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Comparison between Pulsed Radio-Frequency Plus Steroid Injection and Thermal Radio-Frequency in Treatment of Trigeminal Neuralgia

Hevy Sherko Fathulla[1], Mortada Abdulhussien Jubara[2], Bnar Halko Ahmad Shawqi[3], Ghassan Faris Idan[4]

1. *M.B.Ch.B, FICMS, Senior specialist in anesthesia & interventional pain management Rizgary hospital , Erbil, KRI, Iraq*
2. *M .B.Ch.B, FICMS, Chairman of Iraqi Council of Regional Anesthesia and Interventional Pain Management, Medical City Complex Nursing Home Hospital ,Baghdad Iraq*
3. *M BChB, FICMS, FIPP, Senior Specialist in Anesthesia & Interventional Pain Management Head of Pain Management Unit, Rizgary Hospital , Erbil, KRI, IRAQ*
4. *M.B.Ch.B, CABA and IC. Arab Council of Interventional Pain Management Baghdad Medical City Complex. Nursing home Hospital, Baghdad Iraq*

**Corresponding Author , contact email : drhevysherko@gmail.com*

Original Article

Summary

***Background**: Trigeminal neuralgia (TN) is a common chronic neuropathic pain that seriously affects the daily life of the patient. Many invasive treatment are currently available. One of the treatment options is radiofrequency for immediate and long term pain relief . **Objectives**: To evaluate outcome of comparison between pulse radiofrequency with steroid injection and thermal radiofrequency alone in treating patients complain of trigeminal neuralgia for getting better result (pain free)for longer duration and less recurrence . Patients and Methods: A prospective study included 40 adult patients, assigned into two groups ; to managed either with pulse radiofrequency with lidocaine and steroid injection, or thermal radiofrequency alone, and followed up for at least 1 year post- intervention , during which, time and pain relief were recorded with checking complications and recurrence time with dose of carbamazepine . **Result** : In group 1, all patients got Immediate pain relive while in group 2 only 50% while the remaining 50% in this group got pain relive within 1 month. Recurrence in group 1 occurred after 2 years while in group 2 it occurred in less or around 1 year but they needed lower dose of tegretol. Fortunately, no mortalities reported in both groups. **Conclusions**: patients gets better result in treatment resistance cases of trigeminal neuralgia when use pulse radiofrequency with lidocaine and steroid inaction related to time of immediate decrease of pain ,longer duration pain free and longer recurrence time.*

***Keywords:** Cranial Nerve, Trigeminal Neuralgia ,Radiofrequency Thermocoagulation, Recurrence ,Immediate Pain Relive*

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1. INTRODUCTION

The trigeminal nerve is the fifth and a large cranial nerve located on both sides of the head, it is projected from the trigeminal ganglion in a bipolar manner. It has three branches emerge these are: Ophthalmic (Upper) nerve which supplies most scalp, forehead, and front of head. Maxillary (Middle) nerve: supply cheeks, upper jaw, upper lip, teeth, gums, nose sides. Mandibular (Lower) nerve: lower jaw, teeth , gums and lower lip (1,2)

Trigeminal neuralgia (TN) is a neuropathic pain attacks at the projection of the innervation of the terminal branches of the trigeminal nerve on the face. This significantly affects the quality of life, physical and psychological condition of patients (3).

Most often, this disease affects people between 50-60 years of age. Also, trigeminal neuralgia occurs in young people with multiple sclerosis . According to statistics, the annual incidence of TN ranges between 4.3-27 per 100,000 population. The prevalence rates between 0.03& to 0.3% in the general population. Women are more susceptible to TN than men in a female to male ratio of 1.5 to 1.0, and the incidence increases with the advancing age, in classical TN, the mean age of onset is almost 53 years while in secondary TN it is almost 10 years less (4–9).

