Original Article

Study of the outcome of patients undergoing pulsed radiofrequency for the treatment of Trigeminal Neuralgia: An observational study.

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Abstract:

Background: Trigeminal neuralgia is sudden unilateral severe, stabbing, recurrent episodes of pain in the distribution of one or more branches of the trigeminal nerve. Pulsed radiofrequency stimulation (PRF) has been recently introduced to alleviate neural, joint pain, and muscle pain. We tried to use PRF for pain relief in trigeminal neuralgia. The primary objective of our study was to observe the effectiveness and safety of pulsed radiofrequency in the patients of trigeminal neuralgia who are refractory to medical management. The secondary objective was to study the effect of pulsed radiofrequency on the duration of pain relief in these patients.

Methodolgy: In this observational study, we enrolled all fresh patients with trigeminal neuralgia attending our pain clinic for the first time and those who had not responded to conservative medical treatment or interventional nerve blocks. All the patients were diagnosed on the basis of signs, symptoms and MRI (CISS sequence). Anatomical landmarks of ophthalmic nerve, maxillary nerve, mandibular nerve were identified and nerve stimulation was done by placing the probe in the affected nerve division. Each point was stimulated with the radiofrequency probe kept for 10 minutes, giving a current of 10 to 30 milli-amperes with a set frequency of 2 Hertz. A total of 10 settings were given on alternate days. Assessment of pain relief, improvement, or deterioration was done using Barrow Neurological Institute Pain Intensity Score and Brief Pain Inventory facial scale scoring.

Results: There was a significant reduction in pain scores observed on Barrow neurological institute (BNI) and Brief Pain Inventory-(BPI) pain intensity score (p value of <0.05) before and after pulsed radiofrequency (PRF) application. The duration of pain relief after the application of PRF was up to 180 days in 15 patients, 181-300 days in 8 patients and 300 to 600 days in 7 patients. Only 2 patients had a prolonged pain relief lasting for 601-720 days. One patient had developed exposure keratitis after 4 sittings of pulsed radiofrequency application at the supraorbital foramen.

Conclusion: PRF offers short term relief in a majority of patients for a period of 18 months to 24 months. However, it was found that the long term effects of PRF may not be seen in patients with TN. PRF may be used as a short term measure for alleviating severe pain of TN till neurolytic blocks or a definitive surgery is carried out.

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Introduction

Trigeminal neuralgia (TN) characterized by sudden, usually unilateral attacks of recurrent excruciating pain in the distribution of the branches of the trigeminal nerve.[1] Two distinct categories have been described "classical" (characterized by a vascular compression of the trigeminal nerve by a tortuous or aberrant vessels) and "symptomatic" which is related to a cause other than a vascular compression.[2,3]

Most of the patients are managed by conservative medical management, others require neurolytic blocks, radiofrequency gangliolysis, glycerol rhizolysis, balloon compression or microvascular decompression for the management of their symptoms. Pharmacological

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Pulsed Radiofrequency, Trigeminal Neuralgia, Pain relief

treatment though considered effective in a number of patients but need to be taken lifelong and higher doses are often required over time in order to maintain efficacy. Neurolytic blocks are feasible and affordable but had limited duration of action and patients need repeated procedures while microvascular decompression is an invasive procedure.[4]

Pulsed radiofrequency (PRF) stimulation has been used in recent years, for treatment of neuralgia, joint pain, and muscle pain.[5,6] The technique works by delivering an electrical current and heat bursts to targeted nerves or tissues via catheter tip without damaging these structures.

To the best of our knowledge ours is the first study that has tried to observe the effects of pulsed radiofrequency with nerve mapper, Stimpod NMS460, in patients of trigeminal neuralgia. This is a pulsed radiofrequency device that has recently developed and approved by the U.S. Food and Drug Administration (FDA) in 2017.The therapeutic effect of the Stimpod NMS460 waveform is based on the cellular metabolic activity observed when a neuropathic nerve is subjected to electromagnetic effects caused by pulsed radio frequency (PRF). Stimpod increases accuracy and close needle tip placements, also simultaneous nerve mapping and nerve location is possible.

The primary aim of our study was to observe the effectiveness of pulsed radiofrequency with nerve mapper in the patients suffering from trigeminal neuralgia refractory to medical management and neurolytic blocks. The secondary aim was to observe the effect of pulsed radiofrequency on duration pain relief.

Methodology:

After obtaining approval from institutional ethical board and informed consent, this observational study was carried out in the Department of Anaesthesiology and Critical Care, Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar, J&K, India. All patients suffering from trigeminal neuralgia attending our pain clinic from September 2017 to December 2020 were enrolled. This included the patients who were refractory to medical management (receiving antiepileptics drugs), had received single or multiple neurolytic blocks, or had undergone peripheral neurectomies. Patients with implanted electrical devices, such as cardiac pacemakers and implanted cardiac devices were excluded from the study.

