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Peripheral Nerve Stimulation Uses High-Frequency Electromagnetic Coupling Technology to Power an Implanted Neurostimulator With a Separate Receiver at the Ilioinguinal Nerve for the Treatment of Chronic Groin and Abdominal Pain: Case Report

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Background: Chronic groin pain can be debilitating to patients, reducing their overall quality of life. Peripheral nerve stimulation (PNS) is an emerging neuromodulation therapy that may be used for groin pain refractory to other treatment modalities.

Case Report: An 86-year-old Hispanic man with a history of left inguinal hernia repair with mesh presenting chronic groin and abdominal pain was successfully treated with subthreshold PNS at the ilioinguinal nerve.

Conclusion: This case study demonstrated that subthreshold PNS can safely and effectively manage chronic groin and abdominal pain.

Key words: Peripheral nerve stimulation, chronic pain, ilioinguinal, groin pain

BACKGROUND

Chronic groin pain after inguinal hernia repair is present in approximately 5% to 10% of patients (1). Groin pain is considered chronic when it lasts longer than the normal tissue healing time of 3 months (2,3). The pain can be broadly categorized as neuropathic or nociceptive (4). The neuropathic component is caused by damage to nerves that results in symptoms of sensory dysfunction, while the nociceptive component is caused by the inflammatory response or direct injury to nonneural somatic and visceral structures (5,6). Chronic groin pain can be extremely detrimental to the individual's ability to perform daily activities and work (7). Additional consequences of chronic groin pain include depression, anxiety, sleep deprivation, cognitive impairment, and increased medical expenses (1). The initial treatment typically involves the use of anti-inflammatory medications, anticonvulsants, and opioids (2). Other treatment options include mesh and suture excision, neurectomy, neuroma excision, local anesthetics, laser therapy, cryo or radiofrequency nerve ablation, and physical therapy (2,7).

Peripheral nerve stimulation (PNS) is an emerging neuromodulation therapy for the management of both pain and urinary/bowel conditions that are refractory to conventional treatments (8). PNS represents an alternative to opioids and may play an important role in reducing opioid prescriptions and consumption (9). This case report presents a patient with chronic groin pain that was effectively managed by externally powered PNS technology.

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CASE PRESENTATION

An 86-year-old Hispanic man presented at our clinic with chronic allodynia and hyperalgesia in the groin and lower abdomen on the left side, since 2016, after a left inguinal hernia repair with mesh followed by revision after infection and exploration. Since the surgery, the patient had been complaining of severe burning, throbbing, and achy sensations with a feeling of pins and needles in his groin region. The patient complained of a pain score of 9/10 on the verbal rating scale (VRS). The pain increased with bending, coughing, sneezing, or bowel movement. The pain was also aggravated by touch or pressure. The patient was diagnosed with ilioinguinal and iliohypogastric entrapment, complex regional pain syndrome (CRPS), and nerve damage. He was taking 300 mg of gabapentin 3 times a day, which made him drowsy, and hydrocodone 10 mg up to 3 times a day as needed. Despite these medications, the patient reported persistent limitations with activities of daily living due to pain.

After a successful diagnostic injection of the ilioinguinal and hypogastric nerves using landmarks with a solution of a local anesthetic and steroid, the patient reported an 80% improvement in pain symptoms. The decision was made to trial the patient for PNS of the ilioinguinal nerve since the diagnostic injection at the ilioinguinal nerve proved to provide the majority of the pain relief.

The trial procedure was performed using ultrasound and fluoroscopic guidance. Two 4-contact electrode arrays with tines were used to provide optimal coverage. They were placed and secured sterilely, and the patient was sent home for the trial period. Preferred stimulation settings were discovered at 1,499 kHz. The patient wore the antenna over the incision site on the left lower abdomen and the transmitter in his pocket (Fig. 1). The patient reported > 50% relief with improved functionality after the trial. The trial electrode arrays were subsequently removed in the office without complications, and the patient decided to proceed with the permanent implant.

Device Description

The Freedom® PNS System (Curonix LLC, Pompano Beach, FL) uses high-frequency electromagnetic coupling technology to power the implanted neurostimulator (Fig. 2). Each neurostimulator is comprised of an electrode array with 4 or 8 contacts, 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 electric current to create an electrical field that acts on nerves to inhibit the transmission of pain signals to the brain.

Permanent Implant Procedure Methods

The patient was placed in the supine position on the operating table. The lower abdomen and groin on the left side were prepped and draped in the usual sterile manner using a chlorhexidine and alcohol prep solution. The ilioinguinal nerve was located by ultrasound. The electrode array was placed on the skin, with the distal electrode placed at the ilioinguinal nerve and the remainder of the electrode array running obliquely up to the lower abdomen. The needle entry point and pathway were planned using palpation and fluoroscopy. The skin and deeper tissues were anesthetized using a mixture of 1% lidocaine and 0.25% Marcaine with 1:100,000 epinephrine. A first incision was made, and the 13G introducer needle was passed through the incision and advanced subcutaneously in the fascial plane to the ilioinguinal nerve target under ultrasound guidance. The electrode array was inserted through the cannula and advanced to the ilioinguinal nerve at the left lateral abdomen. A second electrode array was placed using the same technique (Fig. 3).

