Original paper

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Therapeutic effect of computed tomography-guided dorsal root ganglion pulsed radiofrequency regulation combined with platelet-rich plasma injection on postherpetic neuralgia: A retrospective study

Zhongwei Wang[1]*, Jing Chen[1]*, Xiaona Guo[2], Yan Lin[1], Weipeng Ge[1], Yunchao Chu[1]

[1]Department of Pain, Shengli Oilfield Central Hospital, Dongying 257034, China, [2]Department of Pain, Dongying People's Hospital, Dongying 257091, China

**These two authors contributed equally to the study.*

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Abstract

Introduction: *Postherpetic neuralgia (PHN) is one of the common refractory neuropathic pains. Oral drug treatment has great side effects and poor efficacy. To study the efficacy of computed tomography (CT)-guided pulsed radiofrequency (PRF) targeting dorsal root ganglion (DRG) and platelet-rich plasma (PRP), this retrospective observation was performed.*

Material and methods: *All patients with PHN were divided into the control group, PRF group, and PRF + PRP group based on their different treatment methods. The control group (45 cases) received drug treatment, the PRF group (45 cases) received CT-guided PRF treatment targeted to DRG, and the PRF + PRP group received PRF and PRP treatment. The changes of the numeric rating scale (NRS), Pittsburgh sleep quality index (PSQI) levels, and short form 36 health survey questionnaire (SF-36) before treatment and 7 days, 14 days, 30 days, and 90 days after treatment were compared among three groups.*

Results: *NRS and PSQI scores in the PRF + PRP group were lower than those in the PRF group and control group at 90 days after treatment ($p < 0.001$). At 90 days after the operation, the scores of SF-36 in the PRF + PRP group were obviously elevated compared with the data of the control group and PRF group ($p < 0.001$).*

Conclusions: *The pain degree, quality of sleep of patients, and quality of life with PHN were significantly improved after PRF combined with PRP treatments.*

Key words: *postherpetic neuralgia, pulsed radiofrequency, platelet-rich plasma, pain degree, life quality.*

Introduction

Herpes zoster (HZ) is an infectious cutaneous disorder caused by the varicella-zoster virus (VZV), which primarily affects the nerves and skin [4]. This virus mainly lurks in the dorsal root ganglion (DRG), causing nerve pain and itchy skin [19]. Postherpetic neuralgia (PHN) is the most common complication of HZ [18]. This kind of pain affects patients' quality of sleep and seriously affects their daily work and life [20]. Postherpetic neuralgia is usually managed conservatively with medical therapy. However, not all patients are suitable for this kind of treatment, and for those patients who continue to suffer from pain, interventional therapy is valuable [13]. Thus, reports on effective interventional treatment are necessary for patients with PHN.

Dorsal root ganglion is the first neuron of the nervous system, located in the dorsal root of the spinal

Communicating author:
Yunchao Chu, Department of Pain, Shengli Oilfield Central Hospital, Dongying 257034, China, e-mail: Chuyunchaodr@163.com

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cord, and it is the target of neuropathic pain [23]. Computed tomography (CT)-guided pulsed radiofrequency (PRF) of the spinal nerve root ganglion is a minimally invasive treatment method, which has the advantages of less trauma, good efficacy, and high safety [25]. Pulsed radiofrequency therapy under the guidance of CT can help doctors find the puncture site quickly and accurately, and improve the puncture accuracy. This method can reduce the frequency of punctures, thereby reducing trauma, sequelae, and complications [9]. Platelet-rich plasma (PRP) is a concentrated form of autologous venous blood [22]. PRP is rich in various growth factors and proteins, which can reduce inflammatory reactions and promote neurovascular repair [14]. In addition, PRP can also promote axonal regeneration and the survival of injured nerves. Therefore, PRP has been widely used in the treatment of some neurological diseases, such as peripheral nerve injury and burn-induced neuropathic pain [10,31]. However, there is little evidence that eliminates the efficacy of the combination of PRF and PRP in treating PHN. The numeric rating scale (NRS) is a common indicator to estimate the pain degree [27]. Pittsburgh sleep quality index (PSQI) is considered to be a crucial assessment system for sleep status [1]. The score of the short form 36 health survey questionnaire (SF-36) is used as a reflection of quality of life [3]. Therefore, this investigation focused on these indicators in patients with PHN.

Considering the current publications, this study collected patients with PHN and studied the efficacy of the combination of PRF and PRP. Specifically, the function of the combination of PRF and PRP was reflected by NRS levels, PSQI levels, and SF-36 levels. In addition, the side effects of this therapy were estimated in the research.

