PAIN MEDICINE CASE REPORTS

ISSN 2768-5152

Volume 8, Number 7, pp. 293-297

Successful Pain Management of Uncontrollable Left Wrist Pain With Peripheral Nerve Stimulation Following Failed Surgeries: A Case Report

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Background: Complex regional pain syndrome (CRPS) of the left superficial radial nerve can present significant challenges in pain management, especially when conservative therapies and multiple surgeries fail to provide relief.

Case Report: This case study examines a 50-year-old patient with a history of CRPS type II of the left superficial radial nerve, who underwent 15 interventions, including 6 unsuccessful surgeries since 2021, and experienced extreme, uncontrolled pain after a work-related injury. After the permanent implantation of peripheral nerve stimulator (PNS) in November 2022, the patient enjoyed remarkable pain relief for the past one and a half years, with no signs of complications or necessity for further interventions. The PNS trial, permitted by work compensation rules, utilized a single incision technique, anchoring the leads to the brachioradialis fascia using a figure-of-eight 2.0 silk suture configuration.

Conclusions: PNS has emerged as a valuable treatment modality for chronic pain following failed surgeries. This case study demonstrates the effectiveness of PNS in providing sustained pain relief for a patient with CRPS of the left superficial radial nerve. Further research is warranted to explore the long-term efficacy and safety of PNS in managing refractory pain conditions.

Key words: Peripheral nerve stimulator, complex regional pain syndrome, refractory pain, nonnarcotic, case report

BACKGROUND

Complex regional pain syndrome (CRPS) type II is a chronic neurological condition affecting limbs. It is characterized by severe pain along with sensory, autonomic, motor, and trophic impairments that may follow trauma or surgery with the evidence of a nerve injury (1). The course of disease and response to treatment are highly unpredictable, which can be very distressing and devastating to patients leading to depression and mood disorders (2). Due to the complex nature of CRPS, treatment usually involves a multidisciplinary approach tailored to each patient, with the main goal focusing on physical therapy, occupational therapy, improving the psychological aspect, and pain coping mechanisms (3). Other treatment modalities that have been implemented include anticonvulsants, bisphosphonates, calcitonin, ketamine, sympathectomies, and nerve blocks, all aimed at improving patient functional-

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Disclaimer: There was no external funding in the preparation of this manuscript.
Conflict of interest: Dr Abd-Elsayed and Dr Moghim consult for Curonix. Dr. Morsi certifies that he, or a member of his immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.
Patient consent for publication: Consent obtained directly from patient(s).
This case report adheres to CARE Guidelines and the CARE Checklist has been provided to the journal editor.
Accepted: 2024-09-26, Published: 2024-11-30

ity (4). Peripheral nerve stimulatorshave been gaining popularity as a successful treatment for resistant cases of CRPS that failed traditional treatments (5). In this case study, we present a 50-year-old patient with a history of CRPS type IIexperiencing extreme uncontrolled pain after a work-related injury. The patient underwent 15 interventions since 2021, including 6 unsuccessful surgeries all providing little to no pain relief. Following the permanent implantation of PNS in November 2022, the patient enjoyed remarkable pain relief for the past one and a half years, with no signs of complications or necessity for further interventions.

CASE PRESENTATION

The patient, a 50-year-old individual, presented with a history of CRPS type II of the left superficial radial nerve after a work-related injury. The patient underwent 15 interventions since 2021, including 6 unsuccessful surgeries all providing little to no pain relief. She presented to us with a burning excruciating pain and edema involving the whole left forearm extending from the elbow down to the wrist. Physical examination of the left forearm was significant for abnormal hair loss pattern with discoloration and allodynia to light touch, as tested with light manual touch was present overlying the whole left forearm. The poor patient effort due to the severe pain limited the motor assessment. The pain was severe and uncontrolled, significantly impacting the patient's quality of life. Conservative therapies had failed to alleviate symptoms, prompting consideration of alternative interventions.

Treatment Approach

Given the refractory nature of the pain and the failure of conservative therapies and multiple surgeries, the decision was made to proceed with a 7-day PNS trial permitted by work compensation rules. The trial involved a 2-lead configuration, utilizing a single incision technique for lead placement (Fig. 1). The leads were placed under ultrasound guidance and placed in a staggered configuration. Both leads were tested and found to cover the entire left forearm and dorsum of the wrist. The patient reported exceptional relief and permanent leads were placed approximately a month after the trial. The leads were anchored to the brachioradialis fascia at one juncture using a figure-of-eight 2.0 silk suture configuration (Fig. 1), ensuring stability and effectiveness of the stimulation using a modification technique to individualize the product to the patient's anatomy (Fig. 2).