All the patients were diagnosed on the basis of signs and symptoms. Patients were evaluated by MRI (CISS sequence) to know whether the trigeminal neuralgia pain was result of pain caused due to vascular loop or idiopathic trigeminal neuralgia. Based on the division of the trigeminal nerve involved a nerve mapper was placed in the anatomical location. Duration of nerve stimulation was 10-15 minutes along the course of affected division of trigeminal nerve at 2 to 3 points each at 0.2 millisecond and 2 to 10 hertz of frequency, whichever was tolerated by the patient and starting with a current of 10mA and increasing it to 30mA as the tolerance of the patient increased and ten sittings on alternate days were given to dispel the symptoms. Assessment of pain relief, improvement, or deterioration was done using Barrow Neurological Institute Pain Intensity Score on the day of procedure before stimulation and then on the subsequent 10 visits. Brief Pain Inventory facial Scale scoring was done before start of the procedure and 1 month after the procedure.

Statistical Analysis:

The recorded data was compiled and entered in Microsoft Excel and then exported to data editor of SPSS Version 22.0. Continuous variables were expressed as Mean±SD and categorical variables were summarized as frequencies and percentages. A p-value of less than 0.05 was considered as statistically significant.

Results:

32 patients suffering from trigeminal neuralgia were included in the present study over a period of 2 years. Out of these 32 patients, 15 patients were enrolled fresh and were not responding to the maximal medical therapy. These patients had not received any peripheral nerve blocks previously. The rest 17 patients were on medical therapy and had received peripheral nerve block previously for pain relief. However all these 17 patients again presented with relapse of the symptoms of trigeminal neuralgia, thereby made it necessary for them to receive Pulsed radiofrequency stimulation for the control of their symptoms and assessment of pain relief. Two patients in our study population were lost to follow up. Among them a male patient was lost to follow up after two sittings of PRF stimulation and another female patient had developed exposure keratitis after 4 sittings (though the cause of exposure keratitis was not evaluated whether it was due to PRF stimulation or due to other reason but onset was during the course of therapy).

The age of majority of the patients in study population was between 56-65 years (43.8%), out of which 62% were female who suffered from trigeminal neuralgia. 46.9% of the patients had associated hypertension. 6.2% patients were hypothyroid and 3.1% were diabetic.

75% of the patients of the study population had

no vascular loop around while only 25% of the patients had present vascular loop around trigeminal nerve in MRI CISS sequence. Right sided (75%) divisions of trigeminal nerve were more affected than left side [25%]. Among which combined V2 and V3 division was involved in almost 53% of patients and V2 divisions was involved the least with only 3% of the patient.

BNI score and BPI-facial scale were used before and after the procedure to assess the outcomes in patients. For BNI score the mean ±SD score before and after application of PRF were 3.5±0.47 and 3.1±0.47 respectively with p value =0.003. On BPI-facial scale pain score before procedure and 1 month after procedure were observed on three variables of this scale i.e. pain intensity, interference in general activity and interference in face specific activity.

For pain intensity the mean±SD BPI score before and after application of PRF were 8.3±0.71 and 4.5±2.08 respectively with p value =0.000.For interference in general activity the mean±SD BPI score before and after application of PRF were 8.3 ±0.87 and 3.3±2.89 respectively with p value =0.001. For interference in face specific activity mean±SD BPI score before and after application of PRF were 8.9±1.14 and 4.2±2.77 respectively with p value 0.000 (Table 1)

Table 1: BNI and BPI scores before and after the application of PRF

	Before the application of PRF (Mean ±SD)	After the application of PRF (Mean ±SD)	P-value
BNI score	3.5±0.47	3.1±0.49	0.003
BPI-Facial score (pain intensity score)	8.3±0.71	4.5±2.08	0.000
BPI-Facial score (Interference of pain with general life activities)	8.3±0.87	3.3±2.89	0.001
BPI-Facial score (Interference of pain with face specific activities)	8.9±1.14	4.2±2.77	0.000

Majority of the patients (46.9%) had pain relief for up to 180 days. Only 2 patients had pain relief for 601-720 days. (Table 2)

Table 2: Duration of pain relief after the application of PRF.

