

Efficacy of High-Voltage Pulsed Radiofrequency for the Treatment of Elderly Patients with Acute Herpes Zoster Neuralgia

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SUMMARY

OBJECTIVE: The aim of this study was to evaluate the efficacy of high-voltage pulsed radiofrequency in comparison with standard-voltage pulsed radiofrequency for the treatment of elderly patients with acute herpes zoster neuralgia.

METHODS: Sixty-four elderly acute herpes zoster neuralgia patients were randomly assigned to the standard-voltage pulsed radiofrequency group (i.e., group S, 32 cases) and the high-voltage pulsed radiofrequency group (i.e., group H, 32 cases), which received the standard-voltage and high-voltage pulsed radiofrequency treatment, respectively. The doses of gabapentin and tramadol for analgesia were adjusted based on pain degree of patients. The therapeutic effectiveness were assessed using the numeric rating scale and the sleep quality scale. The doses of gabapentin and tramadol before pulsed radiofrequency and 1, 2, 4, 8, and 12 weeks after pulsed radiofrequency were measured. The incidence of clinically meaningful postherpetic neuralgia (pulsed radiofrequency) 12 weeks after pulsed radiofrequency was noted.

RESULTS: After pulsed radiofrequency, the numeric rating scale score and the doses of gabapentin and tramadol in group H were significantly lower than those in group S, respectively ($p < 0.05$). The sleep quality scale score in group H was significantly higher than that in group S ($p < 0.05$). The incidence of clinically meaningful pulsed radiofrequency in group H was significantly lower than that in group S ($p < 0.05$).

CONCLUSION: For the treatment of elderly patients with acute herpes zoster neuralgia, when compared with the standard-voltage pulsed radiofrequency, the high-voltage pulsed radiofrequency can rapidly and steadily reduce the pain degree, improve the sleep quality, reduce the doses of anticonvulsants and analgesics, and decrease the incidence of clinically meaningful postherpetic neuralgia.

KEYWORDS: Pulsed radiofrequency treatment. Elderly. Herpes Zoster Oticus. Self-efficacy.

INTRODUCTION

The herpes zoster infection is caused by reactivation of the latent varicella zoster virus in the spinal or cranial nerve sensory ganglia, and it is characterized by a unilateral dermatomal rash and pain termed as “acute herpes zoster neuralgia (AHN)¹.” Moderate-to-severe AHN can cause physical disability and emotional distress². Pain that persists for more than 3 months after the onset of acute zoster rash is

generally considered to be postherpetic neuralgia (PHN)³. Moreover, the age and severity of AHN are the key risk factors for developing PHN⁴. The chronic pain in PHN can be difficult to alleviate despite the reported efficacy of many different treatments such as analgesics, topical lidocaine, topical capsaicin, nerve blocks, biofeedback, tricyclic antidepressants, gabapentin, and pregabalin⁵, associated with a high economic burden on the individual and society.

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Therefore, much attention has been paid to improving the therapeutic effectiveness and alleviating pain quickly for patients with AHN.

Pulsed radiofrequency (PRF) can significantly improve the therapeutic effect of AHN and decrease the doses of analgesics⁶. Recent studies have demonstrated that the therapeutic effectiveness of PRF is affected by its parameters⁷, and the high-voltage PRF has been demonstrated to enhance the clinical therapeutic effectiveness significantly for patients with neuralgia⁸. This study aimed to evaluate the efficacy of high-voltage PRF in comparison with standard-voltage PRF for the treatment of elderly patients with AHN.

METHODS

Patients and grouping

Sixty-four elderly AHN patients receiving PRF treatment in our hospital from February 2019 to June 2019 were enrolled. Based on the observer-blinded randomized controlled trial, 32 patients underwent high-voltage PRF (group H), and another 32 patients underwent standard-voltage PRF (group S). In group S, there were 13 males and 19 females, with the age of 71.42 ± 5.43 years and the disease duration of 22.40 ± 5.46 days. In group H, there were 15 males and 17 females, with the age of 72.81 ± 5.92 years and the disease duration of 23.20 ± 4.61 days. There was no significant difference in sex, age, or disease duration between two groups ($p > 0.05$). This study was approved by the Ethics Committee of The Third People's Hospital of Hangzhou. The written informed consent was obtained from all participants.

Inclusion and exclusion criteria

The inclusion criteria were as follows: aged more than 65 years, exhibiting AHN located at the unilateral thoracolumbar section for less than 1 month, and the Numeric Rating Scale (NRS) score > 6 points on a scale of 0–10 points. The exclusion criteria were as follows: inability to understand mandarin, inability to properly describe pain to investigator, relevant drug allergy, preexisting neuralgia, history of chronic pain, alcohol, or drug abuse, and contraindications to peripheral nerve block.

