PAIN MEDICINE CASE REPORTS

ISSN 2768-5152

Volume 5, Number 7, pp. 363-366

THREE CASES OF INTRACTABLE CHRONIC HAND PAIN SUCCESSFULLY TREATED WITH PULSED RADIOFREQUENCY GUIDED BY ULTRASOUND AND SENSORY NERVE STIMULATION TEST

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Background: Pulsed radiofrequency (PRF) is widely used as a safe and effective method against chronic pain. However, the detailed description showing a reliable effect on intractable chronic peripheral neuralgia is not clear.

Case Report: We experienced 3 cases of chronic intractable peripheral neuralgia, in which long-term pain relief of 2 months was obtained. This relief was achieved by performing PRF at a position (target point) where the sensory nerve stimulation from the needle tip coincided with the painful area.

Conclusions: This report suggests that a nerve block at the target point may be important in PRF for peripheral nerves. From our experience, there was a dermatome-like distribution map of the skin in the peripheral nerves, and it was presumed that PRF was effective at the target point.

Key words: Pulsed radiofrequency, peripheral nerve, chronic pain, sensory test, target point, dermatome

BACKGROUND

Pulsed radiofrequency (PRF) is widely used as a safe and effective treatment for chronic pain, and has been applied to various types of pain (1-6). However, there is no detailed description on how to treat intractable chronic peripheral neuralgia effectively (3). Thus far, there is no evidence that PRF is effective in some peripheral neuralgia (1,2). Currently, there are few reports of PRF for peripheral nerves in the forearm (7-9). We report 3 cases of intractable chronic pain (7) successfully treated with PRF dually guided by ultrasound and a sensory nerve stimulation test, which showed improvement over a 2-month period.

CASE REPORT

We obtained approval from the ethics committee of our hospital for the case reports (approval number: 2020-0224) and written informed consents from the patients.

Case 1

A 39-year-old man was diagnosed with right-handed complex regional pain syndrome (CRPS). When he injured his fourth finger at work, the pain and swelling persisted, and 2 years later he underwent an orthopedic neurotomy, which further aggravated his condition and extended the range of symptoms to his third

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Disclaimer: There was no external funding in the preparation of this manuscript.
Conflict of interest: Each author certifies that he or she, or a member of his or her 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.
Accepted: 2021-08-10, Published: 2021-09-30

and fifth fingers. At the time of visiting our clinic, we found muscle atrophy, flexion contracture, allodynia, and abnormal sweating on his right fourth finger. He was diagnosed with CRPS based on the diagnostic criteria for CRPS established by the Ministry of Health, Labor, and Welfare research group in 2008 (10). He was prescribed 600 mg of pregabalin, 30 mg of duloxetine, and 300 mg of tramadol as oral treatment; however, no significant improvement was noted, and PRF was introduced. The pain site of this patient is shown in Fig. 1. First, a diagnostic nerve block was performed on the median and ulnar nerves with 1% mepivacaine 2 mL. However, the pain remained in the third finger; therefore, the radial nerve was also blocked, resulting in pain relief. Based on this result, PRF was introduced into the 3 nerves. In the first treatment, PRF was performed under ultrasound guidance alone. Immediately after PRF, the Numerical Rating Scale (NRS-11) score from 0 to 10 decreased from 8 to 6, and the allodynia disappeared. Nevertheless, the pain recurred within one week. In the second treatment, PRF was performed after identifying the nerve under ultrasound guidance and a detailed sensory nerve stimulation test in each of the radial, median, and ulnar nerves. Then, the analgesic effect lasted for approximately 2 months. Subsequently, PRF was performed 7 times approximately every 2 months, and the same analgesic effect was obtained. The medications were slightly reduced, and pregabalin 450 mg, duloxetine 20 mg, and tramadol 300 mg have been continued. Details of the PRF for which the detailed sensory nerve stimulation test was performed are described below. First, the patient was placed in the supine position and the right arm was placed on the table to create a 90°external dislocation. We sterilized the skin and identified the transverse sections of the radial, median, and ulnar nerves in the middle forearm under ultrasound guidance (Sonosite M-Turbo by Fujifilm in Japan) using an 11-mHz, 30-mm linear probe. A 22G 54-mm guiding needle was used, and the needle tip was advanced to the vicinity of the nerve. Next, as a detailed sensory nerve stimulation test, we applied an electrical stimulation of 100 Hz 0.3 V. Subsequently, we asked the patient where the stimulation was felt. A needle tip was placed near the nerve site where sensory nerve stimulation was obtained at the painful area, and PRF was performed at 42°C for 360 seconds (Fig. 2). Around the nerve prior to and after PRF, 0.75% ropivacaine 1mL and dexamethasone 1.5 mg were injected. During the first sensory nerve stimulation test, the identification of the location of the stimulation on the painful third, fourth, and fifth fingers (named the target points) required a considerable amount of time. Hence, we created a diagram showing the target points of the nerve cross section (Fig. 3), and used it as a reference for the subsequent PRF.

