Simultaneous use of implantable cardioverter-defibrillator in a patient with a preexisting deep brain stimulator: A proposed protocol of implantation to avoid dangerous interactions

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Recently, the number of implantations of cardiac implantable electronic devices (CIED) has increased. Similarly, the field of extracardiac stimulation devices including deep brain stimulation (DBS) in medically refractory Parkinson's disease or essential tremor has also expanded. The DBS stimulator delivers continuous pacing of the subthalamic nucleus or internal globus pallidus with a frequency range of 130–185 Hz, a target amplitude typically 1.0–3.5 V, and a pulse width of 60–120 µs (depending on symptoms). Simultaneous indications for both types of the device may cause CIED malfunction induced by electromagnetic interference, namely inhibition of cardiac pacing, asynchronous pacing, inadequate high voltage therapy, or mode switch. Likewise, the high voltage therapy of implantable cardioverter-defibrillator (ICD) may cause damage to DBS or reset its programming [1–3]. Thus, proper programming (including bipolar configuration of pacing pulse if possible) of both devices, patient education, and testing for the "worst case" scenarios diminish the risk of interactions [1, 3–5]. It is also important to separate both devices by more than 20 cm. Close cooperation of a multidisciplinary team (including a cardiologist, neurologist, technicians, and nurses) is mandatory during preparation, implantation, and follow-up.

A 73-year-old male was referred for a single chamber cardioverter-defibrillator (VVI-ICD) implantation procedure as secondary prophylaxis of sudden death. This patient had a DBS implanted in the left subclavian region to treat tremors of the right upper extremity resistant to standard medications. The neurostimulator was programmed to deliver 2.6 V/60 µs unipolar impulses with a frequency of 130 Hz. Additionally, we checked the device for the minimal energy of DBS at which the neurological side effects of the stimulation occurred (the setting of 4.0 V/60 µs revealed a slow speech and muscle spasticity).

Due to the localization of the DBS can (left subclavian region), we decided to implant a VVI-ICD system (dual coil, active fixation, DF4 RV-HV Medtronic 6947 — 62 cm lead and Medtronic Visia AF MRI S VR SureScan generator) on the contralateral side using the right subclavian vein access and keeping the maximal possible distance (above 20 cm) between both devices.

The first check-up of the ICD system was performed after the lead implantation and before attaching it to the generator. It followed a routine protocol (impedance, sensing, pacing threshold), and it included a gradual increase of the neurostimulator impulse energy from 2.6 V to 4.0 V with the sensing at 0.3 mV, which did not provoke any artifacts in the V-EGM record. After attaching the lead to the generator and suturing the pocket, the second check-up was performed (R wave amplitude, 9.9 mV; pacing threshold, 0.5 V/0.4 ms; impedance, 399/55/55 Ohm). Again, the neurostimulator impulse energy was gradually increased and did not provoke any artifacts in the V-EGM record. Some far-field can-coil artifacts were