Days	Frequency	Percent
0-180	15	46.9
181-300	8	25.0
301-450	4	12.5
451-600	3	9.4
601-720	2	6.2
Total	32	100.0

Discussion:

This study was conducted with the background that the routine treatments of trigeminal neuralgia like nerve block need recurrent visits, are invasive in nature and effects are transitory. Alcohol injection for peripheral nerve blocks may lead to temporo-mandibular joint fibrosis, radiofrequency ablation of gasserian ganglion are invasive procedure and may not be possible in elderly or co morbid patients. . The method of using Pulsed radiofrequency nerve mapper is non invasive and convenient for the patient. The mechanism by which pulsed radiofrequency controls pain is unclear, but it may involve a temperature independent pathway mediated by rapidly changing electric fields. The electric fields generated by PRF affect neuronal membranes is supported by neurophysiologic studies that demonstrate PRF changes synaptic signaling and causes electroporation.7 Another mechanism is that the rapidly changing electric fields produced by PRF alter the transmission of pain signals via a pathway involving c-Fos, so-called immediate early gene.[8]

We didn't find any study to the best of our knowledge in which pulsed radiofrequency stimulation had been given after peripheral neurectomies. In our study population we also involved the patients who had undergone previous neurectomies for trigeminal neuralgia and then received pulsed radiofrequency (PRF) stimulation as they hadn't had adequate pain relief after neurectomies. Maximum patients (46.9%) in our study group had not received peripheral neurolytic block before pulsed radiofrequency stimulation. 34.4% patients were exposed to neurolytic block one time in life, whereas 3.1% of the patients had received peripheral neurolytic block 4 times. But the pain relief wasn't adequate and patients were on medication even after the blocks. The pain relief in

the patients who underwent pulsed radiofrequency stimulation post neurectomies was more or less similar to those patients who hadn't received any block before pulsed radiofrequency stimulation i.e. pain relief period of 3-24 months post pulsed radiofrequency stimulation.

There are numerous studies in which pulsed radiofrequency stimulation was done and there effects were studied. A study conducted by Fang Luo et al [9] on 60 patients with refractory neuralgia of the infraorbital nerve. They were randomly divided into the high voltage PRF group and the standard voltage pulsed radiofrequency stimulation group to treat their infraorbital nerves. The intent-to-treat analysis showed that the one-month, 3-month, 6-month, and one year response rates were all 90% in the high voltage group, which were significantly higher than the rates in the standard voltage group.

Another study by Elawamy A et al [10] in their prospective study, compared the effectiveness and pain relief for idiopathic trigeminal neuralgia (ITN) after continuous radiofrequency (CRF), pulsed radiofrequency (PRF), and combined continuous and pulsed radiofrequency (CCPRF) treatment of the gasserian ganglion (GG). The best results were observed in the CCPRF group, followed by the CRF group, and then the PRF group.

Yuan yuan Ding et al [11] did a reterospective comparative study aimed to assess the efficacy and safety of computed tomography (CT)-guided pulsed radiofrequency combined with low-temperature continuous radiofrequency thermocoagulation in V2/V3 primary trigeminal neuralgia. Patients were randomly assigned to 2 groups differentiated by therapeutic method: CRF (CRF group, n = 40) and PRF + CRF (PCRF group, n = 40). The Visual Analog Scale (VAS) scores decreased in both groups after surgery. After one month, the decrease in the VAS score in the PCRF group was more apparent. The differences in total efficiency rate of pain between the 2 groups at 6 months, 1 year, and 2 years were statistically significant.

In comparison with the earlier studies, pain relief in our study was more or less similar. After application of PRF stimulation, pain relief varied from 3 to 24 months. As compared to the complications in the above mentioned studies, there was no complication seen in our study population post PRF application. The follow-up period lasted only two years in this study; thus, long-term efficacy needs to be further confirmed.

In our study we did three-dimensional constructive interference in steady state (3D-CISS sequence) magnetic resonance imaging of the patients in which 25% of the patients had vascular loop present around trigeminal nerve whereas 75% had absent vascular loop around trigeminal nerve. However, we didn't come across such study to the best of our knowledge that had undergone three-dimensional constructive interference in steady state (3D-CISS sequence) magnetic resonance imaging to diagnose vascular loop compression around trigeminal nerve but some studies did detect neurovascular compression through other methods like Patel et al [12] reported 90.5% sensitivity and 100% specificity when using 1.5T magnetic resonance imaging and contrast enhanced magnetic resonance angiography to detect vascular compression of the trigeminal root.

Pain scores used to assess the pain relief of trigeminal neuralgia are Barrow Neurological Institute (BNI) and Brief Pain Inventory-Facial scale (BPI-Facial Scale). Barrow Neurological Institute (BNI) includes 2 elements. The first part often involves a measure of pain intensity in 3 to 5 categories specifying the level of pain (e.g. none, some and severe). The second part of this composite scale describes the level of medication usage such as no medication use, reduced medication use and continued medication use.[13] Barrow Neurological Institute (BNI) scale is composed of 18 items on a 1-point scale (0-10, with 0 being the best score and 10 being the worst score). 4 questions centre on pain intensity, 7 questions deal with the interference of pain with general life activities and the remaining 7 questions deal with the interference of pain with face specific activities. Most of the studies have mentioned VAS (visual analogue scale) to assess the pain. However Visual Analog Scale (VAS) score have some disadvantages like risk of over simplifying the patients' experience of pain, patient may feel that you care more about the number than the effect of pain on patients' life, Visual Analog Scale (VAS) score is unidimensional, it attempts to assign a single value to a complex multidimensional experience, some patients have trouble deciding how to choose a single number to represent their pain sensation.

