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Peripheral Nerve Stimulation with High-Frequency Electromagnetic Coupling (HF-EMC) at the Posterior Tibial and Common Peroneal Nerves for the Treatment of Chronic Lower Limb Pain: Case Report

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Background: Chronic lower limb pain due to mononeuropathy can be highly debilitating, affecting quality of life both physically and psychosocially. Attention around peripheral nerve stimulation has heightened in recent years due to increasing data demonstrating positive outcomes in chronic pain management. This study discusses a case of chronic lower limb pain managed effectively with peripheral nerve stimulation of 2 key nerves in the lower extremity: the posterior tibial and common peroneal.

Case Report: A 68-year-old man presented with squeezing and crushing pressure encasing the entire left foot and ankle, with paresthesias along the heel and arch while walking and sharp radiating pain at the medial ankle and along the arch when sitting. In addition, 3 to 4 evenings per week, episodes of sharp radiating pain between the calf and ankle would occur for several hours. The average foot and ankle pain was 7 of 10 on the Verbal Rating Scale (VRS), with the evening calf episodes averaging 10 of 10. Previous therapies included nonsteroidal anti-inflammatory drugs (NSAIDS), nerve blocks, nerve ablation, opioids, spinal cord stimulation (SCS), and intrathecal drug delivery, all of which resulted in minimal, temporary relief. After successful diagnostic nerve blocks, peripheral nerve stimulators were placed at the posterior tibial and common peroneal nerves providing significant relief.

Conclusion: Subthreshold peripheral nerve stimulation at the posterior tibial and common peroneal nerves has proven successful for a patient suffering from chronic, debilitating lower limb pain due to mononeuropathy; results included decreased chronic pain and fewer pain episodes as well as increased activity, better socialization, and a significantly improved quality of life.

Key words: Ankle, chronic pain, common peroneal, foot, lower limb, mononeuropathy, peripheral nerve stimulation, posterior tibial

BACKGROUND

Chronic pain is a significant source of disability in the elderly (1). Lower extremity mononeuropathies are frequently seen in clinical settings, with discomfort affecting mobility and significantly reducing quality of life. Lower limb pain can be caused by various conditions and may have multiple contributing factors, complicating diagnosis and treatment. Nerve compression, entrap-

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ment, and trauma in the lower extremity often lead to neuropathy characterized by pain in the calf, ankle, and foot and are frequently accompanied by paresthesias.

Treatment for neuropathies may include surgery when less invasive options such as physical therapy, anti-inflammatory drugs, antidepressants, antiepileptics, corticosteroid injections, and immobilizing splints are unsuccessful. Early intervention is necessary for peripheral neuropathies to prevent complications and associated comorbidities (2). Since peripheral nerve stimulation (PNS) is the least invasive form of neuromodulation, PNS is becoming increasingly popular as a treatment option for persistent lower limb pain (3).

This report presents the case of an elderly male patient who underwent PNS of the left posterior tibial and common peroneal nerves to treat chronic pain of the left lower extremity due to mononeuropathy that was previously unresponsive to conservative therapy, spinal cord stimulation (SCS), and intrathecal pump therapy.

CASE

A 68-year-old man presented to the Texas Institute of Pain and Spine with a crushing sensation encasing the entire left foot, paresthesias along the heel and arch while walking, and sharp, shooting pain in the plantar foot and medial ankle when sitting. He also experienced shooting pain in the calf lasting several hours, 3 to 4 evenings per week. The average pain scores were 7 of 10 in the foot and ankle, with the lower leg episodes rated 10 of 10 on the evenings they occurred. The patient was subsequently diagnosed with mononeuropathy at the left posterior tibial and common peroneal nerves. Previous therapies included nonsteroidal anti-inflammatory drugs (NSAIDS), nerve injections, nerve ablation, opioids, SCS therapy (explanted due to ineffectiveness), and an intrathecal pump.

After successful diagnostic nerve blocks, the decision was made to trial the patient for PNS of the left posterior tibial and common peroneal nerves. The procedure was performed using ultrasound and fluoroscopic guidance. Two electrode arrays were placed percutaneously and secured sterilely, and the patient was sent home for the trial period. The patient wore the transmitter on the lower leg with the antenna on the posterior calf. Preferred stimulation settings were 1000 Hz and 1.4 to 1.9 mA. After the trial, the patient reported approximately 60% pain relief. The trial electrode arrays were subsequently removed in the office without complications, and the patient elected to proceed with the permanent implantation.

Device Description

The Freedom® PNS System (Curonix LLC, Pompano Beach, FL) uses high-frequency electromagnetic coupling technology to power the implanted neurostimulator (Fig. 1). Each stimulator is comprised of an electrode array with 4 or 8 contacts (1.3 mm in diameter with 4-mm spacing) and the electrode array is connected to a separate implanted receiver. A small, external rechargeable transmitter supplies the energy and data to the implanted neurostimulator through the skin. The device uses pulsed electrical current to create an electrical field that acts on nerves to inhibit the transmission of pain signals to the brain.

Procedure

The path of the common peroneal nerve near the fibular head was visualized, and a needle entry point and pathway were planned using ultrasound, palpation, and fluoroscopy. The electrode array was laid on the skin with the 0-electrode at the top of the device placed at the common peroneal nerve. The needle entry location was identified at the midcalf. The skin and deeper tissues were anesthetized using a mixture of 1% lidocaine and 0.25% bupivacaine with epinephrine. A #10 blade was used for the first incision at the needle entry point. A 13-gauge PNS introducer was passed through the subcutaneous tissues and advanced subcutaneously in the fascial plane from the midcalf superiorly toward the common peroneal nerve at the fibular head. The electrode array was inserted through the cannula of the introducer and advanced to the common peroneal nerve (Fig. 2).

