

Case Report

Pulsed radiofrequency applied to the dorsal root ganglia for treatment of post-stroke complex regional pain syndrome: A case series



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Abstract

Study objective: Complex regional pain syndrome is a painful and disabling syndrome where the patient presents with neuropathic pain, edema, or vasomotor or pseudomotor abnormalities that are often refractory to treatment. Complex regional pain syndrome type 1 may occurs in stroke patients. Radiofrequency is a therapeutic modality that has been used for years for diseases associated with neuropathic pain. Design: Case series report. Setting: Selcuk University Hospital. Patients: A 69-year-old woman and a 48-year-old women who suffered post-stroke complex regional pain syndrome type 1. Interventions: Pulsed radiofrequency current application to the cervical dorsal root ganglia. Measurements: Pain reduction. Main results: The patients had complete resolution of their symptoms, which was maintained at 10 and 5 months of follow-up. Conclusions: These cases illustrates that pulsed radiofrequency applied to cervical dorsal root ganglia might play a significant role in multi-modal approach of complex regional pain syndrome type 1 management after stroke. Further randomized, controlled studies are needed to support this argument. © 2016 Elsevier Inc. All rights reserved.

1. Introduction

The authors have no conflict of interest.

http://dx.doi.org/10.1016/j.jclinane.2016.03.059 0952-8180/© 2016 Elsevier Inc. All rights reserved. Complex regional pain syndrome (CRPS) is a painful and disabling syndrome where the patient presents with neuropathic pain, edema, or vasomotor or pseudomotor abnormalities. CRPS type 1 occurs up to 48% of patients suffering from stroke [1]. Little is known about the etiology, diagnosis, and treatment

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of CRPS, which is a complex syndrome. It usually develops within 2 weeks to 3 months after a stroke and rarely one year later [2]. In cases with CRPS resistant to medical therapy, invasive approaches from repeated sympathetic blocks [3] to spinal cord stimulation [4] is reached.

Radiofrequency is a therapeutic modality that has been used for years for diseases associated with neuropathic pain [5,6]. Recently, the application of pulsed radiofrequency (PRF) to the dorsal root ganglia (DRG), as a non- or minimally neurodestructive technique, has been used effectively to produce long-term pain relief for neuropathic pain modalities and has been proposed as an alternative to heat lesion radiofrequency [7,8].

We present 2 cases that suffered from CRPS type 1 after stroke and were successfully treated with PRF current application to the cervical DRGs.

2. Cases

2.1. Case 1

A 69-year-old woman was hospitalized in the physical medicine and rehabilitation department with a diagnosis of left-sided weakness and hypoestesia, which developed following ischemic stroke that she has suffered 9 months previously. A detailed history revealed that this was her first stroke and she had weakness in the lower and upper left side of her body and pain in her left shoulder and left wrist, which worsened with movement; she was ambulatory with the use of a single crutch. The patient had hypertension and diabetes mellitus and had received dipyridamole 225 mg/day for the past 9 months.

In the physical evaluation of the patient, the muscle strength of the left upper extremity was 2/5, the muscle strength of the left lower extremity was 3/5, and a spasticity score of 1 was observed in the left hip adductor muscles according to the ambulatory Modified Ashworth Scale (MAS) [9]. The motor recovery was stage 2 for the left upper extremity, stage 2 for the left hand, and stage 3 for the left lower extremity according to the Brunnstrom recovery stage (BRS) [10]. The patient was able to walk by use of a single crutch. She had edema, color change (in comparison to the right upper extremity), allodynia, and hyperalgesia in the left upper extremity, and the skin temperature of the left upper extremity was warmer than that of the contralateral upper extremity (Fig. 1). Her signs and symptoms were not suggested cervical spinal nerve radiculopathy. The pain score in the left upper extremity during movement was 80 as assessed using a Visual Analogue Scale (VAS; 0, no pain, 100, intolerable severe pain). The range of motion (ROM) of the left shoulder and left wrist joints were limited both during passive and active movements (a universal full-circle goniometer was used to evaluate the ROM of these joints) (Table). Radiography of the left shoulder did not show subluxation. MRI scan of the left shoulder was recommended to exclude other pathologies relevant to the left shoulder, but the patient refused the procedure. Based on these findings, she was diagnosed with left hemiplegia and CRPS type 1 according to the Budapest diagnostic criteria for CRPS [11].

