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Impact of combining pulsed and thermal radiofrequency on long-term therapy of idiopathic trigeminal neuralgia: A prospective study

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ABSTRACT

Background: Trigeminal neuralgia (TN) is a painful condition characterized by sudden onset, severe unilateral, brief, stabbing recurrent episodes electric shock like pain in the distribution of one or more branches of the trigeminal nerve. Many approaches were used for treatment of TN as balloon decompression, thermocoagulation radiofrequency (TRF), and pulsed radiofrequency (PRF).

Objectives: This study evaluated the effectiveness of combined PRF and TRF for long-term therapy of patients with idiopathic TN.

Patient and methods: Our prospective study was carried out after the approval of ethical committee of Zagazig University Hospital Pain Management Unit from June 2017 to May2019. Overall, 20 adult patients suffering from idiopathic TN who treated with combining PRF and TRF for the gasserian ganglion. PRF (continuous for 20 min, at 42°C) followed by TRF (for 60 s at 70°C, then for 60 s, at 75°C) was performed to the gasserian ganglion. The post-operative pain relief and complications were evaluated at first day, 1, 3, 6, 12, 18, and 24 months after treatment.

Results: There were significant improvements of pain relief as regards Visual Analog Scale showed baseline VAS [8.65 ± 0.59] and first day, 1, 3, 6, 12, 18, 24 months [3.60 ± 1.09, 2.55 ± 0.69, 1.7 ± 0.65, 1.05 ± 0.68, 0.85 ± 0.67, 0.80 ± 0.69, 0.9 ± 0.69], respectively, facial numbness and postoperative masseter muscle weakness recovered more rapidly in patients receiving combined PRF and TRF therapy.

Conclusion: Combination of PRF followed by TRF is effective in treating TN pain with minimal postoperative complications.

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Thermocoagulation; pulsed radiofrequency; idiopathic trigeminal neuralgia

1. Introduction

Trigeminal neuralgia (TN) is the worst type of facial pain. It is described as intense, sharp, stabbing, and shooting like electric shock pain. It can be triggered by touch, chewing, laughing, shaving or face wash [1,2].

TN shows the complex neurophysiological mechanisms. As demyelination of branches of the nerve or activation of peripheral receptor, transmission and projection of nociceptive information, and convergence of nociceptive afferents into common central neurons, as well as the interaction of a multitude of neurotransmitters and neuromodulators, may play a key role in the perception of pain [3].

Interventional therapy for TN is either destructive with trigeminal nerve sensory function destroyed intentionally or non-destructive with decompression of the trigeminal nerve and preservation of its regular function [4]. The most common procedures in treating TN pain are the use of radiofrequency (RF). The main advantages of RF seem to be its effectiveness and high pain relief rate without the dangerous complications of surgical procedures and lack of side effects and reduction of oral medication [5].

2. Patient and methods

This prospective study was conducted at Zagazig University Hospital, Pain Management Unit in a period from June 2017 to May 2019. After approval was obtained from the local ethics committee and informed consent was obtained from 20 patients presenting with idiopathic TN (V2–V3) at our hospital, of either sex, average age 48–75 years old, undergo a multidisciplinary assessment, including complete neurological evaluation and magnetic resonance imaging (MRI).

All patients were subjected to the following: pain assessment as onset, course, duration, and severity of pain using (VAS), clinical, physical, and neurological examination, investigation as coagulation profile, ESR, CRP, CBC.

Patients are fasted for at least 6 h before the procedure. Intravenous access is obtained prophylactic antibiotic is administered 1 h before the procedure, standard monitors (ECG, non-invasive blood pressure monitoring, and pulse oximetry) were connected to the patients, O_2 was administered via a nasal prong. Patient lied in the supine position with slight hyperextension of the neck to facilitate the submental view