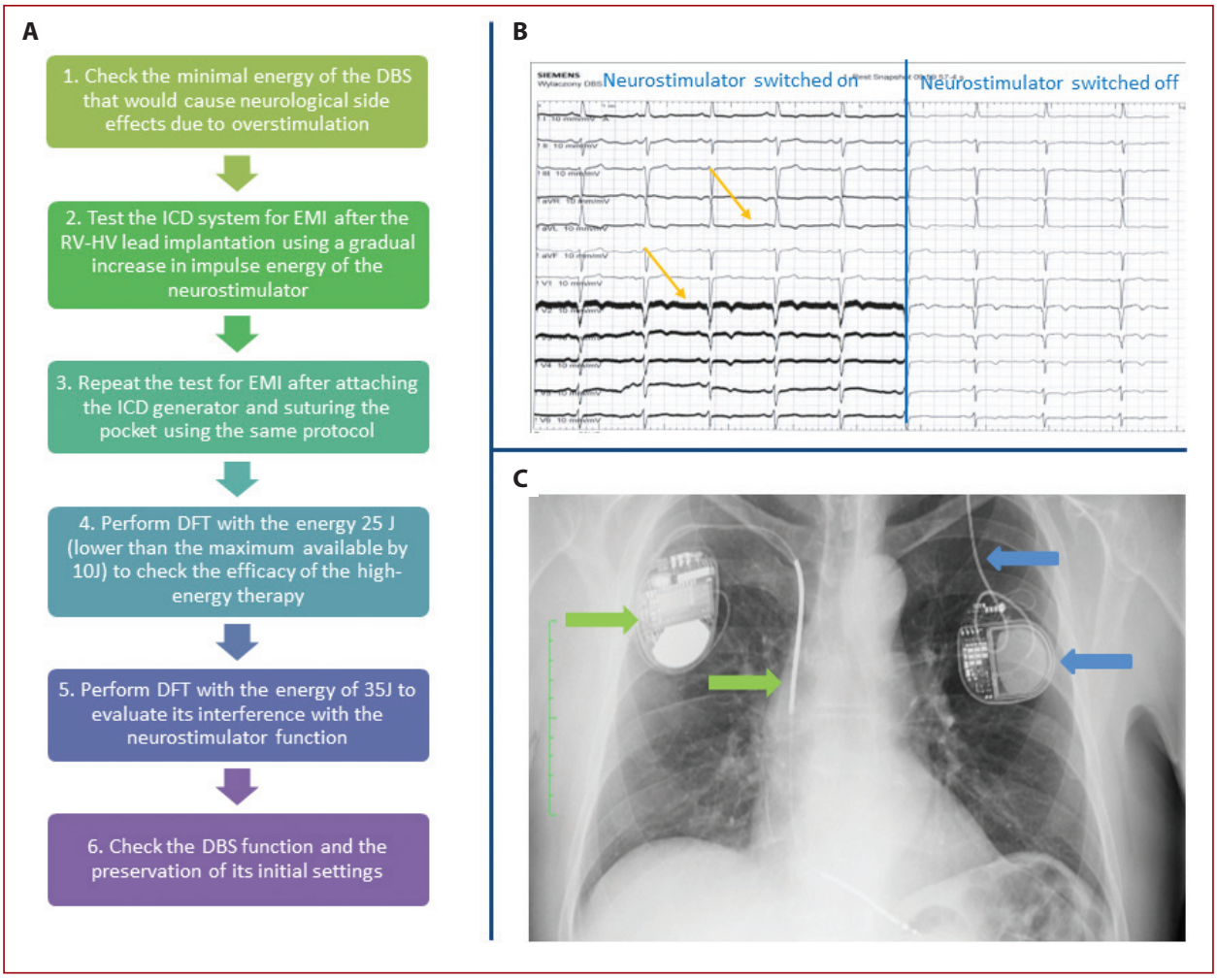

Figure 1. A. A protocol proposed to be followed during the procedure of ICD implantation in patients with preexisting neurostimulator. **B.** Our patient's electrocardiogram with the neurostimulator switched on (cycles 1 to 6) and off (cycles 7 to 9). The artifacts seen on all leads caused by EMI (the orange arrows). **C.** Our patient's chest X-ray after the procedure depicting the ICD generator with the RV-HV lead (the green arrows) and the DBS generator with the lead (the blue arrows)

Abbreviations: DBS, deep brain stimulator; DFT, defibrillation test; EMI, electromagnetic interference; ICD, implantable cardioverter-defibrillator; RV-HV, right ventricle-high voltage lead

observed, albeit they did not disturb the proper sensing of QRS complexes. The setting of the ICD was as follows: sensing 0.3 mV (standard programming), ventricular tachycardia, and fibrillation detection thresholds: 171–200 bpm and >200 bpm, respectively. The defibrillation vector was set between the superior vena cava and right ventricular coil, omitting the can of ICD ("cold can").

Subsequently, defibrillation tests (DFT) were performed. Firstly, we tested the energy of 25 J (lower than the maximum energy by 10 J). The DFT confirmed the efficacy of defibrillation delivered with the programmed vector by the ICD implanted in the right subclavian region. Secondly, the maximal energy of 35 J was delivered to evaluate its potential effect on the neurostimulator's function. Both energies effectively restored the sinus rhythm. Notably, the DBS function was re-checked, and we confirmed that its initial settings were preserved.

We found no dysfunction in either device during the 2-year follow-up.

Article information

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