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Original Research Article

Caudal Pulsed Radiofrequency for Distal Symmetrical Polyneuropathy

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Abstract

Background: Numbness, tingling, discomfort, and/or weakness in the toes are symptoms of distal symmetrical polyneuropathy (DSP), which proceeds in a stocking-glove pattern proximally. There is still no particular therapy available. ***Objective:*** CPRF (caudal pulsed radiofrequency) is used to treat people who have sensory symptoms. ***Study Design:*** This is a prospective study at Alsdr teaching hospital in Iraq-Basra. ***Methods:*** CPRF, Boston Scientific G4™ RF Generator, Twenty-four subjects with DSP who were stimulated reported sensory complaints that did not respond to therapy. Under fluoroscopy at S2-3 level, inserted a caudal 21 gauge, 20-mm active tip RF cannula into the epidural space through the sacral hiatus. After the sensory and motor RF, give PRF at 5 Hz for 600 seconds at 45 V. Within the first week of the operation, the impact of activation was examined using a numeric rating scale, which was repeated every three months for the next three months. Patient satisfaction levels were assessed three months following treatment; patients who scored "7" (very good) or "6" (good) on the treatment satisfaction scale were rated fulfilled. ***Results:*** Neuropathic pain was effectively diminished after four visits ($P< 0.001$, test one-factor analysis). Furthermore, three months after receiving CPRF, more than half of the patients had an effective reaction (≥60 percent pain reduction) and were comfortable with the therapeutic outcomes. ***Limitations:*** The research included a small number of patients and was only for a brief time. ***Conclusion:*** CPRF is a safer, less expensive, and more effective way to treat symptoms.

Keywords: DSP, Neuropathic pain, PRF, NRS score, CPRF.

INTRODUCTION

In nearly half of all diabetic mellitus (DM) patients, distal symmetrical polyneuropathy develops. It's characterized by long-term clinical or subclinical symptoms caused by nerve fiber damage in the somatic peripheral nervous system. It causes oxidative stress and inflammation in peripheral neurons, as well as voltage-dependent sodium channel alterations that aggravate DSP (Attal *et al.*, 2010, Callaghan *et al.*, 2013, Callaghan *et al.*, 2012).

The most incapacitating clinical consequence of neuropathic pain (NP) is DSP which is produced by significant lesions in fine Aβ-, Aδ-, and C-type nerve fibers, which damage the sensory and motor nerve components. Clinical symptoms, pathophysiological processes, development, and evolution are all diverse (Smith & Singleton 2013, Johannsen *et al*., 2001). NP presents as chronic pain that occurs without a trigger or as painful hypersensitivity, numbness, and tingling that is caused by sensitive neuronal damage. Oxidative stress has been linked to nerve fiber loss, axonal degeneration, and demyelination in pathophysiological investigations. Chronic hyperglycemia induces mitochondrial damage, which leads to neuronal apoptosis (Callaghan *et al*., 2014, Daousi *et al.*, 2004). In 10-20 percent of instances with chronic axonal polyneuropathy, despite intensive studies, no etiology can be identified (Attal *et al.*, 2010, Callaghan *et al.*, 2013, Callaghan *et al.*, 2012). Sensory or sensorimotor deficits are the most common, and symptoms gradually worsen. Numerous oral drugs and methods are used to treat neuropathic pain in DSP patients (Johannsen *et al*., 2001, Callaghan *et at*., 2014, Daousi *et al.*, 2004). However, some individuals' discomfort continues after these therapies. The pulsed radiofrequency (PRF) technology, which was recently invented, is frequently utilized to relieve long-term discomfort (Arsanious *et al.*, 2016, Chang *et al*., 2017, Cho *et al*., 2017). Although the technique of PRF's pain-relieving function has not been well investigated, the electrical field created by it has been suggested to be responsible for its