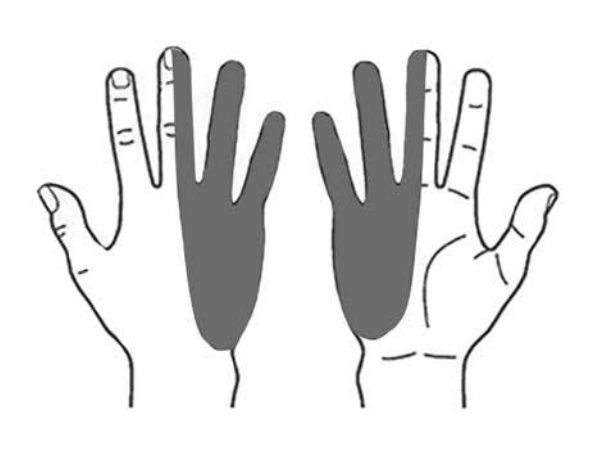

Fig. 1. Painful area of the right hand in Case 1.

Case 2

A 56-year-old woman was diagnosed with venous malformation (VM) on her right thumb. VM is an abnormality in the formation of blood vessels during fetal life, and is sometimes painful. This patient had persistent pain and breakthrough pain in the same area of the VM, and the latter hindered sleep at night. For 4 years before visiting our clinic, she received a finger block and fentanyl patch of 8 mg per day. However, there was no significant improvement. As a diagnostic test block, we first blocked the median nerve with 1% mepivacaine 2 mL, but the pain remained, so we also blocked the radial nerve, and the pain disappeared. Therefore, we decided to perform PRF on these 2 nerves. After one week, we identified the target points for each nerve, and performed PRF on each nerve where stimulus came to the thumb. The sensory nerve stimulation test and PRF were performed using the method described in Case 1. The NRS-11 decreased from 10 to 3 after the PRF, and breakthrough pain at night disappeared. This effect lasted for 2 months, and the same analgesic effect was obtained by performing PRF 8 times every 2 months. A fentanyl patch, which had been used at 8 mg per day, was reduced by 0.5 mg every 2 months to a current dose of 4 mg per day.

Case 3

A 46-year-old woman. She was injured by violence from her husband and was diagnosed with CRPS in her right hand. Medications, such as pregabalin and duloxetine, were discontinued due to strong side effects, and PRF was introduced. After blocking the radial, median, and ulnar nerves with 1% mepivacaine 2 mL for diagnostic nerve block, the pain disappeared, and PRF was introduced to the same 3 nerves. After PRF, the NRS-11 decreased from 6 to 0, allodynia disappeared, joint contracture improved, and the patient had no difficulty in daily life. Since then, PRF has been performed every 2 months with similar results.

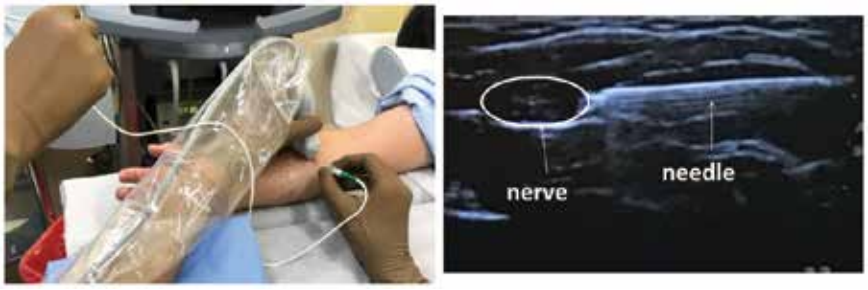

Fig. 2. PRF for the median nerve.

