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Comparison of the Effect of Continuous Radiofrequency and Pulsed Radiofrequency Treatment on Third Occipital Neuralgia

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ABSTRACT

***Background**: Third occipital neuralgia (TON) is an uncommon headache caused by C2-3 zygapophyseal joint osteoarthritis. Both continuous and pulsed radiofrequency have been used to treat TON. However, no studies have compared the effects of continuous radiofrequency (CRF) and pulsed radiofrequency (PRF) on TON. This study aimed to determine the most effective treatment for TON.*

***Methods**: A total of 61 patients were enrolled. CRF was performed at 80°C for 90 sec at three target lesions. During PRF, 42°C for 120 sec was applied to the target lesions. Numeric rating scale score (NRS) was assessed in all patients before treatment and at 2 weeks, 3, and 6 months after treatment. Successful treatment was defined as an NRS pain reduction of at least 50% at 6 months, as compared with the pretreatment score.*

***Results**: The mean post treatment pain scores at 2 weeks, 3, and 6 months were significantly lower in both groups. At 2 weeks and 6 months post-procedure, the CRF group showed significantly more pain reduction than the PRF group. The prevalence of pain reduction by at least 50% was lower in the PRF group than in the CRF group. The proportion of patients with > 50% reduction in the NRS was 71% in the CRF versus 50% in the PRF group at the final follow-up.*

***Conclusion**: CRF was associated with earlier and longer pain reduction than PRF in patients with TON. Therefore, CRF should be recommended for patients with TON as much as possible.*

Keywords

Third occipital neuralgia, Headache, Continuous radiofrequency.

Introduction

Third occipital neuralgia (TON) is an uncommon headache caused by C2-3 zygapophyseal joint osteoarthritis [1]. After whiplash injury, 27% of patients (100 patients) in a study experienced TON [2]. The third occipital nerve is a superficial medial branch of the dorsal ramus of the C3 spinal nerve and is thicker than the other medial branches [3]. The dorsal ramus of the C3 spinal nerve divides into lateral and medial branches. The medial division further divides into superficial and deep branches; the superficial division is called the third occipital nerve, which travels through the dorsolateral surface of the C2-C3 facet joint.

To treat TON, continuous radiofrequency (CRF) or pulsed radiofrequency (PRF) of the third occipital nerve have been tried [4-7]. Govid et al. [8] revealed that 88% of patients with TON had pain relief after CRF. In idiopathic trigeminal neuralgia, CRF has been shown to be more effective than PRF [9]. Additionally, CRF has been reported to be effective for 6 months for occipital headache [6]. PRF is also used to treat occipital headache or TON [7,10-12]. In occipital neuralgia, PRF may decrease pain by generating a low-intensity electrical field around the sensory

nerves, which hinders the functioning of the A-delta and C fibers in the long run [3]. Kim et al. [7] reported successful ultrasound-guided PRF in two male patients with headache in the occipital region. In another study by Cohen et al. [5], PRF was found to be superior to steroid injections in relieving pain caused by TON. However, no study has compared the effects of CRF and PRF on TON. This study aimed to compare the effects of these treatments on TON.

Methods

Study Design and Patient Characteristics

This study included a total of 61 patients who underwent CRF or PRF for the treatment of TON. The inclusion criteria were as follows: 1) neck pain; 2) tenderness at the C2-3 facet joint; 3) at least a 3-month history of pain; 4) positive response to diagnostic block; 5) arthropathy revealed in an imaging study, such as x-ray, computed tomography, or magnetic resonance imaging; and 5) age 20–79 years. The exclusion criteria were: 1) myelopathy; 2) spinal infection; 3) coagulation disorder; 4) pregnancy; and 5) less than 50% pain relief after diagnostic block.

Diagnosis

The Institutional Review Board approved the study, and all patients provided written informed consent. The diagnostic block was performed two times. During the first injection, 0.3 ml of 2% lidocaine was injected into the third occipital nerve under C-arm guidance. One week after the block, if more than 50% pain relief was observed, the second block was performed with 0.5% ropivacaine. At the second visit, if more than 50% pain relief was reported, the patient was diagnosed with TON.

The patients were randomly allocated to CRF or PRF treatment. Radiofrequency treatment was performed under C-arm fluoroscopy with the patient in a prone position on the fluoroscopy table. The procedure site was prepared, draped in a sterile fashion, and infiltrated with 1% local anesthetic.

PRF procedure

PRF was performed at three points. Under lateral C-arm guidance, a 10-cm, 22-G straight radiofrequency (RF) cannula with a 10-mm active tip (OWL, Diros, Canada) was advanced perpendicularly toward the C2-C3 zygapophyseal mid-joint. The stylet was removed and replaced with a RF probe. Sensory and motor tests were performed at 50 Hz and 2 Hz, respectively. After confirming the needle position with the C-arm and sensory and motor tests, PRF was performed using a Diros URF-3AP RF generator (Diros, Canada) with 20 ms current at 2 Hz for 120 s at 42°C. After performing PRF at the first point, the RF cannula was moved slightly up and down to perform PRF at the second and third points.

