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A Case Report of Successful High-Frequency 10-kHz Spinal Cord Stimulator Trial in a Patient with Refractory Thoracic Postherpetic Neuralgia

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Background: Spinal cord stimulation can be an effective treatment modality in patients suffering from postherpetic neuralgia who have failed first-line pharmacotherapy and continue to struggle from debilitating pain. Appropriate patient selection and having a wide array of stimulation waveforms can enhance the success of spinal cord stimulator trials.

Case Report: In this article, we present a case report of a patient suffering from refractory thoracic postherpetic neuralgia who underwent a successful high-frequency 10-kHz spinal cord stimulator trial. Lead tips were successfully placed at the midline and left paramedial side of the top of T1 vertebral bodies at the source of the pain. The patient was followed up in our clinic 7 days post procedure. At the time of follow-up, our patient reported an 85% to 90% reduction in his pain symptom scores and a significant improvement in his quality of life.

Conclusion: Similar successful trials for postherpetic neuralgia have been reported in small studies using traditional low-frequency stimulation waveforms. However, to our knowledge, this is the first report of a successful spinal cord stimulator trial using high-density 10 kHz.

Key words: Postherpetic neuralgia, high-frequency spinal cord stimulator, acute herpes zoster

BACKGROUND

An estimated one million people in the United States experience acute herpes zoster (AHZ) reactivation. It is most commonly seen in the fifth and sixth decade of life and stems from a recurrence of latent varicella infection localized to sensory ganglia. In most patients, it presents as a severe sharp and burning pain with herpetic vesicles accompanying the pain in the dermatomes of the affected dorsal root ganglia (1). Within 4 months, most patients see a resolution of dermatomal pain after healing of herpes zoster vesicles. However, in 9% to 14% of patients, the pain persists for months to years after resolution of the vesicles. This persistent pain is diagnosed by clinicians as postherpetic neuralgia (PHN) (2). PHN is a debilitating chronic condition that most commonly affects the elderly, immunosuppressed, diabetic, and those with lupus. Patients with PHN describe their pain as burning, sharp, stabbing, electrical,

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and shock-like sensations (4). The pain disrupts quality of life in these patients. Currently, many theories exist regarding the exact pathophysiology of PHN, but there is no consensus. Some theories point to peripheral nerve injury and subsequent changes in the neurotransmitter-mediated central nervous system signaling and gating system as the primary cause of severe allodynia and subsequent pain (3). Another theory points to spontaneous nerve discharge and formation of new connections and new receptor channels after nerve injury as the etiology of pain (4). One channel type that increases in density at the site of injury is the transient receptor potential vanilloid-1 receptor (TRPV1) (5). Substance P, released from capsaicin, is an agonist of TRPV1 receptors, and topical administration leading to chronic overstimulation of these receptors may result in desensitization (6). As a result, there has been increased interest in using topical capsaicin, which may modulate these channels to treat pain associated with PHN, though the quality of evidence is low to moderate per a recent Cochrane review (7). Multiple etiologies likely exist in the pathophysiology of PHN and a multimodal treatment plan remains the most effective therapy in management.

First-line management of PHN includes pharmacotherapy with gabapentin, pregabalin, tricyclic antidepressants, and lidocaine transdermal patches (8). Studies from randomized controlled trials show that patients experience a minimal to modest reduction in pain, and can experience side effects such as drowsiness, dizziness, and sedation leading to intolerance (8). Unfortunately, a small subset of patients is refractory to all conservative therapies. In this group, neuromodulation with a spinal cord stimulator offers another modality to effectively manage the pain. Here, we describe a patient with PHN whose pain was refractory to pharmacotherapy but who responded quite well to a high-frequency spinal cord stimulator trial.

