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Efficacy of Dorsal Root Ganglion Stimulation for Chronic Pain in Leprosy: A Case Report

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Background: Leprosy is a chronic infectious disease that can be associated with refractory neuropathic pain. Neuromodulation with dorsal root ganglion stimulation (DRGS) represents a novel potential therapeutic option for the nonpharmacological management of leprosy-associated chronic pain.

Case Report: We present a case of a leprosy-associated chronic lower extremity neuropathic pain in a 56-year-old man managed with DRGS. The patient underwent implantation of DRG electrodes at the left L5 and right S1 levels for refractory lower extremity pain. Following the procedure, reported significant reduction in pain intensity, decreased analgesic requirements, and improved functionality at short-term follow-up, with no reported postprocedure complications.

Conclusions: The successful treatment of post-leprosy neuropathic pain with DRGS contributes to the expanding body of evidence supporting the use of neuromodulation in the management of treatment-refractory pain. We suggest that DRGS may be a viable interventional option for chronic neuropathic pain from leprosy and other potential indications.

Key words: Dorsal root ganglion stimulation, neuromodulation, chronic pain, leprosy, case report

BACKGROUND

Leprosy is a chronic infectious disease caused by Mycobacterium leprae and Mycobacterium lepromatosis primarily affecting the skin and peripheral nervous system. A few hundred new cases are detected in North America per year, approximately 75% of which are among immigrants (1). Although considered a largely curable disease, individuals with leprosy are at risk of developing long-term complications, including neuropathic pain.

Neuropathic pain is caused by disease of the somatosensory system (2). The prevalence of neuropathic pain in leprosy is reported to be as high as 66% (3). The pathophysiology is thought to involve both leprosy-associated nerve damage, as well as inflammatory components (4).

Neuropathic pain has been shown to have limited response to conventional analgesics. Therefore, recommended therapy has been limited to select antidepressants and anticonvulsants, with patients often requiring combination therapy (5,6). Despite multimodal nonpharmacological and pharmacological treatments, many patients with leprosy still report poorly controlled pain with significant impacts on quality of life.

The prevalence of refractory neuropathic pain is estimated to be 1.5% of the population (7). Interventional pain management strategies for chronic neuropathic pain may be considered after failure of conservative

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treatment modalities, and may include epidural steroid injections, peripheral nerve blocks, radiofrequency ablation, and neuromodulation techniques (2,4,8-10).

Neuromodulation with spinal cord stimulation (SCS) has been successfully used in the management of chronic pain associated with failed back surgery syndrome (11), complex regional pain syndrome (12,13), and refractory neuropathic pain (7,14). Recent evidence (2,9) proposes the dorsal root ganglion (DRG) as an appropriate target for neuromodulation, as it plays a key role in the development of neuropathic pain. In fact, some data (9,10,15) suggests that DRG stimulation (DRGS) may have superior outcomes to SCS. Despite this, limited data exists on the efficacy of neuromodulation, in particular, DRGS, for the treatment of neuropathic pain associated with leprosy (10).

The aim of this case report was to demonstrate the potential efficacy of DRGS in a patient with chronic neuropathic pain secondary to leprosy, providing a new interventional approach to pain considered to be refractory to pharmacological therapy.

CASE PRESENTATION

In 2020, a 56-year-old man, who immigrated from India to Canada, was referred to the Interventional Pain Clinic at St. Paul's Hospital for management for chronic neuropathic pain of the lower extremities secondary to leprosy. His medical history was significant for coronary artery disease, type II diabetes, and leprosy. He was formally diagnosed and underwent treatment for leprosy in December of 2017. He was managed by a multidisciplinary chronic pain clinic, having received ketamine treatments, K-laser therapy, peripheral nerve blocks, as well as epidural steroid injections, all with limited efficacy. For pharmacotherapy, he was taking duloxetine, nortriptyline, pregabalin, and tramadol. This combination afforded an overall pain improvement of 20% to 30% over 2 years.

