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Case Report

Phrenic Nerve Stimulation in a Patient with a Dorsal Column Stimulator

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We present a case of a 76-year-old female who developed recurrent left-sided muscle spasms resembling hiccups after permanent dorsal column stimulator (DCS) implantation. The patient had a cardiac resynchronization device with defibrillating capabilities (CRT-D) in place, which was interrogated before and after the permanent DCS placement with no interference reported. Due to the timing of the event with the placement of the DCS, it was presumed that the spasms were related to the DCS implantation, and removal of the DCS was considered. However, further evaluation by a cardiology consultant revealed that a lead from her CRT-D was most likely stimulating the phrenic nerve and causing diaphragmatic contractions. The patient was sent to the electrophysiology clinic where the voltage on her left ventricular lead was reduced, and her symptoms resolved completely. Due to the time, risks, and expense of implanting a DCS, it is imperative to consider all other possible causes of diaphragmatic contractions prior to removing a DCS system.

Key words: Dorsal column stimulator, cardiac resynchronization therapy device, phrenic nerve stimulation, hiccups, muscle spasms, diaphragmatic contractions, interference

We describe a patient who developed persistent hiccups immediately after dorsal column stimulator (DCS) implantation. After further investigation, it was determined that the cause of her symptoms was a lead from her cardiac resynchronization device with defibrillating capabilities stimulating the phrenic nerve and resulting in diaphragmatic contractions.

CASE REPORT

A 76-year-old female presented to our pain clinic for evaluation after permanent DCS placement. She complained of recurrent muscle spasms across her left upper abdomen. These spasms, which she described as a hiccup, began several hours after her DCS was implanted. Her DCS was turned off, and she was started on metaxalone. Despite this, 2 weeks after surgery she was still having persistent left-sided diaphragmatic contractions.

The patient had undergone a successful trial with the Nevro system (Nevro Corp., Redwood City, CA) a month prior, and she did not experience diaphragmatic contractions at that time. Of note, the patient had a cardiac resynchronization therapy device with defibrillating capabilities (CRT-D) in place. Her CRT-D was interrogated before and after the trial with no interference reported.

Placement of the permanent DCS was uneventful. Epidural access was obtained at T12-L1, and the generator was placed in the right gluteal region. The placement of her DCS was completed with lead tips at the bottom of the eighth thoracic vertebrae on the left and the top of the eighth thoracic vertebrae on the right. The patient received monitored anesthesia care, and she recovered from her anesthetic without any adverse events. Her CRT-D was again interrogated before and after the permanent DCS placement with no interference reported.

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The patient's DCS trial had been successful with no untoward side effects. However, due to the temporal relationship of the DCS placement and the onset of the diaphragmatic contractions, it was presumed that the spasms were related to the DCS implantation, and removal of the DCS was considered. Since a lead from the CRT-D can rarely lead to phrenic nerve stimulation with resultant diaphragmatic contractions resembling hiccups, an additional interrogation of the device was planned. The patient was sent to the electrophysiology clinic where the voltage on her left ventricular lead was reduced, and her diaphragmatic symptoms resolved completely.

DISCUSSION

The temporal relationship of the onset of our patient's symptoms with the permanent DCS implant led us to consider the DCS as the cause of her left-sided diaphragmatic contractions. To our knowledge, the literature contains no reports of a DCS causing diaphragmatic contractions; however, epidural manipulation in the form of medications has been implicated in persistent hiccups by an undetermined mechanism (1). Our patient also had a CRT-D in place, and left phrenic nerve stimulation (PNS) is a well-known complication of these devices (2,3). The left ventricular lead is placed in the coronary sinus, and its proximity to the phrenic nerve creates a potential for nerve stimulation resulting in diaphragmatic contractions. PNS occurs in 33 – 37% of patients with CRT-D and is a limiting factor when implanting left ventricular leads from coronary veins (4).

Toggweiler et al (5) described a case study which illustrates that a simple, noninvasive test of acoustic cardiography can be applied during biventricular pacemaker implantation to ensure that the pacemaker settings are not leading to PNS (5). Some studies suggest that reducing left ventricular bipolar electrode spacing may significantly increase the PNS threshold (6). Additionally, a new quadripolar electrode left ventricular lead may provide more programming options to manage PNS (7). The elevated pacing thresholds and PNS sometimes seen with CRT-D may require that the coronary sinus lead be repositioned or the voltage reduced. In the case of our patient, the electrophysiology team was able to reduce the voltage in the left ventricular lead, and her symptoms resolved completely.

Historically, concern has existed regarding the combination of spinal cord stimulators and cardiac permanent pacemakers due to the possibility of false inhibition of the permanent pacemaker. Our patient underwent interrogation of her CRT-D before and after placement of the DCS with no signs of interference, and case reports in the literature describe the safe use of a DCS in patients with a permanent cardiac pacemaker (8). Ekre et al (9) described a study of 18 patients who were tested to see if a spinal cord stimulator and permanent pacemaker could be safely combined. Their pacemaker settings were temporarily modified to increase the probability of interference, and the spinal cord stimulator intensity was increased to the maximum level tolerated. No patients displayed signs of inhibition during the tests, and this study suggested that bipolar spinal cord stimulators and permanent pacemakers could be used together safely; however, individual testing is mandatory in each patient.

CONCLUSION

When implanting a DCS, it is important to be knowledgeable about other electronic devices the patient has. It is important to always consider these other devices and potential interactions if a patient develops unusual complications after DCS implantation. The pacemaker device company and electrophysiology team may be valuable resources in the setting of a coexisting pacemaker or CRT-D and DCS. It is unclear why this patient's CRT-D had previously not produced PNS but did following insertion of the DCS. They are likely unrelated events; however, the possibility of the DCS causing a change in thresholds of the CRT-D cannot be ruled out. Ultimately, due to the time, risks, and expense of placing a DCS, it is imperative to specifically consider a patient's CRT-D as the cause of diaphragmatic contractions prior to removing a DCS, even when the temporal relationship of the DCS and onset of new symptoms may suggest otherwise.

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