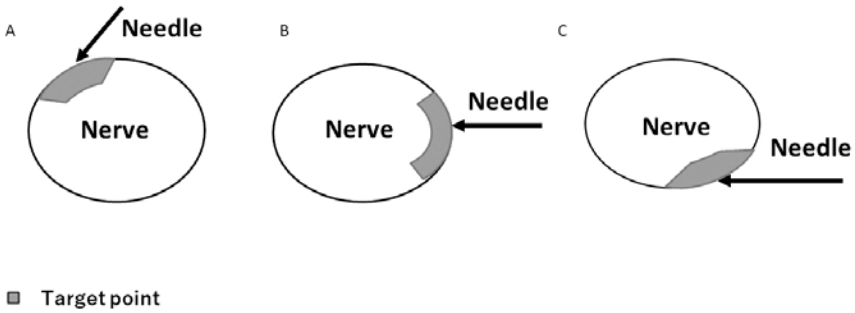

Fig. 3. Transverse view of each nerve (upper shows palm side). A) Radial nerve; B) Median nerve; C) Ulnar nerve.

DISCUSSION

By intermittently generating high-frequency waves, PRF can generate an electric field without the thermal effect of diffusing the surrounding temperature and destroying the nerves. Therefore, it has fewer complications than conventional RF thermocoagulation. RF coagulates the surrounding tissue in an oval shape at the exposed tip of the needle. In PRF, the radial electric field generated by the tip of the needle is thought to play an important role in the analgesic effect, and even if the tip of the electrode is not in direct contact with the nerve, directing the tip of the electrode to the target nerve is said to have an analgesic effect (Fig. 4) (3).To the best of our knowledge, there is no report investigating the diagram of the sensory nerve stimulation test. The present report is the first to address this topic. In Case 1, PRF with the sensory stimulation test prolonged the effect more than PRF without the sensory stimulation test. In addition, from our experience, there was a dermatome-like distribution map of the skin in the peripheral nerves, and it was presumed that PRF was effective at the target point. For example, in Case 3, the radial nerve was stimulated at the base of the thumb, at the tip of the thumb, and at the second finger instead of the thumb, depending on the stimulation site. We performed PRF on the target point of the radial nerve where the stimulation came to the tip of the thumb. The effect of PRF in Case 1 was inadequate compared with that in Case 3. The reason for this difference may be that the orthopedic neurotomy has caused a new strong CRPS.

CONCLUSIONS

We experienced 3 cases of chronic intractable peripheral neuralgia (7) in which long-term pain relief of 2 months was obtained by performing PRF at a position (target point) where the sensory nerve stimulation from the needle tip coincided with the painful area. This was achieved by applying a detailed sensory nerve stimulation test. The results suggest that a nerve block at the target point is important in PRF for peripheral nerves. Furthermore, it was presumed that peripheral nerves also have a distribution map similar to the dermatome of the skin. On the basis of these 3 cases, further studies are needed to determine whether there is a universal neurological map. In any case, the present results suggested that performing the procedure at the target point is important for the outcome of peripheral nerve PRF. It may be possible to further improve the treatment results of PRF in the future by producing a universal

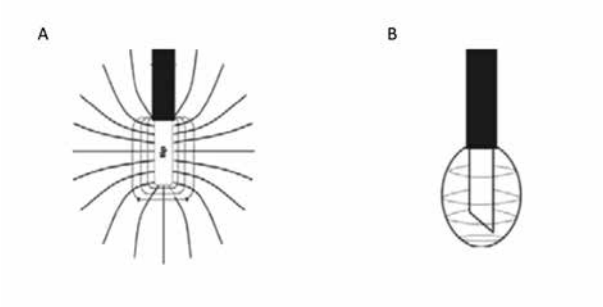

Fig. 4. Electric field of PRF. A) Electric field of PRF; B) Thermal coagulation field of RF.

neural distribution map through data collection. Similar studies with other peripheral nerves are also desired.

Author Contributions

MJ and YS contributed to writing, editing, and research. KN contributed to writing and editing.

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