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by fluoroscopy. The patients were sedated using fentanyl (1-2ug/kg) and midazolam (0.03–0.05 mg/kg), local anesthesia infiltration at the site of puncture, then propofol (0.75 mg/kg), IV infusion during needle journey through foramen ovale and during RF periods. After proper sterilization of the skin and draping, fluoroscopy was adjusted in the submental view (craniocaudal up to 20°) with slight obliqueness (up to 20°) to visualize the foramen oval in between the inner side of the mandibular ramus of the affected side and medial border of maxilla as oval opening. The entry point was 2–3 cm lateral to the angle of the mouth. The RF needle (neurotherm, 100 mm, 22 gauge, 5 mm active tip, curved) was inserted after injection of lidocaine 1% infiltration. The tunnel view technique for the needle pathway was tried during the anteroposterior view of oval opening. The needle passed end-on until a depth of 5–7 cm.

Once the needle enters the foramen ovale into Meckel's cave, the C-arm is then rotated laterally to confirm the needle position. The final position of the needle tip between the angle formed by the petrosal ridge of the temporal bone and the clivus (Figure 1). Propofol sedation is discontinued, the patient is allowed to awaken and trial stimulation: first, sensory stimulation is carried out at 50 Hz using the neurotherm machine. The targeted position of the electrode was verified through induction of paresthesia using neurotherm machine by sensory stimulation using a voltage btween 0.1–0.3 in the affected painful area, patient was asked about site of pain behind nose, ear, nasopharynx, inside the mouth represent (V2). As a second step, motor stimulation was performed using 2 Hz with 0.1–1 V, and the masseter muscle contractions were observed represent mandibular branch (V1).

After sensory and motor stimulation, RF treatment was started by use of the RF machine (Neurotherm 1100), as:

At first PRF current is applied continuous for 18 min at 45 V, the cut-off needle tip temperature was set at 42°C (6 min each rotation of needle Rt., Lt., down side, respectively).

Then TRF lessoning was done at 65°C for 60 s; then 70°C for 60 s; at each stage, the needle rotate Rt., Lt., down side, respectively), the patient was allowed to recover from the I.V. propofol, and we examine him for sensory and pupil reactivity.

After RF lessoning inject, 1 cc xylocaine 1% + 0.5 cc dexamethasone 4 mg before withdrawal of needle.

Patients were observed and monitored in the recovery room and discharged after 2 h. The post-operative pain relief and complications were evaluated at first day 1, 3, 6, 12, 18, and 24 months after treatment. The patients came to pain clinic to be evaluated using the Visual Analog Scale (VAS) (0 = no pain, 10 = worst pain). Complications as facial hematoma, pain at puncture site, facial numbness, anesthesia dolorosa and masseter muscle weakness was reported.

Table 1. Demographic patients' characteristics.

Variable	Value (n = 20)
Age (years)	64.1 ± 6.51
Gender (F/M)	15/5
Side of pain (Rt/Lt)	14/6
Duration of pain (months)	13.45 ± 5.61
Preoperative VAS	8.60 ± 0.59

2.1. Statistical analysis

The data were tabulated and analyzed using Statistical Package of Social Sciences program (SPSS version 20.0) software. Qualitative data were expressed as number and percentage and analyzed using the chi square (χ^2) test. Quantitative data were expressed as mean ± SD and analyzed by using the *t*-test.

3. Results

A total of 20 patients who underwent TRF and PRF treatment of the gasserian ganglion for idiopathic TN were evaluated in this study. The baseline characteristics of the patients are shown in Table 1. Twenty patients were interviewed by telephone for long-term follow-up.

Age was distributed as range from 58 to 75 years, also TN was presented more in female and common in right side of the face.intable (2) patient with TN had differant sleep character and psychological stats

Results of the present study demonstrated that there was highly significant decrease in VAS score at