Material and methods

Recruited volunteers

One hundred and thirty five (135) patients with PHN admitted to the Shengli Oilfield Central Hospital from May 2019 to August 2022 were selected. The sample size was calculated based on the results of our previous experiments. Calculations were made by using two independent proportional efficacy analyses where α (two-tailed) = 0.05 and β = 0.1 (90% power), which showed that 40 subjects per group were required for each group. The diagnosis of PHN was mainly based on the history and clinical manifestations, such as time of onset and duration of disease, pain, history of herpes, quality of life, scarring, pain sensation, and neurologic dysfunction. The inclusion criteria were as follows: 1) meeting the diagnostic criteria of PHN [32]; 2) NRS ≥ 6; 3) duration time ≥ 1 month; 4) visual analogue scale (VAS) ≥ 6; and 5) receiving normal treatment, or PRF, or PRF combined with PRP injection. Exclusion criteria included: 1) central and peripheral analgesic drugs and other invasive analgesic treatments used one week before treatment; 2) received previous treatments such as radiofrequency or neurotomy; 3) combined with systemic immune diseases, haematological diseases, or other malignant tumours; 4) coagulation dysfunction; and 5) mental illness or cognitive impairment. The patient voluntarily participated and signed the written informed consent form. The design of this research was approved by our hospital. All patients completed the treatment and follow-up, and there were no shedding cases.

The patients who met the inclusion criteria were divided into the control group, PRF group, and PRF + PRP group according to the treatment method, with 45 cases in each group. Patients were grouped according to their different treatment wishes. Prior to grouping, clinicians provided detailed explanations and descriptions of the different treatment options. As shown in Table I, 45 patients were included in the control group, including 21 males and 24 females, ranging in age from 46 to 77 years. There were 20 males and 25 females, ranging in age from 51 to 80 years in the PRF group. There were 16 males and 29 females in the PRF + PRP group, ranging in age from 43 to 78 years. No differences were found in age, sex, pain duration, and pain side among these three groups ($p > 0.05$, Table I).

Routine drug treatment

The patients in the control group were given routine drug treatment for 4 weeks. The patients were given 0.5 mg mecobalamin tablets each time, once every 8 hours. The administration method of gabapentin capsules was as follows: take 300 mg before going to

Table I. Clinical parameters of patients

Parameter	Control	PRF	PRF + PRP	*P* value
Age (year)	59.0 (46.0-77.0)	61.0 (51.0-80.0)	62.0 (43.0-78.0)	0.217
Sex (female/male)	24/21	25/20	29/16	0.529
Pain duration (month)	2.0 (1.1-2.7)	2.0 (1.0-3.0)	1.9 (1.0-2.70)	0.261
Pain side (left/right)	21/24	23/22	25/20	0.701

PRF – pulsed radiofrequency, PRP – platelet-rich plasma

bed on the first day; increase by 300 mg on the second day; and take 300 mg every time on the third day, once every 8 hours. According to the patient's pain degree and patient's tolerance, increase or decrease the dosage appropriately, with a maximum of 1800 mg per day.

CT-guided PRF treatment of DRG

The patients in the PRF group were treated with PRF and drug treatment. According to the patient's condition, the pain site and the spinal ganglion segment involved in the pain were determined. Patients took a prone position or lateral position. Under the guidance of CT, the most painful segment and its surroundings were scanned to determine the vertebral body segment to be operated on and the puncture point (5-6 cm away from the affected side of the spinous process space). Routine disinfection and towel spreading were carried out, and the patients were locally anesthetized with 5 ml of 1% lidocaine. A radiofrequency puncture trocar (20G, Inomed, Emmendingen, Baden-Wurttemberg, Germany) was selected and punctured into the targeted side at an angle of 45 degrees with the skin surface. When the needle reached the intervertebral foramen, a radiofrequency therapeutic instrument was connected and the field intensity was adjusted to the patient's tolerable range. Then, the position of the needle tip was fixed after eliciting the corresponding nerve sensation. Finally, the PRF was continuously performed with 2 Hz frequency, 20 ms pulse width, and 42°C treatment temperature for 300 s. This operation was repeated twice. The PRF generator was from Baylis (Montreal, Quebec, Canada).

The operation method of PRP

In the RPF + PRP group, patients received PRP injections on the basis of RPF and drug treatment. 8 ml of the patient's venous blood was extracted by the doctor and placed in a disposable human venous blood collection container. The blood was centrifuged at 4000 r/min for 10 min to obtain stratification. 2 ml platelet-poor plasma (PPP) from the first layer was extracted and discarded, and the remaining PPP was mixed with the platelet aggregation layer for injection. PRP was injected into the target dorsal root ganglion through the radiofrequency trocar. 1 mL PRP was injected into each injection site. After the injection, the patient was observed for 30 minutes to prevent serious complications.

