

Transient Sensory Recovery in Stroke Patients After Pulsed Radiofrequency Electrical Stimulation on Dorsal Root Ganglia

A Case Series

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Introduction: The integrity of the somatosensory system is important for motor recovery and neuroplasticity after strokes. Peripheral stimulation or central stimulation in patients with central nervous system lesions can be an effective modality in improving function and in facilitating neuroplasticity.

Case Report: We present 2 hemiplegic cases with sensory motor deficit and the result of the pulsed radiofrequency (PRF) electrical stimulation to the dorsal root ganglia. After PRF electrical stimulation, significant improvement was achieved in the examination of patients with superficial and deep sensation. However, during the follow-up visits were observed that the effect of PRF electrical stimulation disappeared.

Conclusions: We believe that these preliminary results could be used in the development of future prospective cohort studies and randomized controlled trials that focus on the effect of PRF electrical stimulation on dorsal root ganglia to treat sensory deficits in poststroke patients.

Key Words: stroke, pulsed radiofrequency, dorsal root ganglia

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The prevalence of people with stroke ranges from 46.1 to 73.3 per 1000 population.¹ Of this population, 50% to 85% have both motor and somatosensory deficits.² The integrity of the somatosensory system is important for motor recovery and neuroplasticity after strokes.³

Pulsed radiofrequency (PRF) electrical stimulation has been widely used in the treatment of the neuropathic pain that occurs from damage or disease affecting the sensorimotor system found in strokes or spinal cord injuries.⁴ A multimodal pain management strategy is used to alleviate complex regional pain syndrome (CRPS) in our hospital. We have used PRF electrical stimulation of >40 patients who suffered from CRPS type 1 for 3 years. Two of these patients were observed CRPS due to stroke. In these patients CRPS related pain decreased and sensory deficit improved with application of PRF electrical stimulation to the dorsal root ganglia (DRG) (unpublished data). This experience motivated us to apply PRF electrical stimulation in hemiplegia cases that suffered from sensory deficit.

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We presented transient sensory recovery in 2 stroke patients after PRF electrical stimulation on DRG. Both patients were informed about this application which was a new treatment approach. This case report was approved by the Ethics Committee of Selcuk University Medical Faculty.

CASE 1

A 66-year-old man was hospitalized in the physical medicine and rehabilitation department with diagnosis of stroke that he has suffered 5 months previously. The brain magnetic resonance imaging of the patient showed an acute infarction region at the left lateral thalamus (Fig. 1).

A neurologic rehabilitation program was scheduled for the patient including exercises. PRF electrical stimulation treatment to the right cervical (C) 5, C6, lumbar (L) 2, L3, L4 DRG was scheduled. The PRF technique was explained to the patient and informed consent was obtained before undertaking the procedure. An experienced anesthetist in carrying out PRF electrical stimulation treatment applied the aseptic techniques. The patient was laid in a supine position under a fluoroscopy using a c-arm (Siemens, Erlangen, Germany), and a 22-G cannula (OWL RF cannula 54 mm with 4 mm active tip; Diros Technology Inc., Canada) was placed around the C5 and C6 DRG. The sensory stimulation test was carried out using a radiofrequency generator

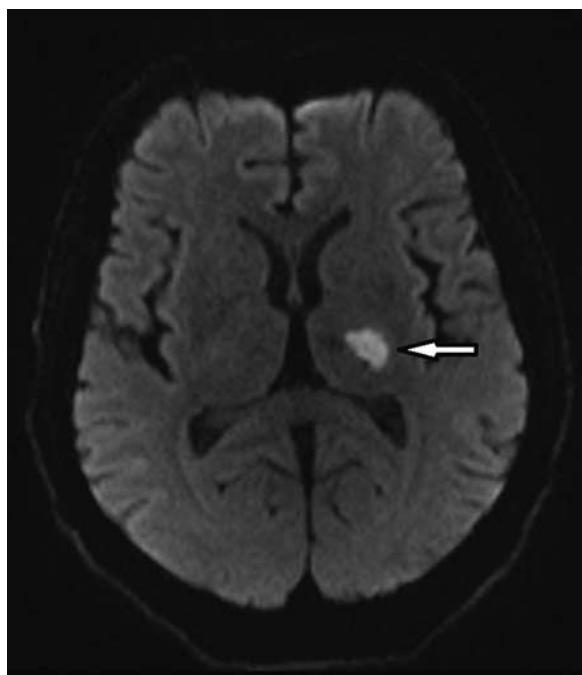


FIGURE 1. The brain magnetic resonance imaging of the patient showed an acute infarction region at the left lateral thalamus (white arrow).