The steering stylets were removed, and separate receivers were connected to the electrode arrays. A receiver pocket was created using a second incision, and the neurostimulators were tunneled beneath the skin from the receiver pocket to the first incisions (Fig. 4). A knot was tied to permanently connect the separate receivers and electrode arrays. The neurostimulators were coiled, and the coils were sutured to the fascia and secured within the pocket. The receiver pocket was closed with subcutaneous and subcuticular sutures using 4-0 Monocryl, then covered with Tegaderm.

RESULTS

Immediately following the permanent procedure, the patient reported dramatically improved pain scores decreasing by 90% with the use of the neurostimulator. This has remained consistent for 18 months after the permanent implant. He currently reports pain scores of 2/10 VRS and no longer experiences allodynia and hyperalgesia at the site of multiple ilioinguinal explorations and surgeries in the groin. The patient stopped using pain medication. No complications were reported.

Fig. 1. Patient wearing the Freedom® PNS system.

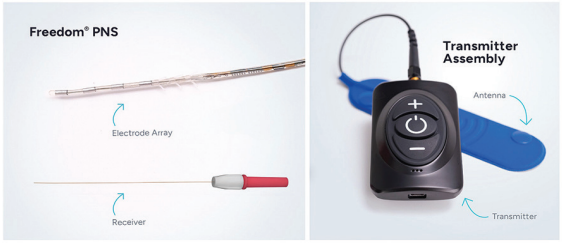

Fig. 2. Freedom® PNS system.

DISCUSSION

This case report details the successful management of groin pain and sensory dysfunctions using PNS. The ilioinguinal nerve was targeted because it is often attributed to the development of groin pain, as it is commonly encountered during open inguinal hernia repair (4).

The patient presented in this case report was diagnosed with CRPS, which is difficult to diagnose. Peripheral nerve entrapment can present with symptoms suggestive of CRPS, but a misinterpretation of the symptoms leading to an incorrect diagnosis would be problematic, as a different treatment method would be required.

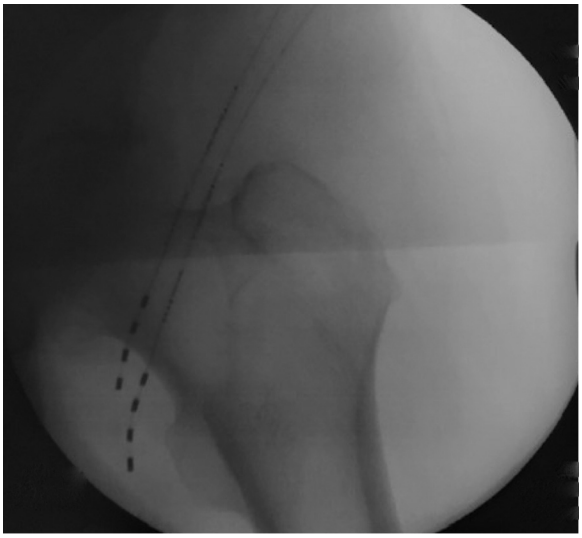

Fig. 3. X-ray image of placement at the ilioinguinal nerve.

Fig. 4. Neurostimulators tunneled beneath the skin from the first incisions to the receiver pocket.

Abd-Elsayed (9) previously reported 2 cases of groin pain that were also successfully managed by externally powered PNS. One patient experienced 100% pain improvement, and the other experienced 50% improvement. Since groin pain consists of both neuropathic and nociceptive components, response to neuromodulation can be variable (4,10). Additional case reports/series (11,12) have also found similar success with conventional PNS systems in treating groin pain.

The role of wireless PNS in treating different chronic pain conditions and neuralgias has been reported at different nerves to treat various conditions (13,14).

Externally powered PNS technology comes with several advantages as compared to conventional systems. Notably, using a wireless external pulse generator removed the need for an implantable battery (9). This avoids additional battery replacement surgeries and reduces the risk of complications overall. Additionally, the transmitter assembly can be placed over regular clothing and does not require special accommodations by the patient.

Our patient achieved 90% improvement at the 18-month follow-up with no reported complications and was satisfied with the device and wearability.

CONCLUSIONS

PNS at the ilioinguinal nerve using subthreshold therapy has proven successful for this patient suffering from chronic, debilitating groin and lower abdomen pain due to ilioinguinal and iliohypogastric entrapment, CRPS, and damage. This treatment has allowed for an impactful reduction in pain scores and improved functionality and quality of life.

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