Treatment procedure

The patient was observed on the computed tomography (CT) in prone position; the electrocardiogram, blood pressure, and heart rate were continuously monitored, and the venous access was established. The nerve of the dorsal root ganglion (DRG) that needed to be therapeutically

targeted was determined based on the region of skin pigmentation due to the herpes zoster infection, which is typically accompanied by hyperalgesia or allodynia. The upper-middle part of the intervertebral foramen corresponding to the target nerve was determined using a thin-slice (2-mm) CT guidance, and the puncture site, angle, and depth were assigned. After inducing local anesthesia, two PRF trocars (i.e., 20 gauge, 15 cm electrode with 10 mm active tip, PMF-20-150-10, Baylis Medical Inc., Montreal, QC, Canada) were carefully inserted until the needle tip reached the upper-middle part of the intervertebral foramen and underwent a three-dimensional CT reconstruction (Figure 1). The needle tip, which is connected to the PMG-230 pain treatment generator (Baylis Medical Inc., Montreal, QC, Canada), was slowly moved in a sensation-testing mode (50 Hz). When abnormal sensations (mainly soreness, numbness, thermally, and an occasional twitch-like or prickly sensation) were observed below 0.5V and no muscle movement was observed above 1.0V over the skin areas with hyperalgesia, we confirmed that the needle tip was appropriately positioned on the target nerve of the DRG. The settings that were subsequently used on the pain treatment generator were as follows: in group S, the output voltage was set at 50V and in group H, the output voltage was set at 50V and increased gradually to the maximum voltage (i.e., bearable without causing pain in conscious patients). The other parameters were as follows: pulse temperature, 42°C ; pulse duration, 20 ms; pulse rate, 2 Hz; and pulse time, 480 s. All procedures were performed by the same physician (Bo Wang).



Figure 1. Images of PRF to the dorsal root ganglion. (A) PRF trocars image; (B) transverse CT image; and (C) three-dimensional CT reconstruction image. PRF: pulsed radiofrequency; CT: computed tomography.

Analgesia

Gabapentin was initiated at 300 mg/day at bedtime, and the dose increased by 300 mg/day up to a ceiling dose of 1,800 mg/day by day 7. The dose was increased regardless of whether efficacy was achieved at a lower dose, oral 25–100 mg of tramadol once or twice a day depend on the degree of pain and drug tolerance. Among patients who developed adverse effects, the dose was reduced to the previously tolerated level.

Observation indexes

The PRF parameters, such as sensation test voltage, resistance, and output voltage, in two groups were noted. The NRS and Sleep Quality Scale (SQS) scores and the doses of gabapentin and tramadol were noted in the morning before PRF and 1, 2, 4, 8, and 12 weeks after PRF, respectively.

Outcome measurement

In various studies, clinically meaningful PHN was defined as persistent pain with an intensity of three points or more on the NRS⁹. In this study, the incidence of clinically meaningful PHN 12 weeks after PRF was recorded.

Statistical analysis

The SPSS version 20.0 software (SPSS, Chicago, IL, USA) was used for the data analysis. The enumeration data were presented as number and rate and were compared using the χ^2 test. The measurement data were presented as mean \pm SD and were compared using the *t*-test. $p < 0.05$ was considered statistically significant.

RESULTS

Comparison of PRF parameters between two groups

In group S and group H, the sensation test voltage was 0.38 ± 0.07 V and 0.37 ± 0.08 V, respectively, with PRF resistance of $249.02 \pm 17.34 \Omega$ and $253.56 \pm 18.04 \Omega$, respectively. There was no significant difference of each index between two groups ($p > 0.05$). PRF voltage in group H was 76.50 ± 5.61 V, which was significantly higher than 47.73 ± 2.45 V in group S ($p < 0.01$).

Comparison of NRS and SQS scores between two groups

As shown in Figure 2, before PRF, there was no significant difference of NRS or SQS score between two groups ($p > 0.05$). The NRS score in group H was significantly lower than that in group S at 1, 2, 4, 8, and 12 weeks after PRF, respectively ($p < 0.05$). The SQS score in group H was significantly higher than that in group S at 1 and 2 weeks after PRF, respectively ($p < 0.05$).