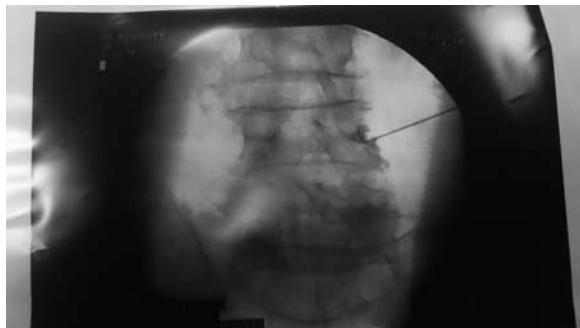


FIGURE 2. The pulsed radiofrequency electrical stimulation to the right lumbar dorsal root ganglia was performed.

(Neuroterm 1100, Massachusetts, MA). Before applying PRF, tissue impedance and sensory tests were checked, which showed impedance $<600\Omega$. The locations of the right C5 and C6 DRGs were confirmed through administration of a contrast material. This technique is similar to the one where DRG blocks were used for the interventions.⁵ PRF electrical stimulation to the right L2, L3, and L4 DRG was performed using the same technique the day after the cervical PRF (Fig. 2).

No complications were observed in the patient. The physical examinations conducted on the day before the PRF, immediately after, and 15 days after PRF are shown in Table 1. During the 1- and 3-month follow-up visits after the procedure, the sensory examinations of the right upper and lower extremities were hypoesthetic. The Romberg test was positive, the muscle strength of the right upper and lower extremities were 5/5, and he was ambulatory.

CASE 2

A 50-year-old woman was hospitalized in the physical medicine and rehabilitation department with diagnosis of stroke that she has suffered 2 months previously. The brain magnetic resonance imaging of the patient showed lateral medullary infarct at the right half of the medulla oblongata (Fig. 3).

A neurologic rehabilitation program was scheduled for the patient including exercises. PRF electrical stimulation treatment to the left C5, C6, L2, L3, and L4 DRG was scheduled. The PRF technique was explained to the patient and informed consent was obtained before undertaking the procedure. The PRF electrical stimulation treatment to the DRG was performed using the same technique as case 1.

No complications were observed in the patient. The physical examinations conducted on the day before the PRF, immediately after the PRF, and 15 days after the PRF are shown in Table 1.

During the 1-month follow-up visit after the procedure, the sensory examinations of the right upper and lower extremities were normoesthetic, the Romberg test was negative, the muscle strength of the right upper and lower extremities were 5/5, and she was ambulatory. During the 3-month follow-up visit after the procedure, the sensory examinations of the right upper and lower extremities were hypoesthetic, the Romberg test was positive, the muscle strength of the right upper and lower extremities were 5/5, and she was ambulatory.

DISCUSSION

To the best of our knowledge, this is the first case series reported in the literature on the application of a PRF current to DRG for the treatment of stroke-induced sensory deficits.

Recent studies indicated that exposure to an enriched environment produces a host of structural and functional changes in the brain.⁶ Enriched environment-induced brain plasticity, such as increased neurogenesis, dendritic branching, synaptogenesis, and levels of trophic factors in the cortex and the hippocampus, has been shown in intact rodents.⁶ Peripheral stimulation⁷⁻⁹ or central stimulation, such as exercise, functional or neuromuscular electrical stimulation, transcutaneous electrical nerve stimulation, and transcranial magnetic stimulation,^{10,11} in patients with central