therapeutic effect (Choi *et al*., 2018, Kesikburun *et al.*, Ding *et al.*, 2019. Furthermore, PRF uses short activation followed by a long rest period to expose target neurons and structures to an electric field without causing major structural failure (Chang *et al.*, 2018, Ojango *et al.*, 2018, Vuka *et al*., 2020). PRF has been quickly embraced in medical care to cure a number of diseases or disorders, including neuralgia, joint stiffness, and muscular pain, because to its low tissue damage. In a case series [8] and a retrospective investigation (Chang *et al.*, 2017), intra-articular PRF treatment was reported to be effective. Direct influence on brain structures could not account for this outcome. Intra- articular PRF is thought to have anti-inflammatory properties, which might be triggered by an immune system effect. For the treatment of (sub) acute lumbosacral radicular pain, caudal epidural injections of local anesthetics with or without corticosteroids have been shown to be beneficial (Choi *et al.*, 2012, Kesikburun *et al.*, Ding *et al.*, Chang *et al.*, 2018). Furthermore, some data suggest that PRF stimulation provided using needle electrodes inserted in the caudal epidural area can be used to treat neuropathic pain (Atim *et al*., 2011, Rohof 2014, Farrar *et al.*, 2001) . The impact of CPRF stimulation on refractory sensory symptoms following DSP was studied in the current study.

Data Acquisition

Twenty-four patients with neuropathic pain owing to DSP who attended the rehabilitation department at Alsdr teaching hospital in Basrah, Iraq, were involved in this study and received caudal epidural PRF simulation. The study's inclusion criteria were as follows: (See Table 1).

Table 1: Inclusion criteria for the research

Age (in years)	65.3 ± 5.3
man : woman	10 : 14
neuropathic pain's duration (mos.)	15.0 ± 11.0
Pretreatment NRS score for the leg	5.4 ± 1.5
Diabetic patients	18

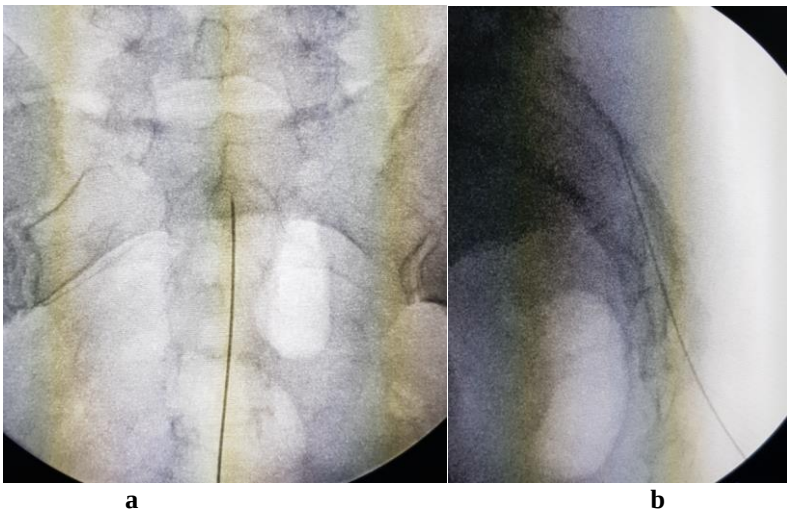
Means ± standard deviations are used to represent values. NRS stands for numeric rating scale.

Procedures

For the CPRF intervention, aseptic methods were used. For Siemens C-arm fluoroscopy, patients were advised to lie down in a prone position. A 22-gauge cannula was inserted into the epidural space through the sacral hiatus under fluoroscopic guidance after local infiltration anesthesia was applied to the injection site (Rohof 2014). After that, the needle was moved to the intervertebral level S2-3 (Fig. 1). An electrode was linked to the cannula after a contrast dye was used to check proper needle insertion in the caudal epidural region (Cosman G4 radiofrequency generator, Boston Medical, Burlington, MA). The following procedures were used to conduct the test stimulation:

1. Motor stimulation (The Frequency about 2Hz, 1mspulse width and the voltage at least equal to 1Volt).
2. Sensory stimulation (The Frequency equal to 50 Hz, 1ms Pulse width and the Voltage up to 5Volt).