The exact pathogenesis is not fully understood, the origin of TN may be related to damage to central and/or peripheral structures of the nervous system. Trigeminal nerve stimulation can cause pain because its primary function is sensory (10). There is usually no organic involvement in the TN in (85%) of cases, although many investigators agree that venous or arterial compression is important for the development of idiopathic neuralgia. Trigeminal neuralgia most often occurs when there is increased pressure on this nerve. It can be squeezed by blood vessels altered due to some pathological processes; nearby tissues, increased in size due to the inflammatory process taking place in them. Less commonly, the cause of compression of the trigeminal nerve can be a tumor (10,11). Also, trigeminal neuralgia can be observed post-traumatic(12). However, TN frequently under or missed-diagnosed (7–9). Vascular compression leads to focal demyelination of the trigeminal nerve. Neuropathic pain is the main symptom of damage to the demyelinated and myelinated primary afferent fibers that transmit impulses from pain receptors (13,14). Trigeminal pain occurs when traumatized (for example, an aneurysm of the internal carotid artery) (15). Also, the cause of trigeminal neuralgia can be trauma to its venous vessels

(16). The causes of TN also include dental diseases and unnecessary dental procedures (17,18), fractures in the nose and mouth, tumors in the facial region, viral infections (such as postherpetic TN) and multiple sclerosis (6,19,20) .

Signs and Symptoms of trigeminal neuralgia:

Trigeminal neuralgia mainly manifested by sharp pain that radiated from the face to the temporal part of the head (right or left). The pain is very intense, shooting or jabbing and sometime like electric shock, patients may have sudden unexpected pain in a term of pain paroxysm which may last for a fraction of second, however, it could be recur many times a day. Almost 50% of TN patients may have continuous pain in a form of low intense aching, burning or dull pain concomitantly with the paroxysmal pain at the same area. However, this type of pain more frequent in females than males (4).

Pain in trigeminal neuralgia can be triggered by innocuous sensory stimuli to the affected side of the face, touching the skin of the face, hygiene procedures, shaving, chewing, drinking, brushing the teeth, smiling, and other daily activities involved the face (4). There are two types of TN; primary that occurs in majority of cases due to pressure on the trigeminal nerve at the area close to its entrance to the brain stem. In most cases the pressure attributed mainly to compressing blood vessels. Secondary TN, occurs due to other underlying medical causes such as tumors, cystic lesions, vascular malformation, multiple sclerosis, injuries of the face, surgeries in the region, such as dental ones (21–24)

Diagnosis and treatment of trigeminal neuralgia

On the basis of the clinical status, different methods used in diagnosis and are helpful to distinguish TN from other differential diagnosis; medical history, thorough physical examination are the base for the diagnosis, additionally, radiological imaging such as plain X-ray, ultrasonography, MRI, and vascular studies are important technique to reach diagnosis.

Treatment of TN are multidisciplinary including many options such as pharmacological therapy, percutaneous interventions, surgical interventions (for example, microvascular decompression), radiation therapy (stereotaxic radiosurgery using a gamma knife) (10) .

Radiofrequency

The first known use of radiofrequency ablation (RFA) was in 1931, when Kirchner treated trigeminal neuralgia with thermocoagulation of gassaeran ganglion. Radiofiequency (RF) is the oscillation's rate of an alternating electric current or voltage or of a magnetic, electric or

electromagnetic field or mechanical system in the frequency range from around 20 kHz to around 300 GHz (3,25–27). This is roughly between the upper limit of audio frequencies and the lower limit of infrared frequency; this is the frequency at which energy from an oscillating current can radiate off a conductor into space as radio waves. Different sources specify different upper and lower bounds for the frequency range. Radiofrequency ablation (RFA) uses heat to destroy tissue. To treat pain, radio waves are sent through a needle precisely placed to heat a part of the nerve. This prevents the transmission of pain signals to the brain. RFA is considered for long-term painful conditions, especially in the neck, back, or arthritic joints that have not been treated by other methods (3,25–27).

Objectives of radiofrequency ablation:

• Stop or reduce pain.

• Function improvements.

• Reduce the amount of pain relievers taken.

• Avoid or delay surgery (3,25–27).

2. PATIENTS and METHODS

Study Design and Settings

The study is prospective single observational study contain 40 adult patients underwent RF for treatment trigeminal neuralgia who resistant to medical therapy from(2017-2022) . The study protocol was approved by the Iraqi council of Medical specializations.