A neurological rehabilitation program was scheduled for the patient including ROM exercises, strengthening exercises for the left upper and lower extremities, proprioceptive neuromuscular facilitation exercises, and stretching exercises for the left hip adductor muscles. Transcutanosis electrical neuronal stimulation and contrast bath therapy were applied to the left



Fig. 1 Edema and color change in the left hand of the hemiplegic patient.

	1st day of rehabilitation	Before PRF	3rd days after PRF	2nd months after PRF	*Last follow-up visits
Case 1 VAS	80	80	30	20	20
Active movement (shoulder)					
Flexion	30°	30°	110°	120°	140°
Extension	20°	20°	40°	60°	60°
Abduction	20°	30°	110°	120°	140°
Adduction	20°	20°	30°	40°	40°
Internal rotation	10°	10°	20°	30°	40°
Eksternal rotation	10°	10°	20°	30°	40°
Active movement (wrist)					
Flexion	10°	15°	30°	50°	60°
Extension	10°	15°	40°	50°	60°
Case 2 VAS	100	100	30	20	10
Active movement (shoulder)					
Flexion	20°	30°	130°	130°	160°
Extension	20°	20°	50°	60°	60°
Abduction	20°	30°	120°	130°	160°
Adduction	10°	10°	30°	40°	40°
Internal rotation	10°	10°	30°	30°	40°
Eksternal rotation	10°	10°	30°	30°	40°
Active movement (wrist)					
Flexion	10°	15°	40°	60°	70°
Extension	5°	15°	40°	60°	65°

Table Degrees of ROM for the left shoulder and left wrist joints and VAS scores after PRF during the follow-up visits for Case 1 and Case 2.

ROM: Range of motion, PRF: Pulsed radiofrequency, VAS: Visual analogue scala.

* 10 months after RFT in Case 1 and 5 months after PRF in Case 2.

upper extremity. For medical therapy to treat CRPS, naproxen 750 mg/day and pregabalin 150 mg twice daily were started.

The patient was given 16 sessions of rehabilitation and medical therapy using this treatment protocol. Her muscle strength of the left lower extremity improved to 4/5 and to stage 4 for the left lower extremity according to the BRS. However, there was no improvement in the muscle strength, ROM of the affected joints, edema, or pain for the left upper extremity. The severity of her pain during movement was 80 by VAS. She exhibited inadequate compliance to the rehabilitation program due to severe pain.

Since no improvement could be achieved in CRPS with the combined use of medical therapy, physical therapy, and the rehabilitation program, the pain clinic consulted with the patient. PRF application to the left cervical 5 (C5) and cervical 6 (C6) DRG was scheduled. Dipyridamole was discontinued, with initiation of enoxaparin 120 mg/day 1 week before the procedure to eliminate the potential risk of bleeding. At the end of 1 week, the patient was transferred to the operating room. The PRF technique was explained to the patient and informed consent was obtained before undertaking the procedure. Aseptic techniques were applied by an experienced anesthetist in carrying out PRF treatment. The patient was laid in a supine position under fluoroscopy using a C-arm (Siemens, Erlangen, Germany), and a 22-gauge cannula (OWL RF cannula 54 mm with 4 mm active tip, Diros Technology Inc., Canada) was placed around the C5 and C6 DRG. The cannula was inserted in the direction of the radiation beam. The sensory stimulation test was carried out using an RF generator (Neuroterm 1100, MA, USA). Before applying PRF, tissue impedance and sensory tests were checked, which showed impedance <600 Ω and a sensory response obtained 0.6 V and 0.7 V in the C5 DRG and C6 DRG, respectively. The locations of the left C5 and C6 DRGs were confirmed via administration of contrast material (Fig. 2). This technique similar to the one for performing dorsal root ganglion blocks was used for the interventions [12,13]. This technique was chosen to avoid possible injection into the vertebral artery, which runs anterior to the ventral part of the foramen. The PRF treatment consisted of passage of PRF currents of 2 Hz at 45 V with 20 m/s active and 480 m/second silent periods. PRF currents were then applied for 120 seconds with the endpoint being an electrode tip temperature not exceeding 42 °C.