Comparison of Gabapentin and Tramadol doses between two groups

Before PRF, there was no significant difference of gabapentin or tramadol dose between two groups ($p > 0.05$). The dose of gabapentin in group H was significantly lower than that in group S at 2, 4, 8, and 12 weeks after PRF, respectively ($p < 0.05$). The dose of tramadol in group H was significantly lower than that in group S at 1, 2, 4, and 8 weeks after PRF, respectively ($p < 0.05$) (Figures 3).

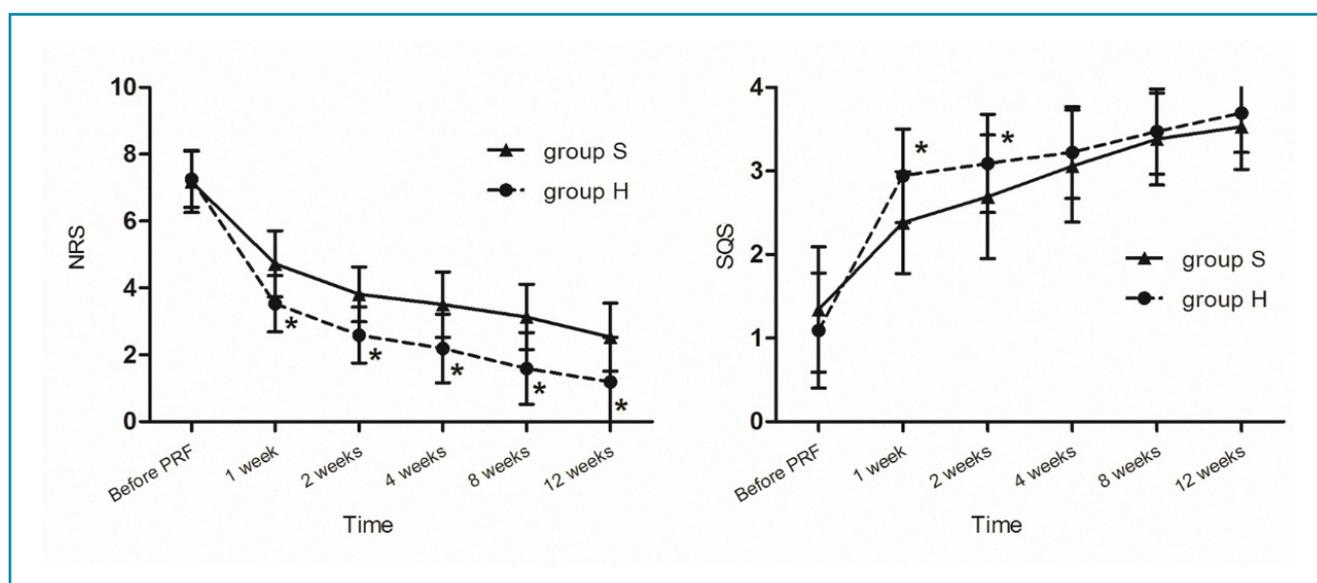


Figure 2. NRS and SQS scores between two groups. * $p < 0.05$ compared with group S. NRS: numeric rating scale; SQS: sleep quality scale.