Outcome

After the permanent implantation of PNS in November 2022, the patient enjoyed significant pain relief for the past one and a half years without any signs of complications. The pain relief is reported to be around 90% to 100%. The PNS implantation effectively delivered sustained relief, enabling the patient to restore functionality and enhance her quality of life. She no longer requires any additional therapy, including opioid therapy. Concerns regarding potential erosion due to the slender nature of the patient's arm have not materialized over the past 18 months, with no issues observed during follow-up examinations. This underscores the durability and safety of the implanted device, particularly noteworthy given the presence of 2 leads in a skinny arm relatively close to each other, along with tines, yet still no signs or issues with erosion. The patient is extremely satisfied with the overall process from implantation to sustained pain relief and the absence of any issues with the device.

DISCUSSION

This case illustrates the successful treatment of a patient with refractory CRPS type II following multiple unsuccessful surgeries and interventions by implanting a permanent PNS targeting the left superficial radial nerve, enabling long-term pain control, and enhancing her quality of life with no complications observed at the last follow-up. This underscores the potential of PNS as a safe and effective alternative for managing refractory, difficult-to-treat pain conditions in the wrist, sparing the need for medication. CPRS type II is a chronic continuous pain syndrome that arises after a trauma or injury to a peripheral nerve, pain is disproportionate in time and degree to any known trauma or lesion (1). The diagnosis of CRPS can be very challenging, hence Budapest criteria were suggested in 2003 to establish a uniform method of diagnosis, clinical communication, and greater generalizability across research populations (6). The criteria indicated that patients should experience continuous pain not following any dermatomal distribution and are disproportionate to the inciting event, they must also report at least one symptom in three out of four and one sign in two out of the four following categories (sensory, motor/trophic, vasomotor, and sudomotor) (6). The Valencia consensus-based adaptation of the International Association for the Study of Pain CRPS diagnostic criteria, in 2021, introduced some changes regarding the CRPS subtypes; in addition

to CRPS type II associated with nerve damage and type I that has no evidence of nerve damage, a third CRPS subtype has been introduced for patients who once had a diagnosis of a fully met CRPS criteria, but currently have insufficient features to fall under the new subtype "CRPS with remission of some features" (7).

PNS has been proven successful in treating resistant and challenging cases of CRPS helping patients regain their quality of life (8). It also offers an alternative to pharmaceutical interventions, particularly opioids, amidst the growing opioid epidemic (9). It has regained popularity during the last few years (8). The mechanism of action of PNS in controlling CRPS pain is still controversial. The gate theory has been suggested as the most widely accepted explanation, which involves implementing a nonpainful stimulus to the large diameter A-beta fibers, causing activation of the descending inhibitory interneurons and preventing the nociceptive conduction of A-delta and C fibers, i.e., pain fibers, to the dorsal horn and cerebral cortex (9,10). In addition to the gate theory, PNS has also been found to cause alteration in the ion channels involved in pain, the release of neurotransmitters, endorphins, and local inflammatory mediators (9,11). Decrease in the levels of substance P and glutamate with enhanced GABAergic pathways has also been thought to play a role (10).

In this study, we utilized a single incision technique for lead placement under ultrasound guidance. This technique offered a minimally invasive and efficient approach for PNS implantation, particularly suitable for patients with a slim build and low body mass index without compromising patient outcomes. Technological advancements have facilitated the implantation of wireless lead connected to an external pulse generator, eliminating the need to place a pulse generator in the chest (12). This avoids the tunneling of the electrodes across multiple joints, reducing the risk of lead displacement and discomfort at the site of device implantation (5,13).

Upon reviewing the literature, the most recent study we found was a case series published by Gutierrez et al (14), where PNS was implanted in 3 patients with CRPS type I, demonstrating long-term pain relief with one patient reporting no pain at 34 months follow-up. In 2023, Abd-Elsayed et al (15) conducted a retrospective review, including 57 patients with a wide variety of neuralgias, including genicular nerves, superior cluneal nerves, posterior tibial nerve ± sural nerve, middle cluneal nerves, radial and ulnar nerves, and right common peroneal nerve, who were treated with the novel high-frequency PNS. This yielded marked improvement in pain scores > 80% that continued over the 24-month follow-up, pain scores dropped significantly from 7.5 ± 1.7 preprocedural to 1.45 ± 1.57 (15).