Observation indicators

The evaluation was performed once before (recorded as 0 days) and 7 days, 14 days, 30 days, and 90 days after treatment.

1. The overall pain was assessed by NRS. The scale has a total score of 10 points, and the score from small to large represents an increase in pain. In this rating system, 0 means no pain, 1-3 represents mild pain, 4-6 is for moderate pain, and 7-10 means extreme pain.

2. The sleep quality scores of patients before and after intervention were estimated using the PSQI scale, which included 7 evaluation items (score range: 0-21). This system adopts a 0-3-point scoring method. The lower the score, the better the perceived sleep quality [2].

3. The SF-36 scale is used to evaluate the quality of life of patients, which included eight aspects [17]. Physical functioning, bodily pain, physical role, mental health index, general health, social function, emotional role, and vitality are the specific dimensions. The score of each aspect ranges from 0 to 100, which is directly proportional to the quality of life of patients.

4. In addition, the situation of adverse reactions was recorded during three months. Adverse reactions include pneumothorax, infection, dizziness, pain, etc.

Statistical analysis

SPSS 21.0 software was used for statistical analysis, and GraphPad 7.0 was used for drawing. Counting data were expressed as numbers and the chi-square test was adopted. Measurement data were expressed as median (minimum-maximum). The data that conform to the normal distribution were tested by independent sample *t*-teat for inter-group comparison. A non-parametric test (Kruskal-Wallis test) was used for indicators that do not conform to normal distribution. $P < 0.05$ was statistically significant.

Results

Comparison of the pain degree among the control group, PRF group, and PRF + PRP group

No difference in the NRS values among the three groups was found before treatment ($p > 0.05$, Fig. 1). Over time, the NRS values of the three groups of patients gradually decreased. At 90 days after treatment, the NRS in the PRF + PRP group was decreased compared with the PRF group and control group ($p < 0.001$, Fig. 1).

Comparison of PSQI among the control group, PRF group, and PRF + PRP group

The preoperative PSQI showed no obvious discrepancy among the control group, PRF group, and PRF + PRP group ($p > 0.05$, Fig. 2). There were significant differences in PSQI scores among the three groups at

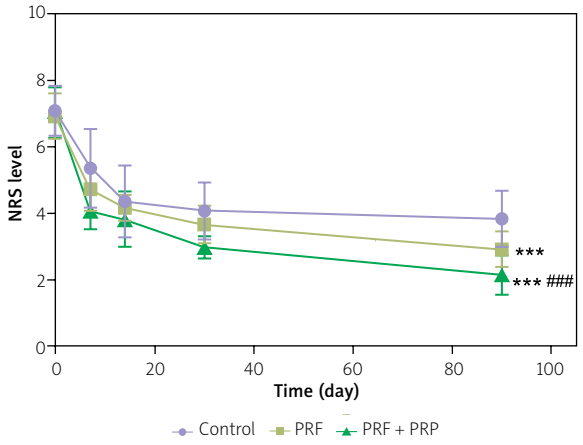

Fig. 1. The treatments of pulsed radiofrequency (PRF) and platelet-rich plasma (PRP) decreased the numeric rating scale (NRS) scores. ***$p < 0.001$, relative to the control group; ###$p < 0.001$, relative to the PRF group.

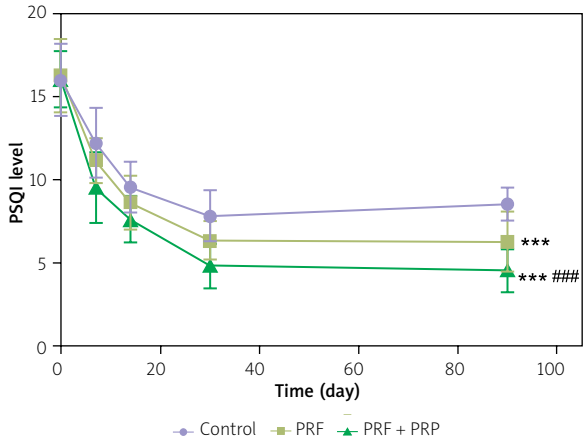

Fig. 2. The effect of pulsed radiofrequency (PRF) and platelet-rich plasma (PRP) on sleep quality. ***$p < 0.001$, relative to the control group; ###$p < 0.001$, relative to the PRF group.

90 days after the operation, and the PSQI scores in the combined treatment group were lower than those in the PRF group ($p < 0.001$, Fig. 2). The results indicated that PRF combined with PRP was more effective in relieving sleep.

