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Cervical Myelomalacia Diagnosed via Magnetic Resonance Imaging in a Patient With a Spinal Cord Stimulator for Complex Regional Pain Syndrome: A Case Report

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Background: Neuromodulation is used to treat chronic pain, especially failed back surgery syndrome (FBSS) and complex regional pain syndrome (CPRS) type 1 and type 2. Until recently, neuromodulation had significant restrictions on magnetic resonance imaging (MRI) usage (4). Our patient provided Health Insurance Portability and Accountability Act of 1996 (HIPAA) compliant consent for the inclusion of his clinical information in this report.

Case Report: A 43-year-old man developed CPRS of his right upper extremity that was treated with an MRI-compatible high frequency spinal cord stimulator (SCS). Two years later, he presented with worsening neck and right upper extremity neuropathic pain. Due to the SCS device being MRI compatible, a cervical MRI was performed and showed severe cervical spinal stenosis at C3-C4 with myelomalacia and adjacent segment disease. The patient underwent posterior cervical decompression spine surgery, and emergent explantation of the SCS device.

Conclusion: The patient maintained adequate strength and neurological function without any complications from myelomalacia. There was no delay in care in obtaining the MRI while the patient had the SCS device in place. In conclusion, the use of MRI-compatible devices should become the standard of care for implanting spinal cord stimulators.

Key words: Spinal cord stimulator, complex regional pain syndrome, myelomalacia, magnetic resonance imaging

BACKGROUND

Neuromodulation is used to treat chronic pain, especially failed back surgery syndrome (FBSS) and complex regional pain syndrome (CRPS) type 1 and type 2 (1). Patients who undergo spinal surgery have been found to have a 10% to 40% rate of postoperative pain, and spinal cord stimulator (SCS) systems have been proven to treat this complication with a lower rate of morbidity when compared to repeat surgery (2). SCS systems have been extensively studied in high quality randomized controlled trials with a meta-analysis showing Level I to Level II evidence for the efficacy in lumbar FBSS; the patients with this indication comprise largest use of SCS in the United States (3).

CRPS is another common indication for neuromodulation. The International Association for the Study of Pain defines CRPS type 1 based on the following diagnostic criteria (known as the Budapest criteria): sensory, vasomotor, sudomotor/edema, and motor/trophic. CRPS type 2 is defined by the above criteria in addition to

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discrete peripheral nerve damage (4). Patients with CRPS comprise the second largest indication for the use of SCS in the United States. A systematic review of the available literature indicates that SCS is an effective option for patients with CRPS type 1 (Level A Evidence) and CRPS type 2 (Level D evidence) (5).

Spinal cord stimulator systems treat pain via the gate control theory of pain by disrupting the electrical current pain signals traveling between the spinal cord and the brain (6). Additionally, newer research suggests that there are also supraspinal mechanisms, such as activation of brainstem pain-modulating centers via dorsal column stimulation or inhibition of nociceptive signals arising from the periphery (7). Until recently, neuromodulation had significant restrictions on magnetic resonance imaging (MRI) usage (8). Over the past 5 years, MRI compatibility has reshaped how we treat patients with SCS devices. We present a case demonstrating the significance of using MRI-compatible SCS devices for treating chronic pain.

CASE REPORT

A 43-year-old man presented with a history of thoracic outlet syndrome status post (s/p) right rib resection and cervical spinal stenosis s/p anterior cervical discectomy fusion at C4-C5. He developed CRPS in his right upper extremity s/p both previous surgeries that was successfully treated with an MRI conditional high frequency spinal cord stimulator. Imaging prior to his SCS implant showed a patent spinal canal with no evidence of cervical spinal stenosis. Two years later, he presented with worsening neck and right upper extremity neuropathic pain. A physical exam showed a positive Hoffman sign. The SCS device was interrogated with poor lead contact. Due to the MRI-compatible SCS device, a cervical MRI was performed without delay and showed severe cervical spinal stenosis at C3-C4 with myelomalacia and adjacent segment disease (Fig. 1).

The patient underwent posterior cervical decompression spine surgery and emergent explantation of the SCS device. He maintained adequate strength and neurological function without any chronic complications due to myelomalacia. To address his original pain, the patient will be re-trialed for SCS implant after he recovers from the decompression surgery.

DISCUSSION

Spinal cord stimulators are part of the treatment algorithm when treating patients with chronic back or neck pain. We present a case that supports the use of MRI-compatible devices as well as a reminder that providers should stay vigilant and re-examine patients, especially after any significant changes in their clinical status.

