SPOTLIGHT

Concomitant use and interaction of a subcutaneous implantable defibrillator and epicardial pacemaker

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Implantable cardiac defibrillators (ICDs) can be classified into transvenous systems and subcutaneous ICDs (S-ICDs). Although S-ICDs have significant advantages, especially regarding device infections, the use of a transvenous system is reasonable if a patient needs cardiac pacing. On the other hand, in some situations, the concomitant use of an S-ICD and another pacing device such as a leadless pacemaker may be taken into consideration. In the present report, combination therapy of an S-ICD and epicardial pacemaker is described focusing on the interactions between the two devices during the defibrillation threshold test.

A 73-year-old male was transferred to our hospital to undergo surgical intervention for severe mitral regurgitation (MR) and tricuspid regurgitation (TR). He had a history of mitral valve repair and tricuspid annuloplasty performed 10 years prior. During the hospitalization at the preceding institute, he developed pulseless ventricular tachycardia so implantation of an ICD was planned after the redo-surgery. He suffered from sustained right heart failure due to severe TR and hemolysis because the MR jet deviated toward the annular ring. In order to minimize the recurrence of TR, implantation of an S-ICD was determined. He also had a history of spontaneous bradycardia due to an atrial standstill. Therefore, an epicardial ventricular pacing lead was implanted during the open-heart surgery including a mitral valve replacement, redo tricuspid annuloplasty, and right ventricular papillary muscle approximation. He received a pacemaker generator 19 days after the index surgery. An attempt to transvenously implant an atrial lead was performed, however, no sections of the right atrium could be electrically captured. Therefore, we connected a single-chamber generator (Evity 8 SR-T, Biotronik) to establish VVI pacing. After 14 days, an S-ICD was implanted under general anesthesia. As a result of the preprocedural ECG screening during bipolar ventricular pacing, a defibrillator lead was implanted in the right sternal subcutaneous tissue, and then a generator (EMBLEM MRI A219, Boston Scientific) was implanted. A post-procedural chest x-ray is shown in Figure 1. A series of defibrillator threshold (DFT) tests were performed in different manners to assure the appropriate functioning of the S-ICD. Initially, the pacemaker was set to the VVI mode, 90 bpm, and a 7.5 V output with

FIGURE 1 Chest X-ray after the implantation of the SICD and epicardial pacemaker. MAR, mitral annular ring; SICD, subcutaneous implantable cardioverter defibrillator; TAR, tricuspid annular ring

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bipolar pacing. The ventricular fibrillation (VF) that was induced was successfully terminated by the S-ICD without any significant undersensing (Figure 2A). Of note, the pacemaker partly undersensed the VF then sporadic pacing was delivered, which was not sensed by the S-ICD. The pacing mode was then set to the VOO mode. The S-ICD successfully terminated the VF at that time (Figure 2B). Lastly, the pacing mode was set to VOO with unipolar pacing at an output of 6V. At that time, the S-ICD undersensed the fibrillatory activity presumably because of an increased threshold after the high-amplitude pacing spikes (Figure 2C). An external shock was delivered to terminate the VF. We also attempted the unipolar VVI mode but the induced VF spontaneously terminated. As the pacing threshold during bipolar pacing of the epicardial lead was unstable around 2.0 V/1.0 ms, the bipolar pacing output was set to 3.6 V/1.0 ms. He was discharged without any procedural complications.

We previously reported a successful case of the simultaneous implantation of an S-ICD and leadless pacemaker in an immunocompromised patient and a following successful defibrillation test. In the present case, the concomitant use of an S-ICD and epicardial pacemaker was established to avoid tricuspid valve dysfunction. The major concern, in this case, was a delay or absence of shock delivery due to: (1) undersensing of VF on the pacemaker resulting in pacing being delivered and (2) undersensing of VF on the S-ICD caused by the pacing spikes. Additionally, the higher epicardial pacing threshold required a large output, while the presence of the unipolar pacing mode potentially interfered with the appropriate sensing of the VF on the S-ICD system. Such a critical condition can presumably start from undersensing lethal arrhythmias on bradycardia devices, which causes unnecessary pacing during lethal tachycardias. If the pacing spike is large enough to be detected on the S-ICD, it affects the variable threshold of the detection and may mask a significant number of wavelets. Finally, accumulated force-prolonged RR’ intervals may result in undersensing on the S-ICD device, resulting in the absence of appropriate shocks and the patient’s death. In this context, a combination of an S-ICD and bradycardia device should be strictly examined by strategic DFT tests and settings before discharge.

The simultaneous use of SICD and epicardial pacemaker seemed feasible if detailed DFT tests were performed, and unipolar pacing was avoided.

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