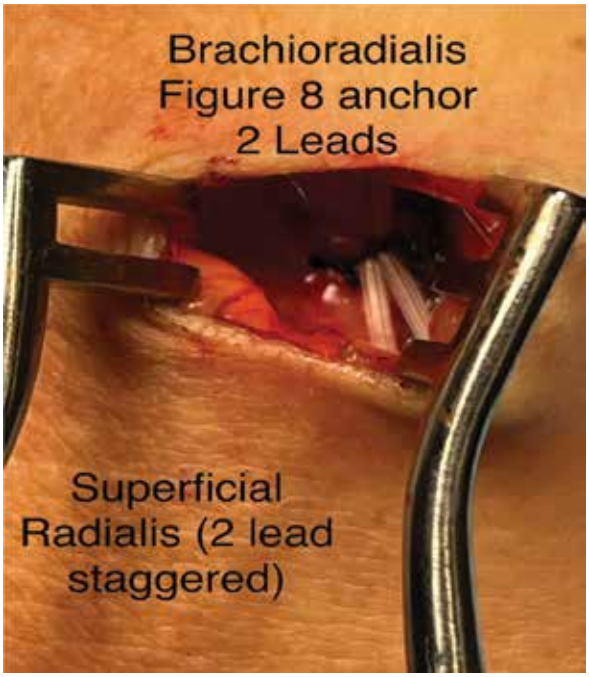

Fig. 1. Single incision technique for leads implantation and attachment to the brachioradialis fascia at one juncture using figure-of-8 configuration.

Fig. 2. Showing the leads reaching the superficial radial nerve.

A comprehensive institutional review of 30 years' experience conducted by Chmiela et al (5), in 2021, encompassing 165 patients exhibited an improvement in pain scores by 1.87 on the Visual Analog Scale

(VAS) scores at the 12-month follow-up along with a significant decrease in opioid consumption. Bouche et al (16), in their report in 2017, studied 26 patients with chronic refractory neuropathic pain, 16 of which had CRPS. At the 27-month follow-up, 20 out of 26 patients were still utilizing the stimulators experiencing a mean pain relief of 67% with minimal reports of complications (16). Another randomized controlled trial conducted by Deer et al (17), in 2016, also showed a mean pain reduction of 27% between baseline and 3-month follow-up, compared to 2% in the control group. However, the authors in the latter study didn't report efficacy at 6- to 12-month follow-ups, raising questions about the long-term efficacy (17). In 1996, Hassenbusch et al (18) published a report on the successful treatment of 19 patients with CRPS, with pain VAS score improving from 8.3 ± 0.3 preimplantation to 3.5 ± 0.4 at the last follow-up at 2 years, with over 60% pain reduction.

Nonetheless, aside from CRPS, Abd-Elsayed et al (19) demonstrated the successful application of PNS in the treatment of patients with refractory low back pain due to superior cluneal neuralgia. Other studies (20-23) have also noted the efficacy of PNS in addressing postamputation pain and cluster headache. An evidence-based consensus guideline review (24) from the American Society of Pain and Neuroscience, published in 2022, presented level I evidence supporting the effectiveness of PNS in treating chronic migraine headaches, chronic hemiplegic shoulder pain, failed back surgery syndrome, and lower extremity neuropathic and lower extremity postamputation pain.

Although PNS appears to be showing promising results for managing patients with chronic refractory pain syndromes based on previously mentioned studies, it Is important to note that, in most studies, the group of patients lost to follow-up usually included those with less pain relief, making reporting the efficacy at long-term follow-up less accurate (5,18).

PNS is generally safe; however, the need for PNS revision is not uncommon, as mentioned by Chmiela et al (5), with dead batteries and lead migration being the leading causes, followed by worsening of pain or decaying of coverage. Other relatively common complications include skin irritation, redness, and pain at the internal pulse generator sites (5,8,9,17). Infection, lead erosions, and fracture are rare complications (8,17). Most of the problems have been mitigated with the introduction of the current circular percutaneous leads and the use of an external pulse generator (8,9). For instance, Abd-Elsayed et al's (15) retrospective study found that there were no revisions required over a 2-year period for 57 patients who used circular percutaneous leads. PNS surpasses spinal cord stimulators in its ability to accurately target well-defined neurons minimizing unnecessary stimulation that may be uncomfortable (25). Unfortunately, over all these years, it is still challenging to have a clear view of how to predict which patients, nerves, or etiology are at high risk for nonresponsiveness (26).

CONCLUSIONS

Although PNS is not flawless as a treatment, advancements in technology undeniably have enhanced its safety and longevity. In addition, we must acknowledge that neuropathic pain is extremely difficult to manage, rendering this patient dysfunctional and PNS can be a beacon of hope for them as highlighted in this review. This case study illustrates how PNS effectively and safely provided sustained pain relief for a patient with CRPS affecting the left superficial radial nerve, even in a slender arm. Further research is warranted to elucidate the long-term efficacy and safety of PNS, which will further expand its use in the treatment of CRPS and other refractory pain conditions.

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