Immediately and the day after the PRF current, the maximum pain score was 30 [14]. No complications were observed in the patient and dipyridamole was started at the previous dosage one day later. Medical therapy and the rehabilitation program were continued after the PRF. Twenty-one days after PRF, the patient was given a home exercise program and discharged. In the physical examination conducted on the 1 day of rehabilitation, before PPR, 3 days after PRF, 2 months after PRF, and 10 months after PRF are shown in Table.

2.2. Case 2

A 48-year-old woman was hospitalized in the physical medicine and rehabilitation department with a diagnosis of left-sided weakness and hypoestesia, which developed



Fig. 2 The location of left C5-C6 DRG was confirmed by administration of contrast material.

following ischemic stroke that she has suffered two months previously. A detailed history revealed that this was her first stroke and she had weakness in the lower and upper left side of her body and pain in her left shoulder and left wrist, which worsened with movement; she was unable to walk. The patient did not have systemic illnesses and had received dipyridamole 225 mg/day for the past 2 months.

In the physical evaluation of the patient, the muscle strength of the left upper extremity was 2/5, the muscle strength of the left lower extremity was 2/5, score 1 spasticity at left biceps muscle according to MAS and score 1 spasticity at left quadriceps and hamstring muscles according to MAS [9]. Motor recovery was stage 2 for the left upper extremity, stage 1 for left hand and stage 2 for the left lower extremity according to the BRS [10]. The patient was able to sit without assistance but could not walk. She had edema, color change [in comparison to the right upper extremity], allodynia, and hyperalgesia in the left upper extremity, and the skin temperature of the left upper extremity was warmer than that of the contralateral upper extremity. Her signs and symptoms were not suggested cervical spinal nerve radiculopathy. The pain score in the left upper extremity during movement was 100 as assessed using a VAS. ROM of the left shoulder and left wrist joints were limited both during passive and active movements (a universal full-circle goniometer was used to evaluate the ROM of these joints) (Table). Based on these findings, she was diagnosed with left hemiplegia and CRPS type 1 according to the Budapest diagnostic criteria for CRPS [11].

A neurological rehabilitation program was scheduled for the patient. ROM exercises, strengthening exercises for the left upper and lower extremities, proprioceptive neuromuscular facilitation exercises, stretching exercises for left biceps, gastrosoleus and hamstring muscles and walking training were initiated. Transcutanosis electrical neuronal stimulation and contrast bath therapy were applied to the left upper extremity. For medical therapy to treat CRPS, naproxen 750 mg/day and pregabalin 150 mg twice daily were started.

The patient was given 16 sessions of rehabilitation and medical therapy using this treatment protocol. Her muscle strength of the left lower extremity improved to 4/5 and to stage 4 for the left lower extremity according to the BRS; the patient reached ambulatory stage by use of a single crutch. However, there was no improvement in the muscle strength, ROM of the affected joints, edema, or pain for the left upper extremity. The severity of her pain during movement was 100 by VAS. She exhibited inadequate compliance to the rehabilitation program due to severe pain.

Since no improvement could be achieved in CRPS with the combined use of medical therapy, physical therapy, and the rehabilitation program, the pain clinic consulted with the patient. PRF application to the left C5 and C6 DRG was performed using with the same technique with Case 1 [12,13]. Before applying PRF, tissue impedance and sensory tests were checked, which showed impedance <600 Ω and a sensory response obtained 0.7 V in both the C5 DRG and C6 DRG.

Immediately and the day after the PRF current, the maximum pain score was 30 [14]. No complications were observed in the patient and dipyridamole was started at the previous dosage one day later. Medical therapy and the rehabilitation program were continued after the PRF. Twenty-one days after PRF, the patient was given a home exercise program and discharged. In the physical examination conducted on the 1 day of rehabilitation, before PPR, 3 days after PRF, 2 months after PRF, 5 months after PRF are shown in Table.

3. Discussion

To our best knowledge, this is the first case series report in the literature on the application of a PRF current to DRG for the treatment of CRPS type 1 after stroke. These cases suggest that PRF applied to the C5 DRG and C6 DRG might play a significant role in a multi-modal approach to CRPS type 1 management after stroke.