The path of the posterior tibial nerve in the lower leg was also visualized in the same manner. The electrode array was placed on the skin with the distal electrode at the posterior tibial nerve near the medial malleolus and the remainder of the electrode array running superiorly. The skin and deeper tissues were anesthetized, and an initial incision was made at the needle entry point on the midcalf. The introducer was passed through the subcutaneous tissues from the midcalf inferiorly toward the posterior tibial nerve and advanced in the fascial plane. The electrode array was inserted and advanced to the posterior tibial nerve with final placement near the medial malleolus (Fig. 3). Both electrode array locations were confirmed using fluoroscopy and ultrasound.

The steering stylets were removed, and separate receivers were connected to the electrode arrays. The tails crossed midcalf (one coming up from the posterior

Fig. 1. Freedom SCS/PNS systems.

tibial, one coming down from the common peroneal) and aligned in a way that allowed both receiver coils to be anchored in a shared receiver pocket. The receiver pocket was created with a second incision, and the electrode arrays were tunneled beneath the skin from the first incisions to the receiver pocket. A knot was tied to connect the separate receivers and electrode arrays. The receivers were coiled and then sutured to the fascia with 2-0 silk in the receiver pocket. The receiver pocket was closed using 2-0 VicrylTM and 4-0 MonocrylTM; then DermabondTM, TelfaTM, and TegadermTM were applied. The patient uses one wearable antenna assembly for both stimulators.

RESULTS

At one week post implant, pain scores were reduced from 7 of 10 to 3 of 10 for the foot and ankle pain, and 10 of 10 to 4 of 10 for the evening calf episodes. These pain scores continued to improve; by 6 months post implant, they were 1 of 10 and 2 of 10, respectively. The calf episodes also decreased in frequency from 3 to 4 evenings per week to 1 to 2 evenings per month with a shorter duration of each episode. This was accompanied by increased activity and quality of life. No complications were reported.

DISCUSSION

Peripheral nerve issues afflict roughly 2.4% of the general population and 8.0% of the elderly (4). The peripheral nervous system consists of a vast circuit in which peripheral nerves send pain (and other) information to the brain. PNS modulates this circuit to control pain. The mechanism of PNS has been the subject of numerous theories. The most widely recognized hypothesis around using PNS as a pain management technique for chronic pain is the gate control theory by Melzack and Wall (5).

Additionally, some research has suggested that PNS may lessen the sensitivity required to feel pain by raising the threshold for nociceptive stimulation of peripheral nerve fibers (7).

Fig. 2. AP view of device placement common peroneal nerve

Fig. 3. AP of device placement posterior tibial nerve
Abbreviations: AP, anteroposterior; PNS, peripheral nerve stimulation; SCS, spinal cord stimulation

Studies on chronic lower limb pain alone are uncommon because persistent low back pain is typically included as an associated component. This PNS case is distinctive as it targets chronic lower limb pain due to mononeuropathy, a target that SCS may not adequately address.

This case study adds to the body of research on PNS that shows promise for considerable neuropathic pain alleviation. In this instance, PNS was successful in treating a 68-year-old man with a crushing sensation encasing his entire left foot and ankle, with paresthesias and sharp pain along the plantar foot, and additional episodes of sharp radiating pain in the calf after failing other therapies, including SCS and an intrathecal pump.

Due to PNS's efficacy in chronic, intractable pain that is refractory to traditional therapy, it has gained popularity in treating several chronic pain syndromes. Externally powered devices can be implanted using ultrasound or fluoroscopy without implantable batteries and with a lower risk of complications.

The Freedom PNS System (Curonix LLC, distributor of Stimwave Freedom products, Pompano Beach, FL) was used on the left posterior tibial and common peroneal nerves in this case. The patient reported approximately 60% pain relief post trial, reached 85% pain relief by 6 months post implant, and has maintained this relief for over a year, along with increased activity and quality of life.

CONCLUSION

PNS has been shown to be a safe and effective treatment for chronic pain resulting from peripheral nerve injury and entrapment in case reports and retrospective reviews.

Recent developments in neuromodulation may open the door to nondrug treatments for chronic pain, which would lessen the need for opioids and their associated risks.

Subthreshold PNS at the posterior tibial and common peroneal nerves has proven successful for a patient suffering from chronic, debilitating lower limb pain due to mononeuropathy and allowed increased activity, better socialization, and a significantly improved quality of life.

REFERENCES

1. Eggermont LHP, Bean JF, Guralnik JM, Leveille SG. Comparing pain severity versus pain location in the MOBILIZE Boston study: Chronic pain and lower extremity function. *J Gerontol A Biol Sci Med Sci* 2009; 64A:763-770.
2. Hammi C, Yeung B. Neuropathy. In: *StatPearls [Internet]*. Treasure Island, FL: StatPearls Publishing; 2022. www.ncbi.nlm.nih.gov/books/NBK542220/
3. Ferreira-Dos-Santos G, Hurdle MFB, Gupta S, Clendenen SR. Ultrasound-guided percutaneous peripheral nerve stimulation for the treatment of lower extremity pain: A rare case report. *Pain Pract* 2019; 19:861-865.
4. Hughes RA. Peripheral neuropathy. *BMJ* 2002; 324:466-469.
5. Melzack R, Wall PD. Pain mechanisms: A new theory. *Science* 1965; 150:971-979.
6. Chakravarthy K, Nava A, Christo PJ, Williams K. Review of recent advances in peripheral nerve stimulation (PNS). *Curr Pain Headache Rep* 2016; 20:60.
7. Nayak R, Banik RK. Current innovations in peripheral nerve stimulation. *Pain Res Treat* 2018; 2018:9091216.