CASE

Our patient was a 70-year-old man who presented to our pain clinic for evaluation of chronic left-sided chest wall pain after an episode of herpes zoster 6 months prior. His pain was mapped out to the left T5-10 dermatomes and radiated to the lateral and anterior chest wall. He described the pain as sharp, burning, and stabbing in quality, and rated it 10 of 10 on a 0-to-10 numeric rating scale for pain. Our patient stated that the pain was constant throughout the day and intensified with postural changes, sleeping on his left side, and very light touch. He had mild relief with pharmacotherapy which included gabapentin, pregabalin, lidocaine gel, lidoderm patch, tricyclic antidepressants (TCAs), topical capsaicin, and hydrocodone. He also had limited benefit with a transcutaneous electrical nerve stimulation (TENS) unit. Over the next year, the patient was treated with T5-10 intercostal nerve blocks and interlaminar epidural steroid injections, which were moderately effective in controlling his pain. However, these only lasted 2 to 3 months with each treatment and he continued to have episodic spikes of severe pain rated 8 of 10. Over time, he felt that the blocks were decreasing in efficacy and the decision was then made to offer him a high-frequency spinal cord stimulation (SCS) trial.

The patient underwent a high-frequency 10-kHz Nevro spinal cord stimulator (Nevro Corporation, Redwood, CA) trial with lead tips successfully placed at the midline and left paramedial side of the top of the T1 vertebral body after sensory confirmation testing in the middle of placed leads showed 100% overlapping pain areas, as shown in Fig. 1. The stimulator initial parameters were set at a frequency of 60 Hz, pulse width between 250 to 400 μs, and an amplitude ranging from 0 to 3 mA. He was also provided with programming of 10 kHz which he preferred over others. He was seen a week later in our pain center for follow-up evaluation and reported 85% to 90% reduction in his baseline pain. He also noted significant reduction in the frequency and intensity of his flareups and commented on his improved, pain-free sleep. However, he deferred a permanent implantation until after his retirement when he would have time for the postoperative recovery.

DISCUSSION

PHN is a chronic neuropathic pain condition that is quite debilitating. Conservative pharmacotherapy remains the mainstay of initial treatment; however, a subset of patients will continue to have moderate to severe refractory pain (3). Currently, there is a dearth of evidence on the management of such refractory patients. Multiple modalities of treatment have been explored in the form of botulinum toxin injections, acupuncture, nerve blocks, TENS units, and epidural steroid injections with varied results (3). The data is sparse and inconclusive. Likewise, the data is also limited on the effectiveness of SCS for this condition. However, we did identify one case report published by Barba et al (9) that showed the utility of using a high-frequency peripheral nerve stimulator for the treatment of supraorbital PHN.

In that case, using an ultrasound-guided approach, a peripheral nerve stimulator was inserted over the left supraorbital and supratrochlear nerve utilizing high-frequency stimulation. The study reported a pain reduction from a score of 8 of 10 to a 1 of 10 over a 9-month follow-up period. To our knowledge, no high-frequency SCS trials were attempted as a treatment modality for patients with PHN.

Although SCS implantation is a surgically invasive and expensive therapy, it does afford patients with a drug-free therapy, especially in the context of medication intolerance or ineffectiveness. In our literature search, we identified a metanalysis of case reports and retrospective studies that examined the analgesic effects of low-frequency paresthesia-driven SCS for PHN in patients whose primary pain was refractory to first- and second-line medication therapy. Their metanalysis revealed 16 such studies that evaluated a total of 255 patients for the efficacy of the spinal cord stimulator trials and implantations for treatment of PHN. In these studies, detailed numeric pain scores were only available and thoroughly reported in 66 patients. Per the data, there was a 79% reduction in the mean numerical pain score from before to after implantation of the spinal cord stimulator. In studies evaluating patients undergoing a temporary trial with low-frequency SCS prior to permanent implantation, 42 out of 54 patients received long-term relief (10). One study noted a dramatic decrease of opioid use in 94.7% of patients (11).