CRF procedure (Posterior-lateral Approach)

The patient was placed in a prone position, with a pillow under the chest. First, the C2-3 facet joint was found in the anterior-posterior (AP) and lateral C-arm views. Subsequently, the C-arm was rotated to obtain an oblique view ranging from 15-30 degree depending on the patient's status. In the oblique view, the skin entry point and final target site were determined. After draping the skin and administering local anesthetic, an RF needle was inserted into the target site to touch the posterior site of the C2-3 facet joint. The RF needle was carefully advanced across the lateral surface of the joint. If the electrode was placed in the correct position and its position was confirmed in the C-arm, it was carefully held in place, and motor (2 Hz) and sensory (50 Hz) tests were performed.

CRF was performed at 80°C for 90 s. After treating the first point, the RF needle was slightly moved for performing CRF at the second point. CRF was performed at the third point by moving the needle a few millimeters downward.

Statistical Analysis

The numeric rating scale (NRS) score was assessed in all patients before RF treatment, as well as at 2 weeks, 3, and 6 months after treatment. Successful treatment was defined as an NRS pain score reduction of at least 50% at 6 months compared with the pretreatment score.

To compare the pain scores within and between the two groups over time, one-way analysis of variance and Mann-Whitney U tests were used. The level of statistical significance was set at $P < 0.05$. Data were analyzed using the Statistical Package for the Social Sciences (SPSS, v. 22.0, IBM Corporation, Armonk, NY, USA).

Results

This study included 61 patients. Among them, 35 and 26 patients underwent CRF and PRF, respectively. A summary of patient characteristics and pain duration is shown in Table 1. The mean post treatment pain scores at 2 weeks, 3 months, and 6 months were significantly lower ($P < 0.05$) in both groups compared with pretreatment scores (Table 2). At 2 weeks and 6 months post-procedure, the CRF group showed significantly more pain reduction than the PRF group (P=0.03) (Table 2). The prevalence of pain reduction of at least 50% was lower in the PRF group than in the CRF group (Table 3); however, the difference was not statistically significant. The proportion of patients with > 50% reduction in VAS score was 71% for CRF versus 50% for PRF at the final follow-up.

Table 1: Patients' characteristics.

N= 61	CRF (n=35)	PRF (n=26)
Age (yrs)	51.8 ± 17.4	60.9 ± 11.7
Sex (M:F)	22: 13	12: 11
Duration of Pain (months)	33.0 ± 45.0	26.5 ± 23.8

Table 2: Changes of numeric rating scores.

N=61	Pre-treat	Post 2 weeks	Post 3 months	Post 6 months	P-value
CRF (n=35)	7.1 ± 1.2	3.5 ± 1.0	3.3 ± 0.8	3.3 ± 0.8	0.000
PRF (n=26)	7.2 ± 1.2	4.2 ± 1.1	3.5 ± 0.9	3.7 ± 0.7	0.000
P value	0.74	0.03	0.53	0.04	

Table 3: Proportion and prevalence of pain reduction by numeric rating scale (ΔNRS %).

N=61	CRF (n=35)			PRF (n=26)		
	2 weeks	3 months	6 months	2 weeks	3 months	6 months
Ruction percentage (%)	48.5 ± 17.5	52.3. ± 14.3	51.3 ± 13.2	40.8 ± 18.5	48.9 ± 14.9	46.4 ± 13.3
Number of NRS > 50% reduction	19 (54%)	24 (68%)	25 (71%)	9 (35%)	18 (70%)	13 (50%)

Discussion

In the present study, both CRF and PRF were found to be effective in treating TON. However, CRF was more effective than PRF at the 6-month follow-up. These results are consistent with those of previous studies [6-8,10-13]. Additionally, we found that CRF resulted in earlier pain relief compared to PRF. In post-mastectomy neuropathic pain, thermal RF of the stellate ganglion was reportedly more effective than pulsed RF of the stellate ganglion [14]. Similarly, in a lumbar facet study, a greater improvement over time was observed in the CRF group. We postulated that the reason for CRF having greater effectiveness than PRF is because CRF directly coagulates the target nerve, although PRF also has an independent thermal effect. However, according to another study [15], PRF provides earlier pain relief in heel pain. This may be attributable to the minimal risk of neuritis due to the low temperature (42°C) used [16]. In the present study, the duration of pain relief was longer in the CRF group than in the PRF group. Moreover, CRF has been reported to provide longer pain relief than PRF in patients with cervical facet joint pain [17,18].

In the present study, the number of patients with pain relief greater than 50% was higher in the CRF group. The mechanism of action of PRF has been explained by the electric field reversibly disrupting the transmission of nerve impulses across unmyelinated C-fibers and small myelinated fibers [19].

However, this study has some limitations. First, the follow-up period was less than 1 year. Second, although two diagnostic blocks with different local anesthetics were performed twice, false positives could not be excluded. Third, we applied 80°C for 90 s in CRF and 42°C for 120 s in PRF. However, there are no reference values for these procedures; therefore, further studies are required to determine optimal RF temperature and duration for CRF and PRF. In conclusion, we found that CRF was associated with earlier and longer pain reduction than PRF in patients with TON. Therefore, CRF should be preferentially used for the treatment of TON.

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