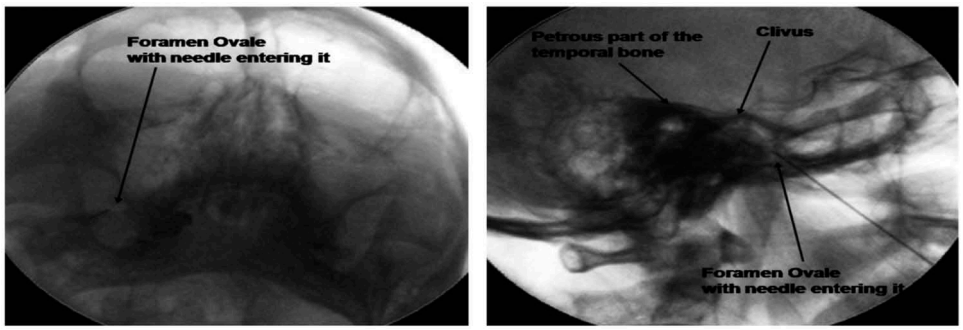

Figure 1. Submental and lateral view of the foramen ovale.

Table 2. Pain affect sleep characters and psychological stats at studied group (n = 20).

Data	No.	%
Pain and sleep		
Interrupted	4	20
Insufficient	5	25
Disturbed	5	25
By hypnotics	6	30
Pain and psychological state		
Balanced	3	15
Worried	4	20
Anxious	7	35
depressed	6	30

Table 3. Change assessment between VAS pre-treatment and other times.

VAS score	Mean	Standard deviation	P
Pre-treatment	8.65	0.59	0.001**
1st day	3.60	1.09	
Pre-treatment	8.65	0.59	0.001**
1st month	2.55	0.69	
Pre treatment	8.65	0.59	0.001**
3th month	1.7	0.65	
Pre-treatment	8.65	0.59	0.001**
6th month	1.05	0.68	
Pre-treatment	8.65	0.59	0.001**
12th month	0.85	0.67	
Pre-treatment	8.65	0.59	0.001**
18th month	0.80	0.69	
Pre-treatment	8.65	0.59	0.001**
24th month	0.9	0.67	

** p value is highly significant

Table 4. Incidence of complication in the study group.

Complication	N	%
Facial numbness	4	20
Pain at entry site	9	45
Mastication muscle weakness	3	15
Anesthesia dolorosa	0	0.0%

different stages of follow-up compared with pre-treatment stage (Table 3).

The incidence of facial numbness was 20% (4 patients) in the first day reduced to 10% (2 patients) at first month and reduced significantly to 5% (1 patients) at third month this with decrease gradual of anticonvulsant drugs till to 0.0% at 6, 12, 18, and 24 months (Figure 2). also 9 patients suffering from pain at the entry site that managed by cold fomintation, as regard masseter musle weakness managed usingphysiothrapy .

4. Discussion

TN is described as the most irritating pain known to humanity, many drugs and surgical procedures have been used for treatment. Despite numerous available approaches, the results are not completely satisfying. Pain treatment in patients with idiopathic TN is a challenge in clinical practice [2,4,6].

Interventional procedures as glycerol injection, percutaneous balloon micro decompression, rhizotomy, thermocoagulation with RF, microvascular decompression, and gamma knife radiosurgery, they have numerous advantages including being minimally invasive, quick and having a low incidence of adverse events, these advantages are balanced with a risk of recurrence, which increases over time [7].

Duransoy et al., Shaefer et al., and Lan et al. found that males to females ratio suffering from TN was 1:3, common in female and this in agreement with our study [8–10].

A similar pattern of results was obtained in this can be explained as the posterior fossa volume in males was larger than posterior fossa volume in females. Other suggestion that smaller posterior fossa volume might be an independent factor in the pathophysiology of TN [11].

Also, we noted that the right side of the face is more commonly affected than the left one. This is in agree-

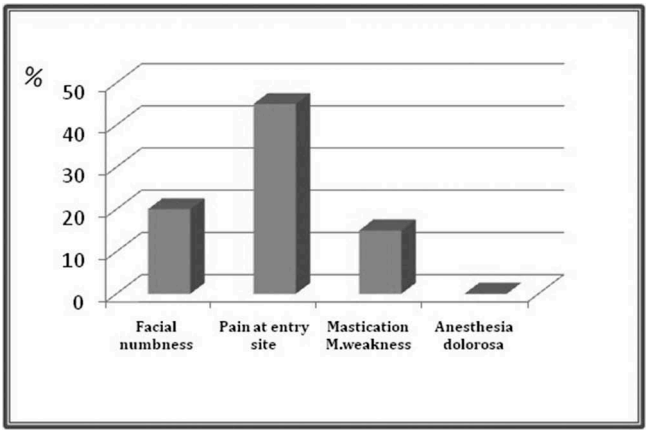

Figure 2. The incidence of facial numbness in the studied patients.