On examination, the patient described burning pain overlaying the dorsal aspect of his feet bilaterally. He reported the pain to be 3/10 in the right foot and 8/10 in the left foot. He was determined to be a suitable candidate for neuromodulation by our interventional pain team and underwent the necessary processes to become eligible for DRGS, which included seeing a psychiatrist, neurosurgeon, undergoing imaging, and attending pain education classes.

After other potential causes had been adequately investigated, and his pain was determined to be a result of leprosy infection, he was consented for a trial of DRGS. In May 2021, he was placed under conscious sedation for implantation of bilateral DRG electrodes. Using an anteroposterior fluoroscopic view, a linear incision was made and a Tuohy needle was advanced under fluoroscopic guidance into the right S1 foramen. The lead was secured at the fascia with an anchor. Due to difficulty accessing the left S1 foramen, a second electrode was placed at the left L5 foramen. The leads were then stimulated resulting in good coverage of the patient's foot pain. Leads were then tunneled to the left side and, after connecting extensions, the sheath and needle were withdrawn. The patient tolerated the procedure well, and reported an overall 60% to 70% improvement in pain 24 hours after implantation, as well as an improved ability to ambulate.

Due to the success of stage I DRGS, the patient decided to proceed with a full system implant with the expectation that he could achieve similar outcomes long term. Stage II SCS battery insertion was pursued in June 2021. The patient was placed under conscious sedation and the right S1/left L5 foramina (Fig. 1) were accessed similarly as in the trial. After infiltration with a local anesthetic, the paraspinal leads were opened and a right-sided pocket was created to house the generator. The leads were tested intraoperatively and found to adequately cover the pain distribution of the feet. The leads were then tunneled to a right-sided flank incision and connected to the implantable pulse generator. Surgery was tolerated well and the patient was transferred to the recovery room in stable condition.

At his 8-week follow-up after the full system implant, he reported continued pain relief and a desire to wean off his medications. The device was kept on 24/7, the left side was adjusted up to the maximum steps allowed, and the right side only slightly. The patient was very pleased with the results, reporting an improvement of his right foot pain to 1-1.5/10 and his left foot to 3/10. He reported that the DRG stimulator had made a "huge difference in my life," as he was now able to work into the evening without a pain flare and was able to ambulate much more comfortably.

Effects persisted at 4 months postimplantation. The patient reported that his pain level was now 10% of what it was prior to the implantation. In addition, he was also able to improve his exercise capacity, reporting that he was walking ~20,000 steps per day. He was able to completely wean off his pregabalin and duloxetine. He continued to take 1-2 tablets of tramadol a day

although he was uncertain of its effect. He also used self-management techniques, such as mindfulness, to help manage his pain flares. Overall, he reports significant improvement in pain intensity and functional capacity with DRGS.

DISCUSSION

Leprosy is a debilitating infectious disease that primarily targets the skin and peripheral nervous system. Both acute and chronic pain account for significant disability for patients with leprosy (3). Twelve percent to fifty-five percent of new leprosy diagnoses present with peripheral nerve involvement in 4% to 8% of these cases as the sole presentation (13). Delay in the diagnosis of leprosy can lead to significant nerve impairment and morbidity, and may increase the likelihood of the development of chronic pain syndromes.

The management of chronic pain requires a multifactorial approach, which may include nonpharmacologic, pharmacologic, and interventional approaches. Existing therapeutics are primarily pharmacological and are limited by both efficacy and side effects, with a significant percentage of neuropathic pain being refractory to current treatment guidelines (5,7).