Comparison of SF-36 among the control group, PRF group, and PRF + PRP group

The bodily pain, physical functioning, physical role, mental health index, general health perception, social function, emotional role, and vitality included in the SF-36 were estimated. At 90 days after the operation, the physical functioning, physical role, mental health index, and social function in the PRF group were lower than in the control group ($p < 0.01$, Fig. 3A-H). At the same time, the parameters of the SF-36 questionnaire in the PRF + PRP group were significantly higher than those in the PRF group and control group ($p < 0.05$, Fig. 3A-H).

Clinical complications and adverse reactions

No serious complications occurred in any patients, including pneumothorax, infection, and nerve root tingling. One case in the control group had sickness and one case in the PRF group had pain at the puncture area. In the combined treatment group, there was a case of discomfort in the puncture area and a case of dizziness. These adverse reactions were relieved within 24 hours after rest and psychological counselling.

Discussion

Herpes zoster is an acute skin disease caused by a virus invading the sensory nervous system [5]. Normally, patients with HZ are completely cured within one month. However, a few patients with HZ have neuralgia that lasts for several months and eventually develops into intractable PHN [29]. The study on the pathogenesis of PHN found that the VZV lurking in DRG proliferated, destroyed nerve axons, and caused nerve tissue damage [16]. These damaged sensory nerves produce abnormal nerve impulses, which continue to be input through DRG, resulting in increased pain sensitivity of peripheral and central nerves [7]. In addition to conventional drug treatment, minimally invasive treatment of PHN has also been widely recognized, which can relieve pain and improve the quality of life and is widely used in the treatment of postherpetic neuralgia [24]. Therefore, this study focuses on studying the clinical efficacy of minimally invasive treatment in treating patients with PHN.

Pulsed radiofrequency technology, as a non-destructive neuroregulatory technique, can stimulate neurons and their behaviours through an electric field, further change their biological effects, and thus have analgesic effects [11]. This technique only stimulates the fine fibre sensory nerve, does not cause necrosis of surrounding cells and tissues, preserves the integrity of nerve structure and function, and avoids complications caused by nerve injury. Pulsed current is stimulated at the location of DRG, and a transient electric field can inhibit synaptic transmission by changing transmembrane potential, which can effectively inhibit