Inclusion criteria

1. All cases who resistant to medical therapy
2. Cases who can't tolerate side effects of medical therapy
3. Medically fit cases
4. Any previous cases who done RF and got benift (recurent cases)

Exclusion criteria

1. Uncontrolled hypertesion
2. Any cases associated with other causes for facial pain like truma ,facial nerver,....
3. Patient's refusal

Study Groups

Patients assigned into two equal groups:

Group 1 cases who underwent RF pulse with steroid and lidocaine injection and

Group 2 cases who underwent thermal RF alone.

Study Interventions

A written consent obtained for each patient. Patient‘s history was reported and physical examination was implemented on each patient before the recruitment, all having MRI and should be checked for definitive diagnosis TN . In the theatre vital signs were taken which included BP, SPO_2 and ECG connected, one cannula inserted antibiotic tested and given. Midazolam 0.05 to 0.1 mg/ kg, fentanyl (2-5) µg/kg ,were given for all patients, then, using the fluoroscopy for detecting foramen ovale ,once reached the exact division ask the patient to know its exact place that feels pain or not ,After making sure of position giving propofol around 100 mg to make patient sleep because it’s very painful procedure For thermal RF giving 3 cycles of 75 C each cycle 60second ,repeat sensory stimulation at 50Hz voltage

Wait to awake patient n reexamine give sensory stimulation should patient tolerate at least double the first time ,if not achieved we repeat 2-3 cycle Then again re check for parasthesia and pain .For pulse RF on 40 C ,6 MINUTES 2 cycles with triamcinone 40 mg with 0.5 ml 2%lidocaine total volume injected ,wait for recovery patient re asses ,staying at hospital 2 hours after rechecking vital sings ,discharge .

Assessment

After patients discharged ,all cases received medicine (analgesia for 2 weeks -1 month) and carbamazepine tablet starting 200mg at night ,increasing dose in case if still have pain .after 1 week ask the patient to visit for another assessment or any complications .

Another assessment after 1 month.

Statistical Analysis : All data recorded in Microsoft excel with statistical package for social sciences (SPSS) software version 24.0 variable explained by mean ± standard deviation (SD) while categories variable that explained by frequency and percentage. Correlation of person involved to analyze the different between two groups .A p value equal or less than 0.05 was considered significant.

3. RESULTS

A total of 40 patients were enrolled in this study, and were assigned into two equal groups a 20 patients in each. Females were relatively dominant composed 52.5% of the studied group, 77.5% of patients had pain recurrence, majority (90%) of patients did not have complication anesthesia dolorosa, 92.5% did not face failed procedure, and 37.5% of respondent’s first visit was in 2020 followed by 17.7% of them in 2018. The mean age ± S.D of the participants was 59.63 ± 11.55 years, the average start of pain relief ± S.D was 13.23 ± 10.92 days, the mean

initial pain relief ratio ± S.D was 87.38 ± 21.69%, the mean follow up duration ± S.D was 2.5 ± 1year, the average tegretol after procedure ± S.D was 486.49 ± 301.07 doses, (**Table 1& 2**).

No significant differences had been found between both groups in gender, pain recurrence rates incidence of complication anesthesia dolorosa and failed procedure rates, in all comparisons, P. value >0.05, (**Tables 3,4,5 &6**)

A statistically significant difference was found in categories of pain relief between the studied groups, all patients (100%) in group 1 had immediate pain relief, while only (50%) in group 2, On the other hand, 45% of patients in group 2 had late pain relief (2 – 4 weeks), in contrary none of group 1 had late pain relief, (P. value =0.001), (**Table 7**).

A statistically significant difference was found between groups in recurrence categories where (60%) of participants in group 1 had recurrence after 2 years, in group 2, 40% of participants recurred after 1 -2 years, (P. value= 0.006),(**Table 8**).

As shown in (**Table 9**), the mean values of scale variables were compared between both groups, the comparisons revealed no statistically significant difference in age and initial pain relief ratio, the mean age of patients in group 1 was 58.9 years and it was 60.35 years in group 2, the mean initial pain relief in group 1 respondents was 93.25% compared to 81.5% in group 2, (P. value = 0.697and 0.093), respectively.

