PAIN MEDICINE CASE REPORTS

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Peripheral Nerve Stimulator Lead Fracture and Indolent Infection Requiring Surgical Explant: A Case Report

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Background: Peripheral nerve stimulation (PNS) is an increasingly prevalent treatment modality for acute and chronic pain. One well-known adverse event is lead fracture, particularly for temporary PNS.

Case Report: We present a case of a 73-year-old man with multiple myeloma whose temporary PNS implant for low back pain was complicated by lead fracture during routine removal. The retained fractured PNS lead led to progressively worsening swelling and patient discomfort requiring surgical explant, with indolent culture-confirmed Staphylococcus aureus infection.

Conclusions: Temporary PNS lead fracture is an acknowledged risk with relatively frequent occurrence. Expectant management is most often employed for this complication. However, we present a case where gradually increasing swelling and discomfort, and subsequently diagnosed infection, required surgical explant.

Key words: Peripheral nerve stimulator, back pain, hardware infection, interventional pain, neuromodulation

BACKGROUND

Peripheral nerve stimulation (PNS) is a modality of neuromodulation increasingly used to treat various etiologies of acute and chronic pain by delivering electrical stimulation to peripheral nerves and disrupting nociceptive signals (1). Specifically, it is postulated that electrical pulses generated by PNS devices alter A-delta and C-fiber nerve conduction, which results in subsequent downregulation of pain perception in the central nervous system (2). PNS has been demonstrated to be effective in reducing severity of neuropathic pain and postoperative pain that can be localized to the innervation of one or more peripheral nerves (3). More recently, the indication for PNS has expanded to certain conditions related to musculoskeletal pain, such as low back pain (4,5). Advancements in PNS placement, such as image guidance, percutaneous technique, and improved design, such as development of temporary helical-shaped leads, have decreased the overall incidence of procedure-related complications. Such complications may include nerve entrapment and fibrosis, lead migration, lead fracture, and infection (6,7). In this report, we present the case of a patient who underwent temporary PNS lead placement for axial back pain complicated by lead fracture during planned removal without initial evidence of infection. Over several months, this patient developed worsening subcutaneous swelling and pain at the site of the retained lead, requiring surgical removal of the fragment. The surgical site had a wound culture that was positive for methicillin-sensitive Staphylococcus aureus (MSSA), and the patient was treated successfully with oral antibiotics. Informed consent was obtained from the patient for the description and publication of this case report.

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CASE REPORT

A 73-year-old man with a past medical history of multiple myeloma (on a multimodal immunotherapy regimen), type 2 diabetes complicated by diabetic neuropathy, hypertension, hyperlipidemia, and prior L1 and L4 kyphoplasty in the setting of vertebral compression fractures, presented with over a decade of chronic axial low back pain, worse on the right side.

The patient described his right-sided low back pain as sharp and stabbing, ranging from 4/10 at rest and up to 9/10 when standing on the Visual Analog Scale. Physical exam was positive for facet loading, Patrick's Test on the right, and lumbar paraspinal tenderness, with normal bilateral lower extremity neurologic function. Magnetic resonance imaging (MRI) of his lumbar spine was significant for multifocal degenerative changes, including multilevel facet arthropathy. Prior treatments had included multiple courses of physical therapy dedicated to rehabilitation of the lower back, chiropractic treatment, and various medication trials, including acetaminophen, oxycodone, ibuprofen, gabapentin, and amitriptyline. About one year prior to presentation for PNS, he had undergone right-sided medial branch nerve radiofrequency ablation without sustained improvement in his low back pain. Two months prior to PNS, he underwent an interlaminar lumbar epidural steroid injection and reported complete improvement of his low back pain for the first week postinjection, after which his pain gradually returned.

Due to the multifactorial etiology of his mixed neuropathic and musculoskeletal right-sided low back pain, and lack of sustained improvement with other conventional treatments, lumbar medial branch PNS was offered for treatment.

The patient underwent a temporary 60-day PNS implant under fluoroscopic guidance to the right medial branch at L5 (Fig. 1). All anatomic landmarks were identified with anteroposterior and oblique fluoroscopy, including the superior articular process, lamina, and transverse process at the level of interest. The introducer was advanced without difficulty, and PNS was deployed at the lateral aspect of the L5 retrolaminar space on the right. Nerve stimulation was performed to demonstrate adequate coverage of the patient's index pain. A small amount of skin adhesive was applied to the site of lead entry at the skin. The lead was then attached to the external battery, which was placed on the skin in a holster. The patient tolerated the procedure well, and no procedural complications were encountered.