Until 2013, there were no SCS systems that were MRI compatible, due to the concern of thermal injury at the site of the leads and the generator (8). This posed a problem as many patients who are candidates for SCS implantation may benefit from use of MRI scans in the future to monitor changes in existing spinal disease and pain syndromes, or to diagnose disease processes such as newly diagnosed cancers. These patients have the option of explanting a working SCS device or using alternative imaging modalities such as computed tomography (CT) scans (9).

While CT scans may help diagnose certain pathologies in the spinal cord, they lack soft tissue detail and are unable to allow assessment of the spinal canal and its contents (10). MRI scans show the greatest range of information, including accurate assessment of intervertebral discs, spinal ligaments, and neural elements (10). MRI scans are the most sensitive and specific imaging modality available to show signal change in the cord, which both indicates the presence of myelopathic change and can be used to predict outcomes (10).

Had our patient waited for SCS explant prior to obtaining an MRI, the myelopathic signs could have worsened, and the patient may have developed chronic irreversible changes. One additional alternative to MRI scans for patients with MRI-incompatible devices is a CT myelogram. In a CT myelogram the patient undergoes a lumbar puncture and contrast medium is administered into the spinal canal under fluoroscopic guidance. The patient then undergoes a CT scan that can better visualize spinal stenosis and nerve root compression when compared to traditional CT. However, this procedure comes with its own risks, such as post-dural puncture headache or nerve root injury from the dural puncture.

There are currently 12 different spinal cord stimulator units approved by the US Food and Drug Administration for the treatment of pain in the United States. Of these 12 units, 7 systems are full-body conditional, 2 are head and extremity compatible, 2 are head only compatible, and one is not MRI compatible (11-15). MRI-compatible devices are defined as MRI safe and shown to neither significantly affect the quality of the diagnostic information nor have its operations affected by the MRI device. MRI-conditional devices vary by manufacturer,

but certain conditions must be met to scan the patient such as specific Tesla or radiofrequency requirements.

Due to advances in technology, MRI compatibility is now offered with many of the SCS systems available in the market, greatly benefiting patients who undergo an SCS implant. Patients no longer must choose between device explantation and undergoing medically necessary imaging. When patients with an MRI-incompatible device need a battery replacement, it would be prudent for the physician to consider replacing the entire system with an MRI-compatible system.

CONCLUSION

Medical providers should be aware of the MRI compatibility of the systems they use and should not delay MRI imaging due to the presence of an implanted SCS device. For providers who treat patients with MRI-incompatible systems, a risk assessment must be made with regards to explantation in order to facilitate an MRI scan that may be necessitated by the evolution of the patient's existing disease or new disease processes. In conclusion, the use of MRI-compatible devices should become the standard of care for implanting an SCS.

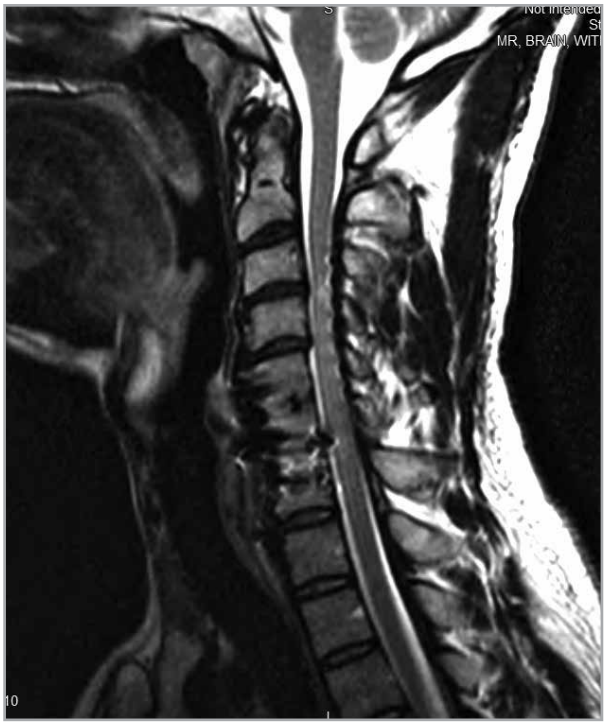

Fig. 1. Sagittal T2-weighted MRI of a patient with cervical spondylotic myelopathy shows the change of spinal cord signal intensity.

Author Contributions

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