To improve the success of SCS therapy, appropriate patient selection is imperative. However, scarce data on predictive factors, stimulation patterns, and lead location for SCS success for PHN exists. In one study, patients who had pain relief with a diagnostic sympathetic block and subsequently received a SCS trial did quite well; pain improvements of > 50% were noted in 82.1% of the patients, indicating that a successful sympathetic block might be predictive of greater response to SCS (11). Similarly, in another case series, Moriyama et al (12) noted that 14 patients who had good pain control with an epidural block but were unable to continue on the therapy secondary to side effects also performed quite well in SCS trials, with pain relief > 50% noted in all 14 patients. The data from both studies suggest that patients who experience improvement with epidural steroids and/or sympathetic nerve blocks may be good candidates for SCS therapy, possibly through modulation of spinal hypersensitization. Patients whose pain was, in part, related to psychogenic causes, sensory disturbances, and central sensitization did not respond well to SCS (13). Shimoji et al (14) looked at 126 patients with such psychogenic etiologies of pain treated with a spinal cord stimulator and noted that only 27.8% of patients reported improvement in pain.

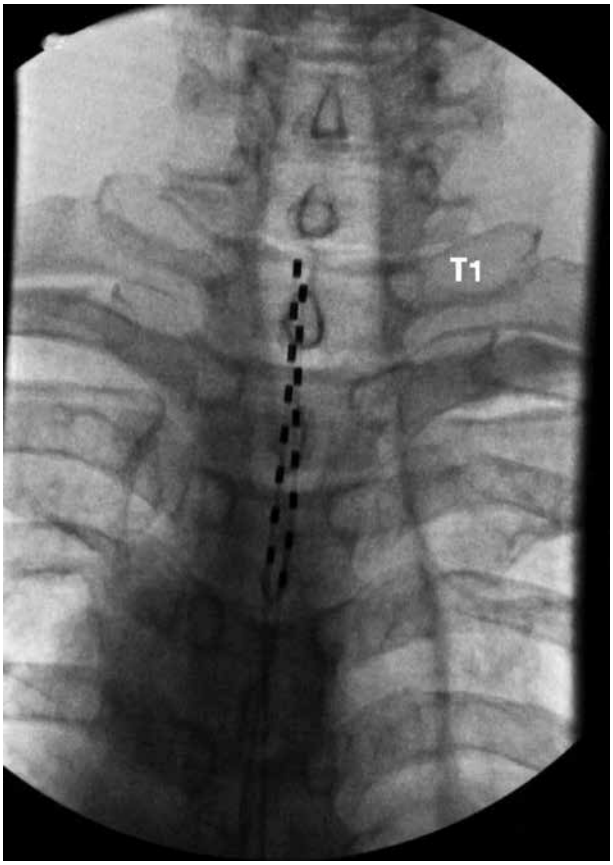

Fig. 1. Placement of the 2 leads at T1 level.

Our patient was responsive to epidural steroid injections and intercostal nerve blocks prior to receiving the SCS trial. Therefore, he was deemed to be a good candidate for the SCS therapy and ultimately had a favorable outcome. We chose to offer high-frequency stimulation at 10 kHz with leads placed in the high thoracic region, as recent preliminary case series data has shown this to be effective in reducing thoracic axial and/or radicular pain in 6 patients (15). Kapurai et al (16) also showed that high-frequency stimulation at 10 kHz was more effective in reducing back pain than traditional low-frequency SCS. Their data showed that 76.5% of patients with 10 kHz stimulation had moderate to significant improvement in back pain compared to just 49.3% of patients in the traditional SCS group. Based on this

data, we speculated that having the ability to provide high-frequency stimulation at 10 kHz would provide substantial relief in our patient. Since low-frequency sensory testing was done during trial lead placement in our patient with achieved 100% paresthesia over pain areas, the option to provide lower-frequency stimulation in a more traditional method was always present. Our patient was provided with multiple programs of stimulation during the trial, including low-frequency with paresthesia, but chose the high-frequency 10 kHz due to the greatest comfort and pain relief experienced. To our knowledge, there are no published studies on the use of high-frequency SCS at 10 kHz for the treatment of refractory thoracic postherpetic pain.

CONCLUSION

Spinal cord stimulators do offer hope to patients with refractory PHN. Their effectiveness can be maximized with appropriate patient selection and offering a wider array of stimulation waveform options, including possibly high-frequency 10 kHz. Current literature is still quite limited in exploring the potential effectiveness of SCS for PHN and there is a great need for multicentered randomized controlled trials to examine this.

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