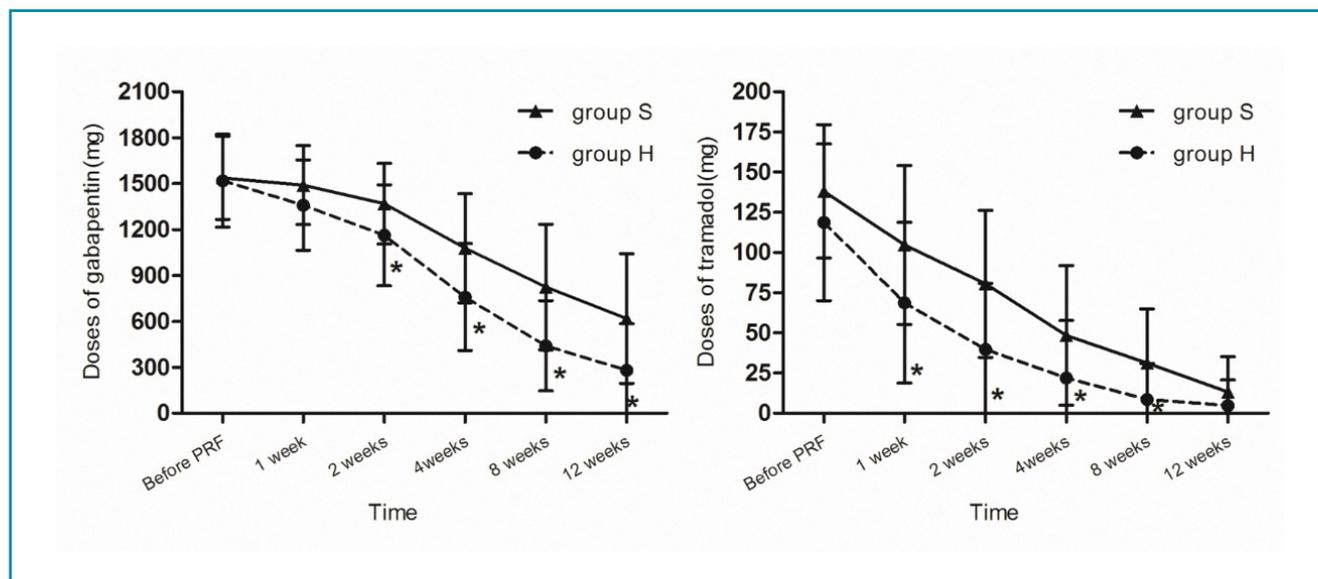


Figure 3. Doses of gabapentin and tramadol between two groups. * $p < 0.05$ compared with group S.

Comparison of clinically meaningful PHN cases between two groups

After 12 weeks from PRF, there were 14 and 5 cases of clinically meaningful PHN in group S and group H, respectively. The incidence of clinically meaningful PHN in group H was 15.63%, which was significantly lower than 43.75% in group S ($p < 0.05$).

DISCUSSION

Pulsed radiofrequency (PRF) is a new type of therapeutic technology. At present, the maximization of the effectiveness of PRF therapy has been a major problem for clinicians and scientists, and a large number of basic experiments and clinical studies have been conducted on parameters such as targets, time, waveform, temperature, and voltage¹⁰⁻¹². This study compared the efficacy of high-voltage PRF and standard-voltage PRF for the treatment of elderly patients with AHN. The results showed that the NRS score in group H was significantly lower than group S 1, 2, 4, 8, and 12 weeks after PRF, indicating that the high-voltage PRF had significantly better therapeutic effect against AHN than the standard-voltage PRF. In addition, the SQS score in group H 1 and 2 weeks after PRF was significantly higher than that in group S. The rapid increase in SQS score was due to the dramatically rapid decrease in the degree of pain and improved the quality of life in group H, demonstrating that the high-voltage PRF had

significantly better therapeutic effect against AHN than the standard-voltage PRF.

Gabapentin is a common drug for the treatment of neuropathic pain, mainly regulating voltage-gated calcium channel the alpha-2-delta subunits and achieving analgesic effects by reducing the release of glutamate, norepinephrine, and substance P¹³. The principal side effect is dose-dependent adverse reactions, such as dizziness and drowsiness; however, liver and kidney function may be impaired in severe cases. Therefore, the dosage should be monitored to reduce the discomfort due to medication in clinical practice, especially for elderly patients. In this study, the doses of gabapentin 2, 4, 8, and 12 weeks after PRF and tramadol 1, 2, 4, and 8 weeks after PRF were significantly lower in group H than in group S, demonstrating that the use of high-voltage PRF leads to the decrease in the dose of anticonvulsants and analgesics. The degree of pain in group H was stable and well controlled, and the patients could reduce the dose of oral medication at an earlier time point, reducing the possible adverse drug reactions.

In this study, 14 clinically meaningful PHN patients in group S and 5 clinically meaningful PHN patients in group H have occurred 12 weeks after PRF. The incidence of clinically meaningful PHN of the patients was lower in group H than in group S. Fortunately, all the NRS scores of PHN patients were not more than 5 points, and they had an acceptable quality of life. The incidence of PHN was less than that in the earlier literature report¹⁴, demonstrating the effectiveness of PRF and early therapy.

This study has certain limitations. The sample size was relatively small, and the follow-up period was relatively short. In addition, we did not study the effect of different timings of PRF on the therapeutic effect of high-output voltage, and we did not investigate the dose-effect relationship between PRF output voltage and therapeutic effect. Ultrasound-guided punctured can be used to reduce the radiation exposure of patient. Such issues will be addressed in future studies. Moreover, multicentered, large-sample studies of high-voltage bipolar PRF for other neuropathic pains can be performed.

CONCLUSION

For the treatment of elderly patients with AHN, when compared with the standard-voltage PRF, the high-voltage PRF can rapidly and steadily reduce the degree of pain, improve the sleep quality, reduce the doses of anticonvulsants and analgesics, and decrease the incidence of clinically meaningful PHN.

AUTHORS' CONTRIBUTIONS

HZ: Conceptualization. BW: Data Curation, Formal Analysis. ZDL: Writing – Original Draft. JX: Writing – Review & Editing.

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