Thoracic Radiculopathy Following Permanent Spinal Cord Stimulator Placement

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Introduction

The incidence of chronic pain and its impact on the health care system is ever increasing. Studies suggest that 70%–80% of the population will experience lower back pain (LBP). LBP-related issues have been reported to be the primary complaint for 2.3% of ER visits annually.[1] This has been estimated to result in an annual $50 billion loss in productivity and lead to overall economic impacts of over $100 billion per year.[2] Spinal cord stimulation as a treatment modality has continuously evolved, but unfortunately it can be associated with complications. Complications associated with SCS are estimated to range from 30%–40% and can be divided into device-related complications or biologic factors.[4] Device-related complications include lead migration, lead breakage, over or under stimulation, intermittent stimulation, hardware malfunction, loose connections, battery failure, and the development of tolerance. Biologic complications include infection, epidural hemorrhage, seroma, paralysis, cerebrospinal fluid (CSF) leakage, pain over implant or battery site, allergic reaction, and skin breakdown. Lead placement can either be percutaneous or via surgical implantation of paddle leads.

We describe a case of thoracic radiculopathy following spinal cord stimulator placement via paddle leads manifesting as severe debilitating abdominal pain. This complication is rarely mentioned in the literature and as such may be misdiagnosed, ignored or even lead to explantation of these expensive devices. The etiology of this pain is suggested to be due to lateral placement of stimulator leads, with irritation of the nerve roots. We pose the question of whether this hypothesized etiology is correct or if patient anatomy and preoperative trial difficulty can be more predictive of this complication.

Patient Imaging

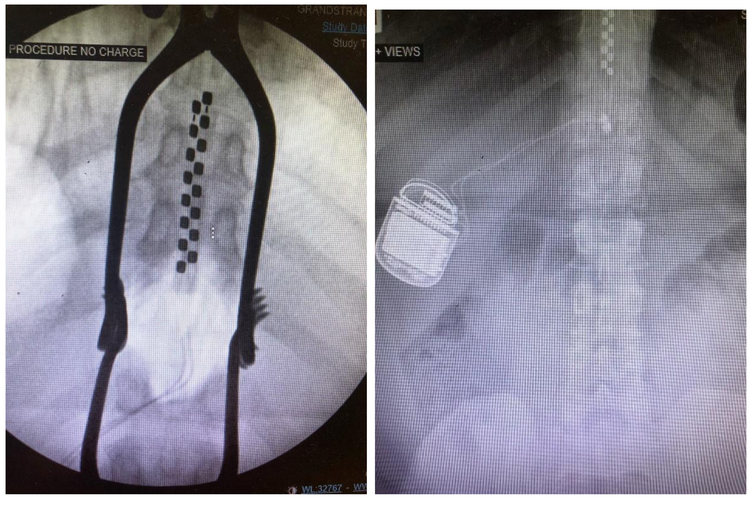

Figure 1 (Left). Intraoperative fluoroscopic image of surgical paddle leads placement.
Figure 2 (Right). Post-operative X-ray imaging of permanent surgical paddle lead stimulator placement.

The Case

This case is a 53 y/o obese female with a history of lumbar spondylosis/degenerative disc disease with axial low back pain and bilateral lumbar radiculopathy in the L5, S1 distribution. The pain affected her activities of daily living and decreased her quality of life. She had no prior history of abdominal pain. Physical examination revealed positive straight leg raise test bilaterally. Lumbar spine MRI showed multilevel lumbar and thoracic spondylosis and epidural lipomatosis. Symptoms initially managed conservatively with physical therapy, chiropractic therapy, bracing, and a TENS unit with little relief. Subsequently, she was started on low dose opioids and adjuvants in addition to interventions such as medial branch blocks, radiofrequency ablations and lumbar epidural steroid injections again with minimal relief. Ultimately, SCS trial with Medtronic DTM waveform (differential target multiplexed) on an Intellis platform attempted with 0% relief. Of note, leads were difficult to drive in the thoracic region. Six months later, with worsening pain, another SCS trial with Nevro-High frequency 10 waveform was attempted with >80% relief. During the second trial only 1 percutaneous lead was successfully placed and the second one could not be placed because of difficulty driving in the thoracic region. Patient subsequently had surgical placement of a Nevro paddle SCS over the T9/10 intervertebral space via a T11-12 laminotomy (Figure 1). Prior to discharge, patient did not report any abdominal pain or discomfort.