He presented back to clinic 63 days postimplantation for planned removal of the PNS lead. Unfortunately, the patient endorsed only 20% reduction in his low back pain.

Despite gentle pulling and countertraction on the skin surface at the site of lead entry, lead removal was complicated by fracture and retention of a lead fragment. The patient was evaluated by neurosurgery 3 days after lead fracture and retention, and expectant management was recommended given the patient's initial lack of symptoms. One month later, the patient presented with a new indurated, movable mass at the site of PNS lead removal. There was no open wound, nor was there erythema, warmth, purulence, or pain with palpation. He denied any constitutional symptoms, such as fever, chills, or malaise. Patient underwent ultrasound of the mass (Fig. 2), which demonstrated the retained lead with hypoechoic soft tissue and surrounding hyperemia without evidence of a drainable fluid collection. At that point, a plan was made to closely monitor the patient for signs of active infection or overall clinical changes.

Several months later, he presented with increased size of the mass, with increasing discomfort, particularly with direct pressure, such as sitting against a chair back. Patient underwent lumbar spine computed tomography (Fig. 3), which demonstrated the retained PNS lead. Surgical explant was then performed. Intraoperative ultrasound was used to localize the fragment within the superficial soft tissue swelling, and the lead was able to be readily seen with the assistance of ultrasound. The mass was circumferentially dissected, and the capsule of the granuloma that had formed around the retained lead was incised. Upon opening the granuloma, there was purulent material that was sent for Gram stain and culture. The lead was visualized and removed entirely (Fig. 4). The patient tolerated the procedure well and was discharged on an antibiotic regimen of cephalexin for 10 days.

Three days after surgical PNS lead removal, cultures obtained from the granulomatous tissue surrounding the lead resulted positive for MSSA. The patient's antibiotic regimen was changed from cefalexin to cefadroxil, 1 g twice daily for 10 days. The patient did not experience any complications secondary to lead removal and reported a total resolution of the mass and related discomfort at 3 months after retained lead removal.

DISCUSSION

In this report, we present a case of PNS lead fracture

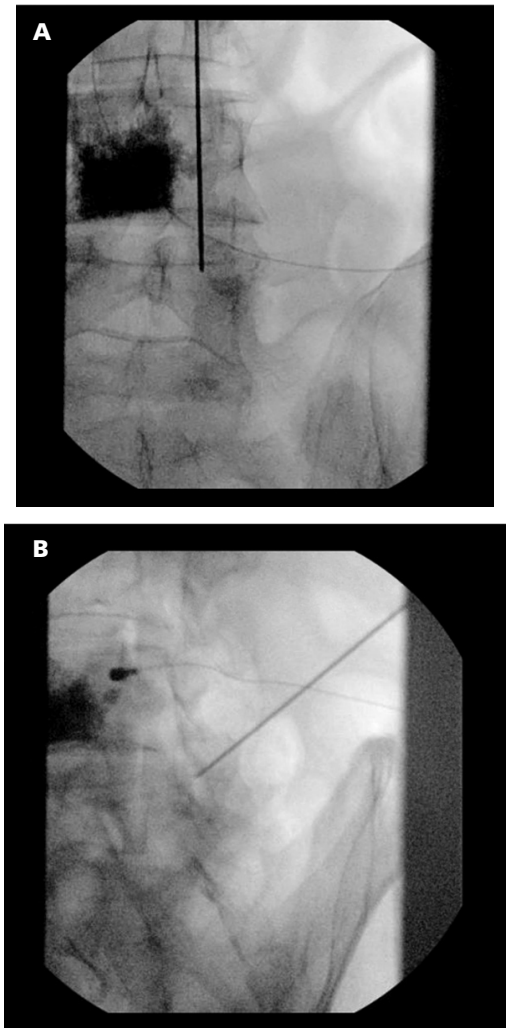

Fig. 1. A) Anterior-posterior fluoroscopic image of introducer placed at the medial branch at L5. B) Contralateral oblique fluoroscopic image of introducer placed at the medial branch at L5.

