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Case Report

Erroneous intramedullary placement of spinal cord stimulator: A case report and review of the literature

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ABSTRACT

Background: Spinal cord stimulation is a common treatment for patients with medically refractory chronic neuropathic pain. Before permanent implantation of spinal cord stimulation, patients will undergo a percutaneous trial to ensure the efficacy of the treatment modality and determine the optimal location of placement. While complications from this procedure are rare, there are reports in the literature of infection, epidural hematoma, and even paralysis. There are few reports of percutaneous leads tracking through the spinal cord itself, and subsequently, few reports of management should such a complication take place. Herein, we provide an example of such a phenomenon with no significant postoperative complications, morbidity, or mortality.

Case Description: A retrospective chart review was completed utilizing the electronic medical record. Data gathered included patient demographics, oncological history, medications, imaging, and operative reports. This is a 64–year-old male with a history of with a history of a traumatic brachial plexus avulsion and right upper extremity amputation at the shoulder after a motorcycle accident approximately 20 years prior presented to our institution with left upper extremity paresthesias, gain imbalance, and urinary incontinence after a permanent percutaneous spinal cord stimulation lead was placed from an outside institution. The patient was found to have the lead tracking through the intramedullary space of his spinal cord. The patient was taken to the operating room for removal of the lead and had no significant complications during his postoperative course.

Conclusion: There is a paucity of literature regarding the removal of an intramedullary percutaneous spinal cord stimulator lead; herein, we present such a case.

Keywords: Case report, Intramedullary, Pain, Stimulation

INTRODUCTION

Spinal cord stimulation (SCS) is a common treatment for patients with medically refractory chronic neuropathic pain, complex regional pain syndrome, and brachial plexus injuries.[1,14] Permanent implantation techniques include percutaneous and open laminotomy/laminectomy. While complications are rare, there are reports in the literature of infection, epidural hematoma, and even paralysis. There are few reports of percutaneous leads tracking through the spinal cord itself, and subsequently, few reports of management should such a complication take place.[3,9,10] Muir documented a case report in which a female had a percutaneous SCS lead placed, which traversed through the dura and into the intramedullary space.[9] The patient subsequently displayed immediate symptoms such as lower extremity pain and paresthesias and

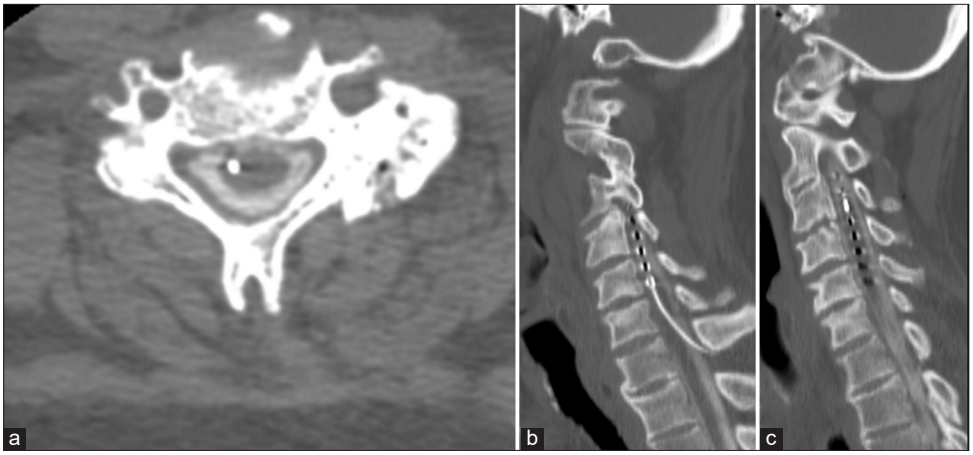

Figure 1: (a) Axial and (b and c) sagittal reconstruction computed tomography myelogram showing all 8 contacts of 8-contact percutaneous spinal cord stimulation lead inside the spinal cord parenchyma.

Figure 2: Myelogram scout radiograph showing 8-contact implanted Spinal cord stimulation (SCS) percutaneous lead and sub-clavicular pulse generator. SCS implanted for neuropathic pain related to traumatic brachial plexus avulsion and arm amputation.

had the lead removed on postoperative day 2.[9] Olmsted *et al*., also published two-cases in which the lead migrated through the dura on implantation; one of the patients developed immediate thoracic allodynia postoperatively upon initial programming, which was the indication for further evaluation of the lead.[9] We report our experience with the management of a misplaced cervical percutaneous cervical spinal cord stimulator, which was positioned intramedullary.