Following the test, PRF was administered at 5Hz for 600 seconds at 55Volt with a 5ms pulse width to keep the electrode tip temperature below 42°C. The surgeon who performed the procedures had 22 years of experience and was not engaged in the evaluation of the results.



a **b**

Fig 1: Anterolateral (a) and lateral (b) Lumbosacral fluoroscopy image show CPRF needle at S2-3 level

Outcome Measures

All pretreatment and follow-up assessments were completed by one investigator, who did not take part in any of the treatments. The NRS was used to quantify pain intensity; assigned ratings ranged from 0 to 10, with 0 representing "no pain" and 10 representing "the most excruciating agony imaginable." Before therapy, 2 weeks, 1, 2, and 3 months following

treatment, NRS scores were calculated. At three months, a successful therapy was defined as a drop in the baseline NRS score of more than 50%. To calculate NRS score reductions percent, score reductions at three months were expressed as percentages of baseline scores (NRS percent). Furthermore, three months after PRF, a 7-point Likert scale was used to assess patient global perceived effect (GPE), and subject who described very good (NRS score = 7) or good outcomes (scoring = 6) were reflected pleased with the treatment.

Statistical Evaluation

To analyze the data, the following tests were used:

1. Student t-test was used to compare the difference in the means of number of days of headache attacks and frequency of headache attacks in the classical and PRF group.
2. Chi-squared or Fisher Exact's tests was used to compare the differences in the pain score, sensitivity to light, sound, nausea, vomiting and headache with physical activity in the classical and PRF group.

RESULTS

The trial protocol was completed by all 24 subjects. The mean NRS (numeric rating scale) score for neuropathic pain decreased from 5.5±1.3 to 3.2±1.8 after one week, 3.0 2.6 after one month, 2.9 ± 1.6 after two months, and 2.7 ± 1.4 after three months following PRF Fig.1. Over time, NRS scores changed dramatically (P <0.001) (Fig. 2). NRS scores were considerably lower than baseline during the first week, 1, 2, and 3 months post-PRF (first week, P = 0.001; 1 to 3 months, P< 0.001) (Fig. 2). At three months after the PRF, 20 of the 24 patients (50 percent) reported effective pain alleviation. After the operation, no adverse effects were noticed in any of the patients.

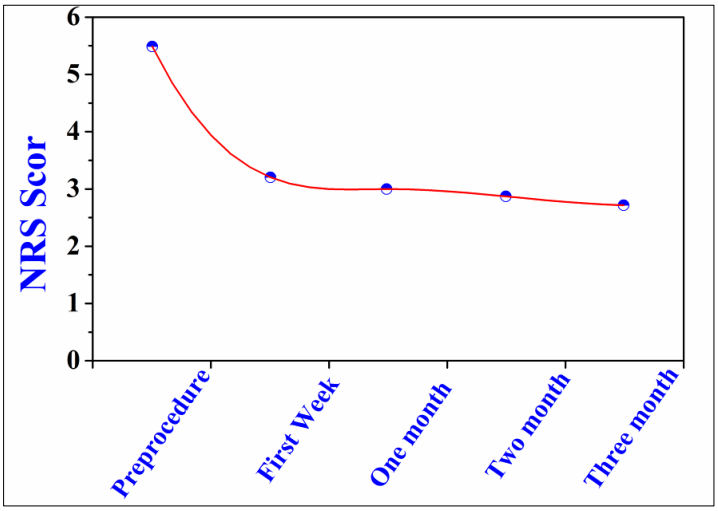


Fig. 2: comparable NRS scores of neuropathic pain before and after procedure at first week, 1, 2, and 3 months

According to the 7-point Likert scale, patient satisfaction with therapy was very good (scoring = 7) in 6 subjects (25 percent), good (scoring = 6) in 8 subjects (33 percent), and fairly good (scoring = 5) in 8 subjects (33 percent). Four subjects reported no change (scoring = 4) in their condition (17 percent). No subject gave a score of less than 4 for satisfaction. At three months after the PRF, 20 subjects (or more than 83 percent of all trial participants) were happy with their outcomes.