On post-op day 2 she started experiencing severe abdominal pain described as a squeezing, band like sensation. There was no reported weakness or numbness reported. She subsequently presented to the emergency department twice in the next 7 days. Her initial ED work up included a benign abdominal exam, a CT abdomen w/wo contrast which was negative and unremarkable blood work and urinalysis. She was treated for GERD with anti-emetics and intravenous narcotics, with no relief of her abdominal pain. On her second visit, abdominal exam was still benign and imaging was not repeated. She was treated for dyspepsia with a regimen of Metoclopramide, Famotidine, combination medication of Aluminum hydroxide, Magnesium hydroxide and Simethicone, Dicyclomine and viscous Lidocaine. Neurosurgical evaluation including a X-ray of the thoracic spine showed proper placement of the paddle without lateral displacement (Figure 2). No further workup was recommended in the absence of neurological deficits. She was discharged home with a diagnosis of constipation.

Following these visits, she was seen by interventional pain management. Further examination revealed pain was radicular in nature bilaterally in the T10-T11 dermatomes. She was neurologically intact with no signs of spinal cord compression. The pain was so severe the patient expressed decrease in quality of life and interest in device removal. The working diagnosis at that time became thoracic radiculopathy and given the lack of neurologic symptoms, eventual recovery was anticipated. All the available programs on her SCS were tried with no relief of her abdominal pain despite great relief of her initial presenting lower back and leg pain. At this time it was decided to turn the SCS off and manage her conservatively with increased doses of oral opioids and Gabapentin. Three days later, her abdominal pain resolved completely. Subsequently, her SCS was turned on with continued great relief of low back pain and radicular symptoms.

Discussion

Permanent spinal cord stimulation is accomplished by surgically placed paddle leads or percutaneous leads. Studies have shown paddle leads have a 33% reduction in re-operations compared to percutaneous leads, likely due to decreased lead migration.[7] Despite this, paddle leads were shown to have higher post-operative complication rates. Specifically, complication rates for surgical paddle leads were higher during the initial hospitalization (1.0% vs. 0.04%), 30-day (2.4% vs. 0.97%), and 90-day (3.4% vs. 2.2%) periods.[7]

Thoracic radiculopathy following SCS placement is under-recognized and not routinely considered in the post-operative period. A large literature review by Eldabe et al did not mention this and a 175 patient case series by Mammis, with a 9% rate of thoracic radiculopathy, remains the most extensive review of this complication.[5] Mammis hypothesized the radiculopathy is due to lateral placement/displacement of paddle leads. Surgical intervention/explanation of the SCS was pursued in all 15 cases. In this case there was difficult trial lead placement and known spondylosis and epidural lipomatosis seen on MRI. We believe transient post-surgical edema is likely the cause of this complication and the transient nature of symptoms supports this. With edema in an already compressed space, we expected full resolution and conservative therapy was pursued.

The delay in diagnosis led to great distress in the patient and near elective explantation. This would have eliminated the immense relief she had initially felt. As such, it is important to be aware of the symptomatology in order to appropriately treat these patients. Perhaps smaller percutaneous leads would have avoided development of this complication. New anchoring techniques have led to a reduction in percutaneous lead migration from 22% to 2.5%. Despite the 2.5% migration rate, there were 0 reported cases of thoracic radiculopathy.[8] The combination of pre-operative imaging, trial difficulty and advances in percutaneous lead technology may help drive a percutaneous vs surgical lead decision.

Conclusion

nterventional physicians who experience difficulties with lead placement during SCS trials as well as patients with significant thoracic spondylosis on their pre-operative or pre-SCS trial MRI should probably avoid paddle lead placement to potentially avoid this complication. Providers should consider thoracic radiculopathy as a differential for abdominal pain post-SCS implant after ruling out the common complications like lateral lead placement and thoracic hematomas. As long as the patient has no neurological deficits, conservative management of this complications with neuropathics and opioids could avoid unnecessary explantation of these expensive devices. More study and hardware advancement in the future may guide specific stimulator choice between percutaneous vs surgical paddle placement.

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This research was supported (in whole or in part) by HCA Healthcare and/or an HCA Healthcare affiliated entity. The views expressed in this publication represent those of the author(s) and do not necessarily represent the official views of HCA Healthcare or any of its affiliated entities.