Hence we found Barrow Neurological Institute (BNI) scale and Brief Pain Inventory-Facial scale (BPI-Facial Scale) more reliable scales post PRF. In our study BNI score and BPI-facial scale were used before and after the procedure to assess the outcomes in patients. Most of the patients came with the BNI

score of IV to V pre-procedure and had the score of II-III post procedure with p-value of 0.003 i.e. results were statistically significant similarly on BPI-facial scale pain score before procedure and 1 month after procedure were observed on three variables of this scale i.e. pain intensity (p-value-0.000), interference in general activity (p-value-0.001) and interference in face specific activity (p-value-0.000) respectively, which shows that our study was statistically significant. Out of 32 patients we were able to follow the improvement in pain scores in 14 patients for a period of 18 to 24 months. In 6 patients we were able to follow the improvement in pain scores for 12 to 18 months. In 5 patients we were able to follow the improvement in pain scores for 6 months to 12 months. Lastly we were able to follow the improvement in pain scores in 7 patients for a period of less than 6 months as we had to compile the data.

In our study population we observed that 46.9% of the patients of study population had pain relief for zero to 180 days only. Therefore, pulsed radiofrequency offers short term relief in a majority of patients in which only 2 patients had pain relief for 720 days.

Conclusion:

From our study we conclude that pulsed radiofrequency offers short term relief in a majority of patients for a period of 18 months to 24 months. However it was found that the long term effects of pulsed radiofrequency may not be seen in patients with trigeminal neuralgia.

To conclude, pulsed radiofrequency may be used as a short term measure for alleviating severe pain of trigeminal neuralgia till neurolytic blocks or a definitive surgery is carried out.

References:

1. Merskey H, Bogduk N. Classification of chronic pain. Descriptors of chronic pain syndromes and definitions of pain terms 2nd Edn. Seattle: IASP Press, 1994 [accessed on 17-09-2017]
2. The International Classification of Headache Disorders: 2nd edition Cephalalgia 2004; 24: 9-160
3. McMillan R. Trigeminal Neuralgia – a debilitating facial pain. Rev Pain. 2011; 5:26-34.
4. T H Mohsin , management of trigeminal neuralgia with four simple treatment modalities,, JODB , VOL6 issue 2 , 2019)
5. Chang MC, Cho YW, Ahn SH, et al. Comparison between bipolar pulsed radiofrequency and monopolar pulsed radiofrequency in chronic lumbosacral radicular pain: A randomized controlled trial. Medicine.2017; 96:e6236.
6. Vallejo R, Benyamin RM, Kramer J, Stanton G, Joesph NJ. Pulsed radiofrequency for the treatment of sacroiliac joint syndrome. Pain Med 2006; :429-34.
7. Cosman Jr, Cossman Sr. Electric and thermal field effects in tissues around radiofrequency lesions electrodes. Pain Med. 2005; 6:405-24.
8. Zundert JV, de Louw AJ, Joosten EA, Kessels AG, HonigW, Dederin PJ, et al. Pulsed and continuous radiofrequency current adjacent to the cervical dorsal root ganglion of the rat induces late cellular activity in the dorsal horn. Anesthesiology.2005; 102:125–31.
9. Luo F, Wang T, Shen Y, Meng L, Lu J, Ji N. High voltage pulsed radiofrequency for the treatment of refractory neuralgia of the infraorbital nerve: A prospective double-blinded randomized controlled study. Pain Physician. 2017; 20 :271-79.
10. Elawamy A, Abdalla EE, Shehata GA. Effects of pulsed versus conventional versus combined radiofrequency for the treatment of trigeminal neuralgia: a prospective study. Pain Physician. 2017;20: 873–81.
11. Ding YY, Li HX, Hong T, Zhu YQ, Yao P, Zhou GG. Combination of Pulsed Radiofrequency with Continuous Radiofrequency Thermocoagulation at Low Temperature Improves Efficacy and Safety in V2/V3 Primary Trigeminal Neuralgia. Pain Physician 2018; 21:545-53.
12. Patel NK, Aquilina K, Clarke Y, Renowden SA, Coakham HB. How accurate is magnetic resonance angiography in predicting neurovascular compression in patients with trigeminal neuralgia? A prospective, single-blinded comparative study. Br J Neurosurg 2003;17:60-4.
13. Rogers CL, Shetter AG, Fiedler JA, Smith KA, Han PP, Speiser BL. Gamma knife radiosurgery for trigeminal neuralgia: The initial experience of the Barrow Neurological Institute. Int RadiatOncolBiol Phys. 2000; 47:1013-19.