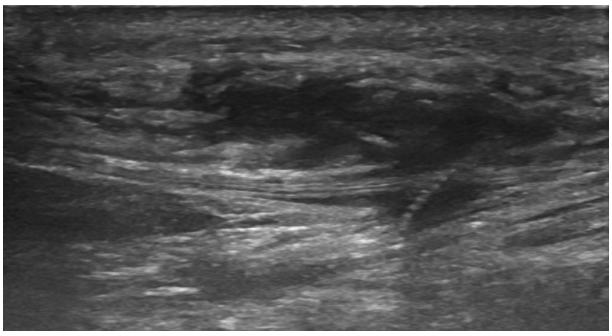

Fig. 2. Ultrasound image of retained PNS lead fragment with surrounding hyperemia

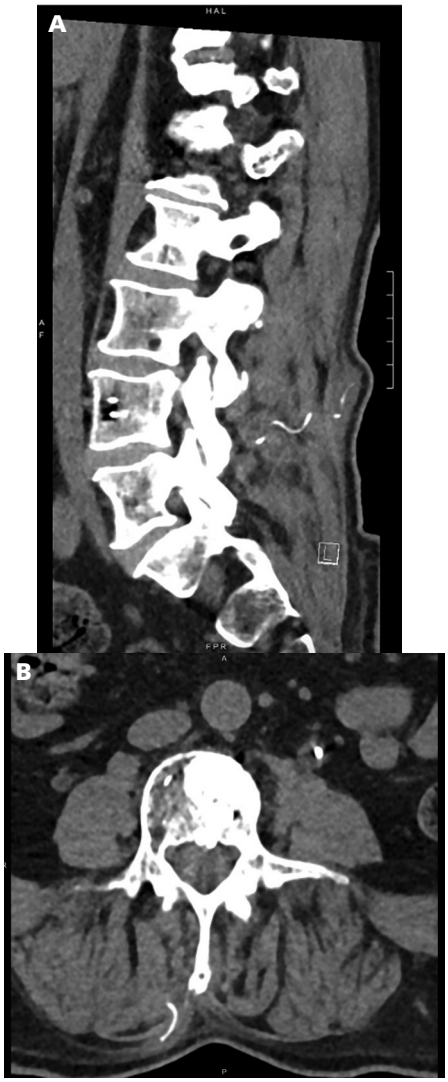

Fig. 3. A) Sagittal computed tomography image of lumbar spine with retained PNS lead and soft tissue mass. B) Axial computed tomography image of lumbar spine with retained PNS lead.

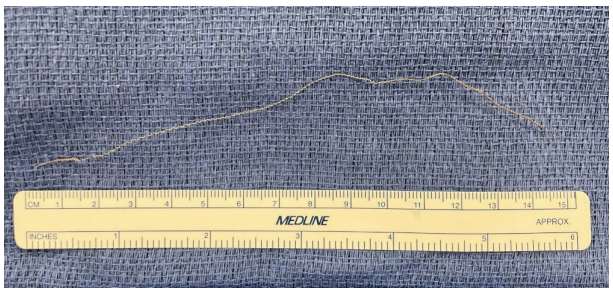

Fig. 4. Image of explanted PNS lead fragment.

and retention necessitating surgical removal, and found to have an indolent MSSA infection. One other case report (8) describes an infected PNS lead, though notably the clinical course in that report was lead infection requiring removal, which caused lead fracture and permanent retention in situ; whereas, the case we present was one in which the fractured lead subsequently became infected. Although the exact mechanism of infection is unknown in this case, the patient's clinical history of immunocompromise secondary to ongoing multiple myeloma treatment may have impacted his overall clinical course.

Notably, the type of implant used in this procedure was a helically coiled PNS lead, which has been shown to have lower risk for infection in comparison with noncoiled leads in a retrospective analysis of PNS complications across trials (one infection per 30,000 coiled lead indwelling days vs one infection per 1,200 noncoiled lead indwelling days, respectively) (9). However, these trials did not subgroup patients by comorbidity, which lends little insight into subgroups who may be experiencing PNS lead infection at higher rates than the general pooled cohort.

The patient in this case was enrolled in a clinical trial using novel immunotherapy agents to treat his refractory multiple myeloma. The mechanism of the primary drug in his regimen remains partially understood (10), though early trials suggest a predisposition toward innate immune system downregulation and suppression. Further, the patient's concurrent dexamethasone and daratumumab treatments may have predisposed him to subcutaneous infection (11).

CONCLUSIONS

There is a relatively high overall incidence of helical PNS hardware fracture and retention (between 6.25% and 7.5% of all PNS lead placements are complicated by fracture) (12,13). Expectant management is generally recommended in cases of lead fracture and retention. The retained fragment is considered MRI conditional (14). It is generally expected that surrounding tissue fibroses around the fragment and remains clinically asymptomatic. However, we describe a case of increased swelling, encapsulated granuloma formation, worsening discomfort, and indolent infection that required surgical excision. As the patient's symptoms worsened gradually over the course of several months, it is important to remain vigilant to late complications related to PNS lead fracture.

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