TABLE 1. Results of Physical Examination of Patients

Cases	Before PRF			Immediately and 15 d After PRF		
	SE	ME	FS	SE	ME	FS
Case 1	Right upper and lower extremities were hypoesthetic	Right upper extremities: 4/5	Right hand's gross motor skills were normal, fine motor skills impaired	Right upper and lower extremities were normoesthetic	Right upper extremities: 5/5	Right hand's gross and fine motor skills were normal
	Rhomberg test was positive	Right lower extremities: 4/5	Ambulatory by use of a single crutch	Rhomberg test was negative	Right lower extremities: 5/5	Able to walk independently
Case 2	Left upper and lower extremities were hypoesthetic	Left upper extremity: 4/5	Left hand's gross motor skills were normal, fine motor skills impaired	Left upper and lower extremities were normoesthetic	Right upper extremities: 5/5	Left hand's gross and fine motor skills were normal
	Rhomberg test was positive	Left lower extremity: 5/5	Ambulatory by use of a single crutch, balance-coordination were damaged	Rhomberg test was negative	Right lower extremities: 5/5	Able to walk independently, balance-coordination were improved by half

FS indicates functional status; ME, motor examination; PRF, pulsed radiofrequency; SE, sensory examination.

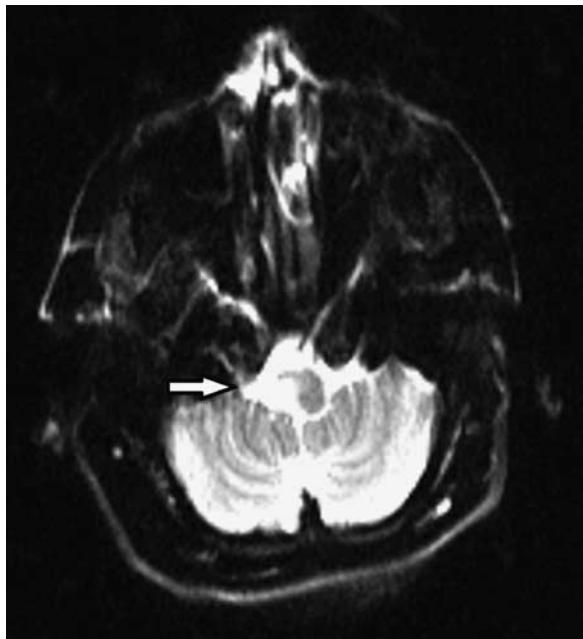


FIGURE 3. The brain magnetic resonance imaging of the patient showed lateral medullary infarct at the right half of the medulla oblongata (white arrow).

nervous system lesions can be an effective modality in improving function and in facilitating neuroplasticity.

However, there are some disadvantages of these treatments in stroke patients, such as requiring long-term and daily application, fatigue of the working muscle, and not being able to apply it in patients with cardiac pacemakers.^{12,13} This situation has brought about alternative treatment options such as PRF electrical stimulation. PRF works by causing changes in synaptic transmission through neuromodulatory action.¹⁴ PRF was shown to activate descendant noradrenergic and serotonergic inhibitor pathways for modulation. The effect of PRF is due to the electromagnetic field produced during the application.¹⁵ Neurons are subjected to the abnormally high electric fields that are characteristic of PRF, and they are subjected to large transmembrane potentials and localized heat flashes whose temperatures exceed the heat-lesion threshold. Through all of these action mechanisms, PRF is considered a safe and effective method for treating patients.¹⁶

In this case series, the results of the PRF electrical stimulation application is submitted to cervical and lumbar DRG for 2 patients who suffered from stroke. Significant improvement was achieved in the examination of the patients with superficial and deep sensation. There was partly improved motor, balance, and walking function. However, during the follow-up visits (1 and 3 mo in case 1 and case 2, respectively), after the PRF electrical stimulation application was observed, the effect of electrical stimulation disappeared. This condition may indicate that the effect is temporary and may be applied at intervals of PRF electrical stimulation application.

The potential limitations of this case series require consideration. First, in this case series, patient examination was

performed by physical examination. More objective criteria could be used for clinical evaluation. Second, there was not 2-month follow-up visit after the treatment.

These cases suggest that PRF electrical stimulation application to the DRG is an option that may be considered for treatment of sensory deficits in poststroke patients. Further randomized, controlled studies are needed to obtain conclusive evidence, and histopathologic studies are needed to explain the mechanism of effect for its use in poststroke patients.

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