Many common diseases, injuries, and interventions cause neuropathic pain by producing lesions in the somatosensory pathways in the peripheral or central nervous system [15]. The management of patients with chronic neuropathic pain can be complex, and many patients do not respond to treatment, obtain only partial relief from their pain, or experience intolerable adverse effects [16]. The efficacy of pharmacological (nonsteroidal antiinflammatory drugs [17]), nonpharmacological (transcutaneous electrical nerve stimulation and cognitive-behavioral therapy, physical medicine, and rehabilitation techniques) and interventional treatment (sympathetic blockade [3], radiofrequency application on sympathetic ganglia [6], spinal cord stimulation [4,18], stimulation of DRG with neurostimulation system [19], intrathecal baclofen application) has not been well studied in terms of neuropathic pain, and the role of such treatment in patient management therefore remains unclear.

Sympathectomy using with local anesthetics is one of the most used invasive therapies for CRPS [3]. A Cochrane database review, however, showed that sympathetic nerve blockade was inefficient when local anesthetic agents or intravenous guanethidine were used [20]. Recently, Kastler et al. [21] showed that radiofrequency neurolysis of the stellate ganglion is more effective than stellate ganglion blockade in the management of chronic refractory type 1 CRPS. In their retrospective study, 50% of patients benefited from a radiofrequency neurolysis. However, these methods are also associated with brachial plexus injury, Horner syndrome, and data on their long-term efficacy are still controversial.

PRF, in which short bursts of radiofrequency energy are applied to the nerve, is thought to be a safer alternative treatment to radiofrequency neurolysis due to its somewhat less invasive nature and the lesion produced by a PRF current is controllable and limited [7]. Moreover, the targets of PRF are DRG [22]. Shanthanna et al [23] showed that clinical improvements with PRF DRG as reflected in the VAS score are small in patients with chronic radicular pain. The biological effects of PRF currents are selective for A-delta and C fibers and do not involve a thermal effect [24]. PRF is considered to be a safe and effective method for treatment of patients with neuropathic pain, especially when other therapeutic options fail to provide any improvement [8,22]. In our experience with refractory CRPS type 1, patients presenting to us in the past 2 years have been treated with the application of PRF to DRG. Before doing the treatment we must know which nerve to treat best. This is done by so-called diagnostic blocks. We did not perform diagnostic block both of this 2 patient mainly following reason. First, C5 and C6 DRGs mainly innervate shoulder [25], hence we choose these ganglions to apply radiofrequency without diagnostic block. Second, the mechanism of radiofrequency is completely different from the mechanisms of local anesthesia therefore the block does not predict what the result of treatment will be and last, needle insertion to cervical DRG s for provide diagnostic block may also cause complication.

The present 2 cases suggest that, PRF is an option that should be considered for the treatment of therapy-resistant CRPS type 1 patients and to increase the effectiveness of conservative therapy and treatment compliance. Further randomized, controlled studies are needed to obtain conclusive evidence for its use in post-stroke CRPS patients.