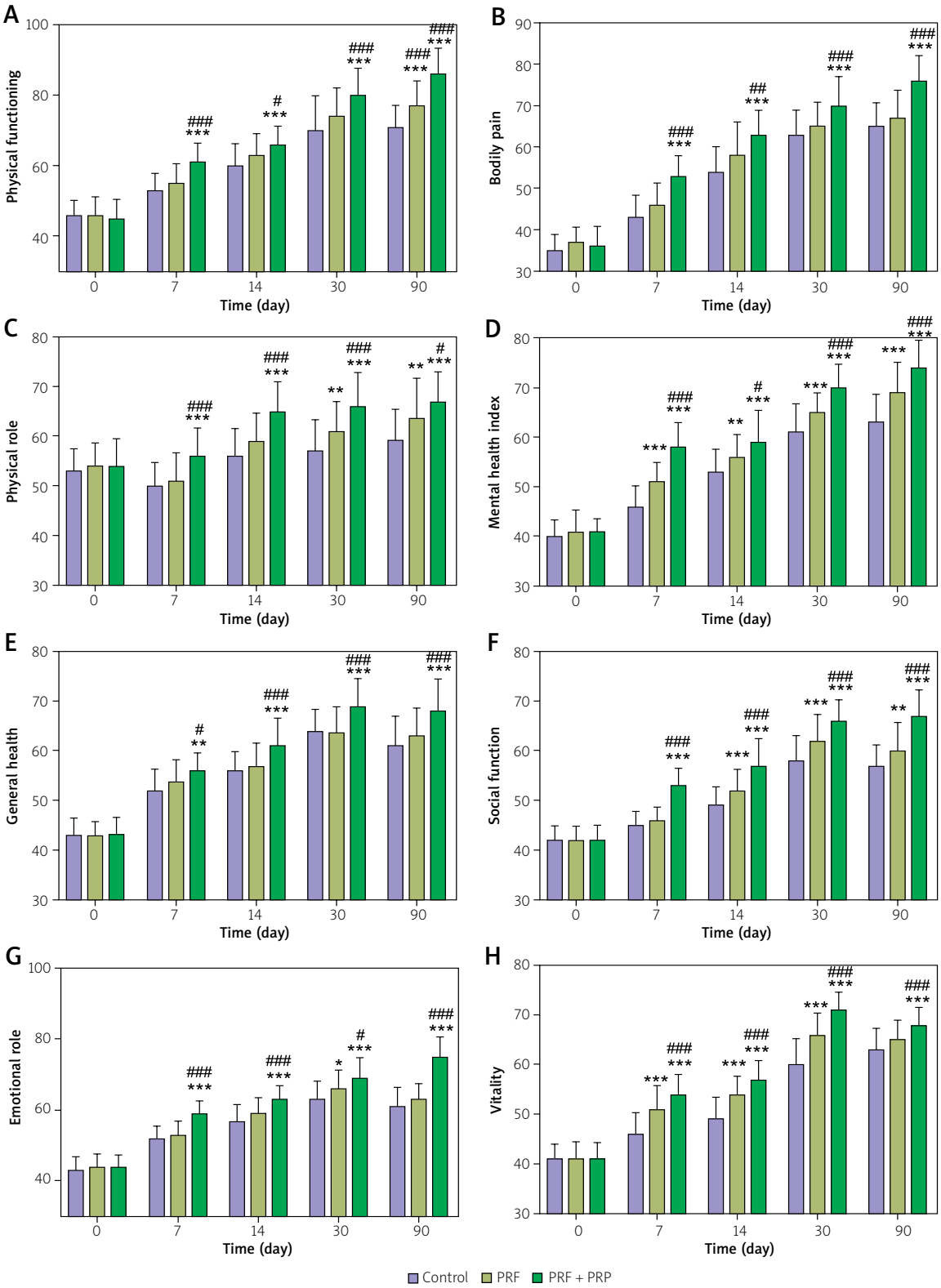

Fig. 3. The significance of pulsed radiofrequency (PRF) and platelet-rich plasma (PRP) on quality of life. The increase of **A**) physical functioning, **B**) bodily pain, **C**) physical role, **D**) mental health index, **E**) general health, **F**) social function, **G**) emotional role, and **H**) vitality. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, relative to the control group; #$p < 0.05$, ##$p < 0.01$, ###$p < 0.001$, relative to the PRF group.

and reduce spontaneous ectopic discharge and relieve pain [21]. In a large number of clinical practices, PRF has been verified as a method with unique advantages in the treatment of neuropathic pain. The roles and safety of CT-guided PRF on patients with PHN are reported and the results unveil that the pain degree, health quality, and side effects of patients with PHN are relieved after PRF treatment [6,9]. The patients with PHN had high SF-36 scores after being treated with PRF, which indicated that PRF improved patients' quality of life [15]E. In this current study, the clinical function of PRF in treating PHN was estimated. Through this operation method, the NRS scores were significantly inhibited, suggesting that the pain sensation was relieved after PRF treatment. The PRF treatment also improved sleep quality, which was certified by the declined PSQI levels in the patients who received PRF treatment. Most aspects of SF-36 in patients who received PRF treatment were elevated, documenting that PRF had a certain effect in relieving the quality of life of patients with PHN.

Platelet-rich plasma has the function of accelerating the repair of injured nerves and relieving pain, and can also promote the repair of fascia, muscle, tendon, and other soft tissue injuries, which has become one of the important means to treat neuralgia [8,26,28]. PRP can promote the recovery and regeneration of injured nerve axons, inhibit the occurrence of peripheral sensitization, and finally play a role in relieving pain [12]. Zhou *et al*. documented that, in patients with HZ neuralgia, the NRS scores decreased significantly, providing that PRP had satisfactory analgesia function and fewer side effects [30]. This present study combined the PRF and PRP techniques and applied this combination treatment to patients with PHN. The findings verified that the NRS scores, PSQI scores, and SF-36 scores after treatment were significantly lower than those before treatment, indicating that PRF + PRP could relieve postherpetic neuralgia, improve sleep quality, and promote quality of life. The scores of these four indicators declined compared with the data of PRF, reflecting that the analgesic effect of PRF combined with PRP injection was more satisfactory. Furthermore, no serious adverse reactions occurred in any patients with PHN, indicating that CT-guided PRF and its combination with PRP would not lead to more adverse reactions. In addition, this article had several limitations, including a small sample size and short follow-up time, which needs more research to support.

In summary, PRF combined with PRP injection could effectively relieve PHN by suppressing pain and improving the sleep quality and quality of life of patients and could serve as a safe avenue in clinical practice.

Ethics approval and consent to participate

The study protocol was approved by the Ethics Committee of Shengli Oilfield Central Hospital and followed the principles outlined in the Declaration of Helsinki. In addition, informed consent has been obtained from the participants involved.

Disclosure

The authors report no conflict of interest.

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