SCS, which involves the placement of electrodes into the dorsal epidural space, has been an attractive area of research for chronic pain syndromes refractory to medical and interventional treatment, so far with promising results (11-15). The lack of precision with SCS, however, may account for less-than-optimal outcomes for some patients suffering from chronic pain (9). Advancements in neuromodulation technology, have sought to improve upon these limitations, for example, by specifically stimulating the DRG. The DRG contains the cell bodies of sensory neurons that are involved in the development of neuropathic pain. Animal models of chronic pain have shown reproducible pathophysiologic alterations in the DRG (9). Due to its sensory function and surgical accessibility, the DRG is an ideal target for neurostimulation. Recent data (9,10,15) might even suggest that DRGS has better outcomes than traditional SCS, with similar risks and complications.

Neuromodulation with DRGS may provide a nonpharmacological alternative to the treatment of leprosy (10). Until now, there has been only one other case reported in the literature where SCS demonstrated improvement in chronic pain secondary to leprosy (13). Our case report has further expanded on the potential utility of DRGS in leprosy-associated neuropathic pain.

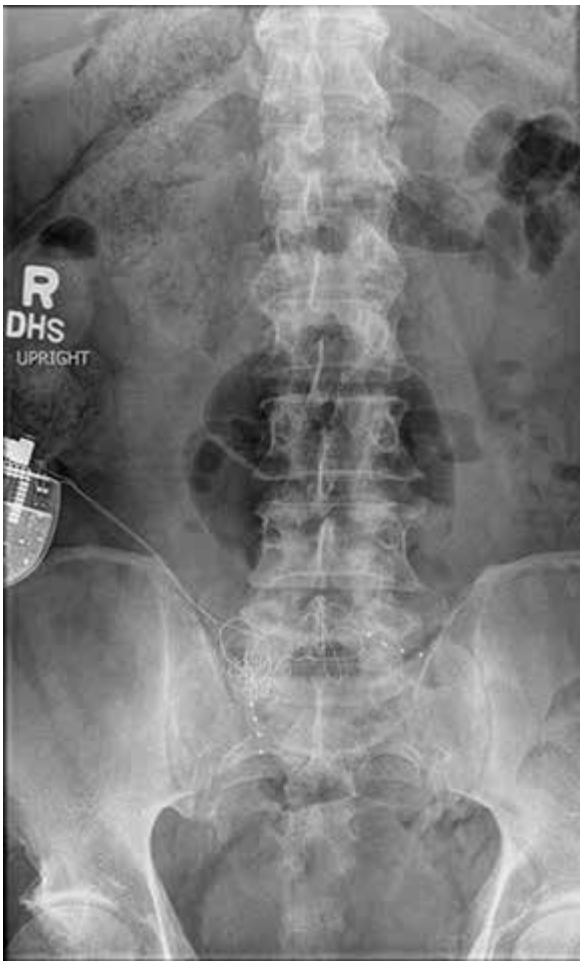

Fig. 1. Lead placement of left L5 and right S1

Our finding of improvement in leprosy-associated neuropathic pain, function, and quality of life in patients undergoing neuromodulation is encouraging. The case presented reported a significant reduction in pain intensity, as well as decreased analgesic requirements and improved functional capacity after implantation. These findings provide optimism for potential non-pharmacological treatment of chronic neuropathic pain refractory to conventional treatment, in the setting of leprosy. However, there are several limitations to this case report. Pre- and post-DRG implantation pain intensity was reported subjectively by the patient, without the use of validated pain scales. In addition, long-term outcomes, complications, and side effects cannot yet be inferred. Further, accessibility of neuromodulation therapies is limited. The observations presented in

this report remain to be confirmed through additional investigation and future prospective controlled studies.

CONCLUSIONS

In summary, our case of a 56-year-old man with chronic leprosy-associated pain is likely the first of its kind to demonstrate the use of DRGS for intractable neuropathic pain following leprosy. While well-designed clinical studies must be done to investigate the efficacy of DRGS for pain associated with leprosy infection, this case report suggests DRGS to be a viable option for those with refractory leprosy-associated neuropathic pain and has the potential to be added to the growing list of indications for neuromodulation.

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