ment with Cruccu et al., which demonstrated that TN common in right side of the face may be due to the narrower foramen rotundum and foramen ovale on the right side [12]. Similar observations were reported by other studies [10,13,14].

In our study, we found sleep disturbance by different manner that managed with hypnotic and this in agreement with Almoznino et al. who found that there are a bidirectional relationship between craniofacial pain and sleep disturbance in a reciprocal manner and it is essential for clinicians to consider both aspects during treatment [15]. Other study reported that patients with TN were found to have a 2.17 times greater risk of developing a sleep disorder [16,17].

It was reported that psychometric scores indicated mild to moderate depression, moderate to severe anxiety, and moderate to severe functional limitation of daily life activities in TN patients [18,19].

TN has been treated by TRF of gasserian ganglion effectively. However, it has postoperative complications such as facial numbness, decreased corneal reflex, and masseter weakness [20].

In our study, we found that combination of pulsed radiofrequency (PRF) followed by thermal radiofrequency has more efficacy and prolonged duration than PRF alone as decrease in VAS from basal (8.65 ± 0.59) to (0.9 ± 0.67) at 24 months and this in agreement with Huang et al. who found that thermocoagulation radiofrequency (TRF) is reported to give higher rates of complete pain relief than either stereotactic radiosurgery or glycerol rhizolysis in treatment of idiopathic TN. The procedure success rate of TRF approaches 100%, being superior to that of microvascular decompression (MVD), which is only 85% [21]. Recently, PRF is becoming an alternative and effective therapy for patients with TN, as it is safe in reputation. But it is unclear whether the combination of TRF with PRF may decrease post-operative complications while maintaining long-term pain relief [22].

Wu et al. illustrated that thermocoagulation of the gasserian ganglion is achieved with a technical success of 98–100% [16]. Also, immediate pain relief is described as high as 90–95% in multiple studies [13,23]).

Doshi and Parikh reported that after TRF treatment pain relief can be achieved in 98% patients but 15–20% of patients may experience recurrence of pain in 12 months [5] and Koning reported that pain recurrence rates are between 25% and 60% after TRF with high incidence of side effects [24].

It was demonstrated that PRF is effective and safe technique for TN patients resistant to conservative management, with gradual increase in VAS score by time during follow-up [10,25]

Elawamy et al. reported complete pain relief was found immediately after the procedure in all patients up to the third month follow-up; after that, pain began to return in the PRF group rather than in the TRF group [26].

In contrast with our observations, Arici et al. suggest that combining TRF and PRF therapy may serve to decrease the side effects but not increase the pain relief. The same interventions with different parameters and different time of RF of the gasserian ganglion may generate better results [27].

Also, Yao et al. suggest that PRF can decrease the recurrence rate of TN, decrease the incidence rate and shorten the recovery time of corneal hypoesthesia, and lead to increased HRQoL scores after CRF. Therefore, we recommend the clinical use of CRF plus PRF for treating V1 TN [28],

Patients undergoing TRF plus PRF had decreased recurrence, reduced complications, including corneal hypoesthesia; and shortened time to recovery compared with patients undergoing TRF only. Other study recently reported that PRF reduced the complications and shortened the recovery time after TRF [28,29].

In agreement with our study, Zhao et al. concluded that combined use of PRF and TRF could help eliminate complications such as facial numbness, masticatory muscle weakness, and decreased corneal reflex [29].

5. Conclusion

We conclude that combination of TRF and PRF in treatment of idiopathic TN provides excellent pain relief and few tolerable side effects relived within short time.

Disclosure statement

No potential conflict of interest was reported by the author.

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