CASE DESCRIPTION

A retrospective chart review was completed utilizing the electronic medical record. Data gathered included patient demographics, oncological history, medications, imaging, and operative reports.

This is a 64-year-old male with a history of a traumatic brachial plexus avulsion and right upper extremity amputation at the shoulder after a motorcycle accident approximately 20 years before presentation presenting with paresthesia in his left upper extremity, balance and gait dysfunction, urinary incontinence and neck pain after placement of a percutaneous spinal cord stimulation lead and pulse generator 1 week ago at an outside institution by the patient's pain specialist. The patient endorsed the new symptoms began on postoperative day one of his recent implantation. He was sent to the hospital for computed tomography (CT) and myelography studies, and the CT myelogram did show evidence of a malposition of cervical spinal cord stimulation lead, which appeared to be within the intramedullary space of the spinal cord parenchyma [Figures 1 and 2].

The patient was admitted to the neurological intensive care unit for close monitoring, started on 4 mg of dexamethasone every 6 h, and was offered an open removal of the cervical percutaneous lead and axillary pulse generator with intraoperative monitoring including continuous/real-time monitoring of the cervical spinal cord was provided using left median, left ulnar, and bilateral tibial nerve somatosensory evoked potentials (SSEP) as well as bilateral trapezius, left upper extremity, and bilateral lower extremity transcranial motor evoked potentials (MEP). C-arm fluoroscopy was used to image the spinal cord stimulation lead within the cervical region as well as the anchor site. The upper thoracic incision was opened with a scalpel, and Metzenbaum scissors were used to open subcutaneous tissues down to the anchor. The

Table 1: Summary of previously reported cases of percutaneous spinal cord stimulation leads tracking into the spinal cord.

Authors	Cases	Vertebral level localization of SCS leads	Neurological symptoms following percutaneous implant	Procedure for lead retrieval	Outcome
Olmstead *et al* [9]	1. 70 y/o male 2. 77 y/o female	1. T9 2. T8	1. Severe pain radiating to the abdomen and lower extremities 2. Burning pain in left ribs and flank	1. T10-T11 Laminectomy 2. T8-T10 Laminectomy	1. Resolution of pain syndrome at 29 months 2. Pain control at 9 months
Patel *et al* [11]	40 y/o female	T12-L1	Intractable groin pain and postural headaches	T9-T10 Laminectomy	Resolution of symptoms
Pope *et al* [13]	Anonymous	T9	Unilateral Paresthesia	No detailed description provided	Resolution of symptoms
Our Case	64 y/o male	C2-C6	Urinary incontinence and worsening gait instability	Manual extraction via percutaneous skin incision	Resolution of symptoms

SCS: Spinal cord stimulator

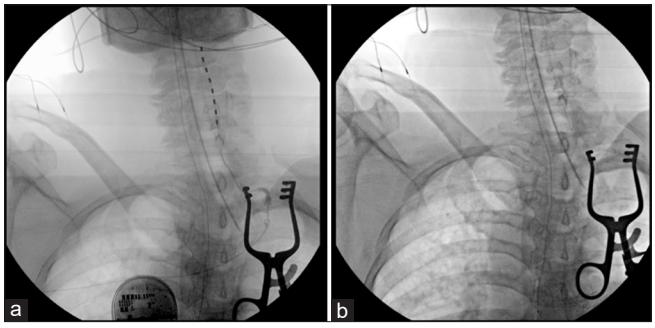

Figure 3: Intraoperative fluoroscopy (a) before and (b) after explantation of lead and pulse generator.

