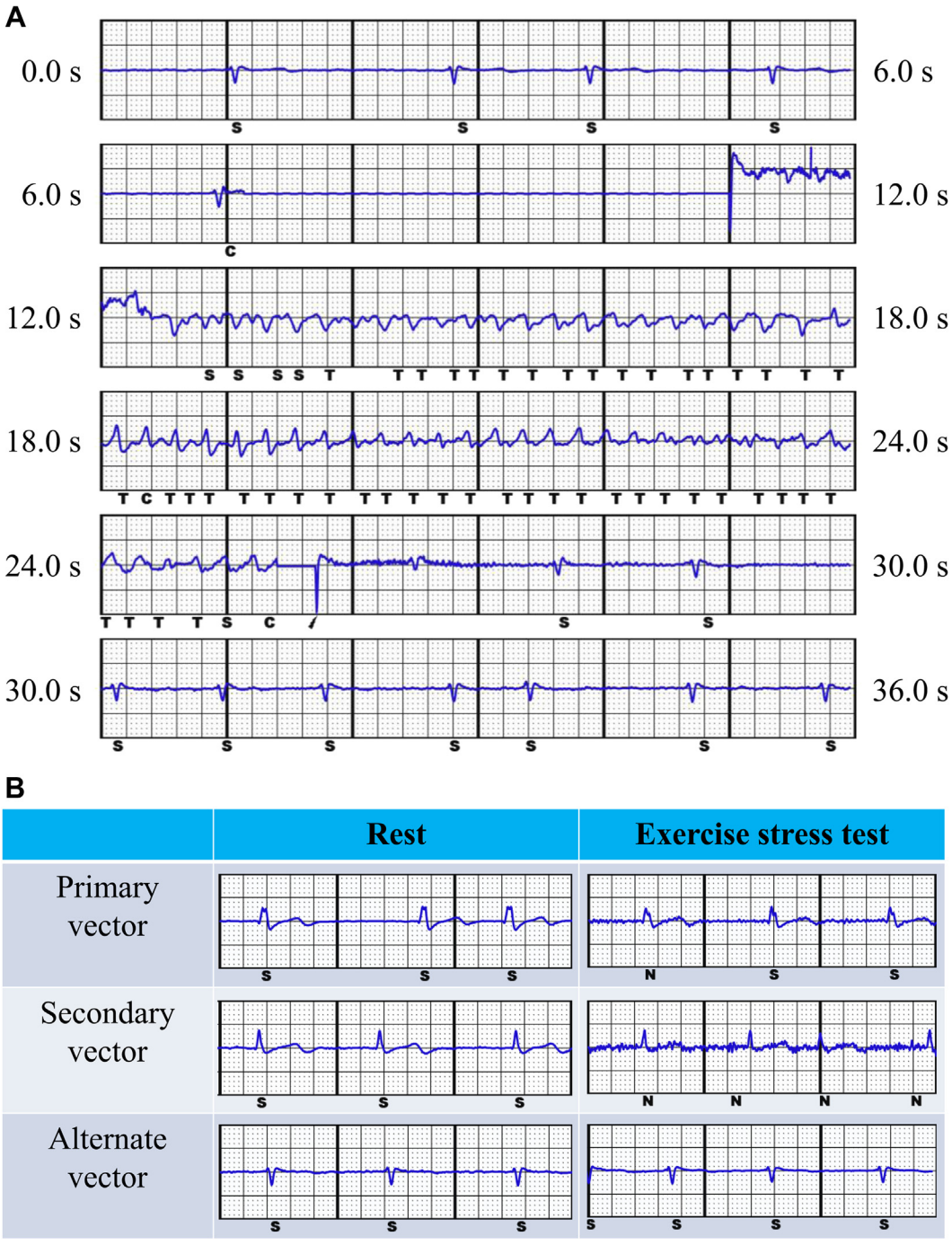

Figure 2 **A:** Defibrillation threshold testing and **B:** postoperative electrocardiograms of each sensing vector recorded by the subcutaneous implantable cardioverter-defibrillator at rest and exercise stress test. C = charge start; N = noise; S = sense; T = tachycardia detection.

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