DISCUSSION

This study examined the impact of caudal epidural PRF stimulation on sensory symptoms of DSP, such as leg discomfort that was resistant to pain medication. In the first week, one month, two months, and three months following PRF, the degree of pain was significantly reduced. Furthermore, more than 83 percent of patients had a positive reaction (pain reduction of 50%) and were happy with the therapeutic outcomes after three months. Numerous prior researches on animal models of peripheral neuropathic pain have discovered activation of glial cells in the dorsal horn of the lumbar spinal cord (Benarroch 2010, Lim *et al.*, 2013, Mika *et al.*, 2009, Milligan & Watkins 2009, Scholz & Woolf 2007). Glial cells emit pro-inflammatory cytokines when they are activated, which enhance pain signal transmission (DiCesare *et al.*, 2013, DiCesare *et al.*, 2014, Kawasaki *et al.*, 2008).

After peripheral nerve damage, glial cells may be increased in DSP and generate cytokines that induce neuropathic pain. In the caudal area, the advantages of epidural PRF stimulation have yet to be shown. In a rat model of lumbar disc herniation, Cho *et al.*, 2016 found that caudal epidural PRF reduced dorsal horn nociceptive neuron activation at many levels of the lumbar spinal cord, as well as reducing microglial activity in the spinal dorsal horn from L3 to S1. Additionally, these modifications impeded the transmission of pain signals by preventing the activation of pain- related cytokines in the spinal dorsal horn. PRF stimulation appeared to function on several

levels of the spinal dorsal horn and decreased neuropathic pain, according to Cho *et al*., 2016 and the current investigation. PRF also harmed the sensory nociceptive axons, according to Erdine *et al.*, 2009. Lesions were found more frequently in the smaller primary sensory nociceptors following PRF than in the larger non-pain-related sensory fibers. As the distance between the PRF electrode and the soft tissue increases, the electrical field created by the electrode drops dramatically. The PRF electrode was inserted in the epidural region of our patients, and the current seemed to be deflected by the bone surfaces of the lumbosacral vertebrae, remaining inside the epidural region with no deterioration (Sluijter *et al*., 2008).

Due to ethical issues, it was not possible to recruit sham control participants for this investigation. Owing to the persistent, degenerative nature of DSP condition, the pain, numbness, and tingling sensation reductions seen were because of the administration of caudal epidural PRF rather than spontaneous healing. As a result, the results of this research support the use of caudal epidural PRF in patients with sensory complaints who have DSP-induced refractory neuropathic pain. The impacts of caudal epidural PRF stimulation in subjects have been studied in three prior investigations. Atim *et al.*, 2017 conducted caudal epidural PRF on 21 patients with coccygodynia and reported pain reduction in about 80% of the patients. Rohof 2014 employed caudal epidural PRF on three patients with post-herpetic neuralgia in another trial, and found that two of the three had a favorable long-term prognosis. Both of the patients who had positive outcome experienced neuralgia in dermatomes L1-4 and T10-11, and caudal epidural PRF effectively relieved their pain. At three months, Dong Gyu Lee presents the impact of caudal epidural pulsed radiofrequency stimulation in subjects with refractory chronic idiopathic axonal polyneuropathy (Farrar *et al.*, 2001); ten of the twenty subjects had a good reaction and were satisfied with their treatment outcomes. Despite the fact that the source of pain is located distant from the active PRF needle-tip in the sacral canal, a recent research found that caudal epidural PRF can successfully relieve pain.

CONCLUSION

In conclusion, it is discovered that leg discomfort, numbness, and tingling feeling caused by DSP refractory to oral medicine were considerably decreased following caudal epidural PRF in the first week, 1, 2, and 3 months. At three months following PRF, however, more than 83 percent of patients had significant pain alleviation and were happy with their treatment. If oral drugs fail to address DSP-related neuropathic pain in the clinic, doctors are left with few alternatives for pain management. As a result, we feel that caudal epidural PRF stimulation is a harmless option for treating sensory complaints associated with refractory DSP pain. However, some of the study's shortcomings should be taken into account. To begin with, the current study did not include a control group, as previously stated. Second, the number of patients who were enlisted was modest. Third, we don't know how caudal epidural PRF may affect such a large region. To corroborate our findings, more research addressing these limitations is required.

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