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References

- Kocabas H, Levendoglu F, Ozerbil OM, Yuruten B. Complex regional pain syndrome in stroke patients. Int J Rehabil Res 2007;30:33-8.
- [2] Dursun E, Dursun N, Ural CE, Cakci A. Glenohumeral joint subluxation and reflex sympathetic dystrophy in hemiplegic patients. Arch Phys Med Rehabil 2000;81:944-6.
- [3] Straube S, Derry S, Moore RA, Cole P. Cervico-thoracic or lumbar sympathectomy for neuropathic pain and complex regional pain syndrome. Cochrane Database Syst Rev 2013;9:CD002918.
- [4] Poree L, Krames E, Pope J, Deer TR, Levy R, Schultz L. Spinal cord stimulation as treatment for complex regional pain syndrome should be considered earlier than last resort therapy. Neuromodulation 2013 Mar-Apr;16(2):125-41. <u>http://dx.doi.org/10.1111/ner.12035.</u>
- [5] Rosomoff HL, Carrol F, Brown J. Percutaneus radiofrequency cervical cordotomy tecnique. J Neurosurg 1965;23:639-44.
- [6] Chen CK, Phui VE, Nizar AJ, Yeo SN. Percutaneous t2 and t3 radiofrequency sympathectomy for complex regional pain syndrome secondary to brachial plexus injury: a case series. Korean J Pain 2013;26:401-5.
- [7] Snidvongs S, Mehta V. Pulsed radio frequency: a non-neurodestructive therapy in pain management. Curr Opin Support Palliat Care 2010;4: 107-10.
- [8] Munglani R. The longer term effect of pulsed radiofrequency for neuropathic pain. Pain 1999;80:437-9.
- [9] Bohannon RW, Smith MB. Interrator reability of a modified ashworth scala of muscle spasticity. Phys Ther 1987;67:206-7.
- [10] Brunnstrom S. Recovery stages and avaluation procedures movement therapy in hemiplegia; A neurophysiological approach. New York, San Francisco, London: Harper and Row Publishers; 1970 34-55.
- [11] Harden RN, Bruehl S, Stanton-Hicks M, Wilson PR. Proposed new diagnostic criteria for complex regional pain syndrome. Pain Med 2007;8:326-31.
- [12] van Kleef M, Spaans F, Dingemans W, Barendse GA, Floor E, Sluijter ME. Effects and side effects of a percutaneous thermal lesion of the dorsal root ganglion in patients with cervical pain syndrome. Pain 1993;52: 49-53.
- [13] Van Zundert J, Patijn J, Kessels A, Lamé I, van Suijlekom H, van Kleef M. Pulsed radiofrequency adjacent to the cervical dorsal root ganglion in chronic cervical radicular pain: a double blind sham controlled randomized clinical trial. Pain 2007;127:173-82.
- [14] Apiliogullari S, Aydin BK, Onal O, Kirac Y, Celik JB. Pulsed radiofrequency of dorsal root ganglia for the treatment of complex regional pain syndrome in an adolescent with poliomyelitis sequel: A case report. Pain Med 2015. http://dx.doi.org/10.1111/pme.12710 [Epub ahead of print].
- [15] Treede RD, Jensen TS, Campbell JN, Cruccu G, Dostrovsky JO, Griffin JW, et al. Neuropathic pain: redefinition and a grading system for clinical and research purposes. Neurology 2008;70:1630-5.
- [16] Dworkin RH, O'Connor AB, Kent J, Mackey SC, Raja SN, Stacey BR, et al. Interventional management of neuropathic pain: NeuPSIG recommendations. Pain 2013;154:2249-61.
- [17] Ribbers GM, Geurtz AC, Stam HJ, Mulder T. Pharmacologic treatment of complex regional pain syndrome 1: a conceptual framework. Arch Phys Med Rehabil 2003;84:141-6.
- [18] Geurts JW, Smits H, Kemler MA, Brunner F, Kessels AG, van Kleef M. Spinal cord stimulation for complex regional pain syndrome type I: a prospective cohort study with long-term follow-up. Neuromodulation 2013; 16:523-9. http://dx.doi.org/10.1111/ner.12024 [discussion 529].
- [19] Van Buyten JP, Smet I, Liem L, Russo M, Huygen F. Stimulation of dorsal root ganglia for the management of complex regional pain syndrome: a prospective case series. Pain Pract 2015;15:208-16.
- [20] O'Connell NE, Wand BM, McAuley J, Marston L, Moseley GL. Interventions for treating pain and disability in adults with complex regional pain syndrome. Cochrane Database Syst Rev 2013;4:CD009416.
- [21] Kastler A, Aubry S, Sailley N, Michalakis D, Siliman G, Gory G, et al. CT-guided stellate ganglion blockade vs. radiofrequency neurolysis in

the management of refractory type I complex regional pain syndrome of the upper limb. Eur Radiol 2013;23:1316-22.

- [22] Ke M, Yinghui F, Yi J, Xeuhua H, Xiaoming L, Zhijun C, et al. Efficacy of pulsed radiofrequency in the treatment of thoracic postherpetic neuralgia from the angulus costae: a randomized, double-blinded, controlled trial. Pain Physician 2013;16:15-25.
- [23] Shanthanna H, Chan P, McChesney J, Thabane L, Paul J. Pulsed radiofrequency treatment of the lumbar dorsal root ganglion in patients with

chronic lumbar radicular pain: a randomized, placebo-controlled pilot study. J Pain Res 2014;7:47-55.

- [24] Hamann W, Abou-Sherif S, Thompson S, Hall S. Pulsed radio frequency applied to dorsal root ganglia causes a selective increase in ATF3 in small neurons. Eur J Pain 2006;10:171-6.
- [25] Dean BJ, Gwilym SE, Carr AJ. Why does my shoulder hurt? A review of the neuroanatomical and biochemical basis of shoulderpain. Br J Sports Med 2013;47:1095-104.