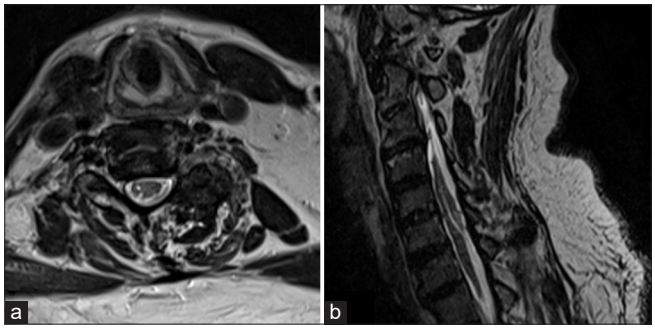

Figure 4: (a) postoperative magnetic resonance imaging of cervical spine axial view (b) postoperative magnetic resonance imaging of cervical spine sagittal view shows abnormal cord signal in the right aspect of the cord extended from C2 to C7.

spinal cord stimulation lead was carefully removed with gentle traction. A silk purse string stitch was placed around the entrance site of the lead to help reduce the risk of cerebrospinal fluid leaking. There were no changes in SSEPs or MEP with the removal of the spinal cord stimulation lead. Next, the left pulse generator site was opened with a scalpel and Metzenbaum scissors, and the pulse generator was removed from its pocket along with the associated wiring. At this point, the entire spinal cord stimulation system had been removed, and C-arm fluoroscopy confirmed a complete explant of the system [Figure 3]. No changes were appreciated with intraoperative neuromonitoring. The patient had an uncomplicated postoperative course and suffered no morbidity or mortality from the procedure. Preoperative symptoms such as reported pain, urinary incontinence, gait, and balance dysfunction resolved after lead removal. The patient was discharged to a skilled nursing facility on postoperative day 8.

DISCUSSION

While spinal cord stimulation has become a crucial operative technique for the treatment of medically refractory neuropathic pain, it is unfortunately common for the implant to be explanted for various reasons, including infection, lack of efficacy, or migration.[2,12,13] Stimulator removal has been shown to be a safe endeavor with minimal complications, which can include a similar complication profile to implantation like infection, cerebrospinal fluid leakage, damage to the spinal cord leading to weakness or paresthesia, retained hardware, or epidural hematoma.[8] A review of the previous literature is appended in Table 1. Topp *et al.*, identified a cohort of 35 patients who underwent SCS removal and documented minimal complications, with two patients having superficial infections, which resolved with a course of oral antibiotics.[15] The technique for removal depended on the extent of scar tissue formation around the implant and would sometimes necessitate extended laminectomy for removal.[6,15]

One of the most common complications of percutaneous procedure is lead migration; however, in this illustrative case, the lead was mispositioned.[4,7] Notably, Eldabe

et al., discuss the benefit of an experienced surgeon for lead implantation as the rate of migration appears to be less.[3] We utilize a series of retention loops and anchors at our institution to prevent postoperative lead migration of the paddle electrode. Calculation of intraoperative impedances and initial programing is essential to determining if the electrode is intradural or not. A common location for epidural mispositioning is in the ventral epidural space, which can be visualized on intraoperative fluoroscopy. Should this occur, removal and replacement of the lead is paramount to achieving the intended purpose of the surgery and proper stimulation of the dorsal columns and medial lemniscus pathway.

Safe implantation and explantation of spinal cord stimulators are often done in conjunction with neuromonitoring of MEP and SSEP to ensure that no harm is being done to the spinal cord due to extrinsic compression by the implant or even an intraoperative hematoma. Owen *et al*. highlight the utilization of neuromonitoring and advocate for the use of a combination of MEP and SSEP in these cases.[10] SSEPs are routinely utilized at our institution to determine the appropriate positioning of the paddle electrode. We perform initial programming intra-operatively to assess any skew of laterality of the implant coverage and determine the optimal initial amplitude of stimulation for pain relief. It is unknown if the percutaneous stimulator was placed with the addition of neuromonitoring. During this illustrative case of a mispositioned intramedullary lead, we managed the explantation as a true intramedullary case with extensive neuromonitoring to ensure the safety of removal.[5]

While magnetic resonance imaging of our patient did show notable myelomalacia along the prior implant track, the patient had minimal residual symptoms after explantation [Figure 4]. A postulated theory as to how the implant ended up in the intramedullary space involves the implantation using the Tuohy needle, which may have pierced the dura, and the lead slowly migrated through the intramedullary plane through blunt dissection through the fibers of the spinal cord.

CONCLUSION

There are few reports about complications involving migration of spinal cord stimulation leads within the intramedullary space of the spinal cord. Herein, we present an illustrative case documenting safe removal with no significant complications.

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