A statistically significant difference was found between groups in the start of pain relief, where, participants of group 1 had earlier pain relief (mean = 6.65) days while participants of group 2 had late pain relief (mean = 20.16) days, (P. value = 0.001).

The difference in follow up of both group was statistically significant where group 1 followed up for a mean of three years while group 2 for two years, (P. value = 0.002).

There was a significant difference between study groups in the dose of tegretol after procedure; cases of group 1 were on average tegretol dose of 600 mg after procedure, patients in group 2 on average tegretol dose of 353 mg, (P. value = 0.011).

The difference in mean time to pain recurrence of both groups was statistically significant; pain recurred after an average of 2.24 years in group 1 while in group 2 reappeared after 1.09 year, (P. value = 0.003).

Table 1. General characteristics of study participants (N=40).

Variables		No.	%
Gender	Male	19	47.5
	Female	21	52.5
Pain recurrence	Recurrence	31	77.5
	No pain till now	7	17.5
	No response	2	5.0
Complication anesthesia dolorosa	Yes	4	10.0
	No	36	90.0
Failed procedure	Yes	3	7.5
	No	37	92.5
Date of first visit	2017	2	5.0
	2018	7	17.5
	2019	8	20.0
	2020	15	37.5
	2021	8	20.0
Total		40	100.0

Table 2. Distribution of age, start of pain relief, initial pain relief ratio, follow up duration, Dose of tegretol after procedure.

Variables	No. of patients	Mean	SD	Range
Age	40	59.63	11.55	38 - 85
Start of pain relief (days)	39	13.23	10.92	2 - 60
Initial pain relief ratio (%)	40	87.38	21.69	0 - 100
Follow up duration (years)	40	2.53	1.13	1 - 5
Dose of tegretol after procedure	37	486.49	301.07	200 - 1200

Table 3. Distribution and comparison of gender between study groups.

Gender	Group 1		Group 2		P. value
	No.	%	No.	%	
Male	10	50.0	9	45.0	0.752
Female	10	50.0	11	55.0	
Total	20	100.0	20	100.0	

Table 4. Distribution and comparison of pain recurrence between study groups.

Pain recurrence	Group 1		Group 2		P. value
	No.	%	No.	%	
Recurrence	16	80.0	15	75.0	0.533
No pain till now	4	20.0	3	15.0	
No response	0	0.0	2	10.0	
Total	20	100.0	20	100.0	

Table 5. Distribution and comparison of complication anesthesia dolorosa between study groups

Complication anesthesia dolorosa	Group 1		Group 2		P. value
	No.	%	No.	%	
Yes	1	5.0	3	15.0	0.605
No	19	95.0	17	85.0	
Total	20	100.0	20	100.0	

Table 6. Distribution and comparison of failed procedure between study groups

Failed procedure	Group 1		Group 2		P. value
	No.	%	No.	%	
Yes	0	0.0	3	15.0	0.231
No	20	100.0	17	85.0	
Total	20	100.0	20	100.0	

Table 7. Distribution and comparison of Categories of pain relief between study groups

Categories of pain relief	Group 1		Group 2		P. value
	No.	%	No.	%	
Pain remained	0	0.0	1	5.0	**0.001**
Immediate pain relief	20	100.0	10	50.0	
Late pain relief (2 – 4 weeks)	0	0.0	9	45.0	
Total	20	100.0	20	100.0	

Table 8. Distribution and comparison of recurrence categories relief between study groups

Recurrence categories	Group 1		Group 2		P. value
	No.	%	No.	%	
No pain till now	4	20.0	5	25.0	**0.006**
< 1 year	2	10.0	5	25.0	
1 -2 years	2	10.0	8	40.0	
> 2 years	12	60.0	2	10.0	
Total	20	100.0	20	100.0	

Table 9. Comparison of the studied groups in studied variables.

Variables	Group 1			Group 2			P. value
	No.	mean	SD	No.	mean	SD	
Age (years)	20	58.9	10.43	20	60.35	12.8	0.697
Initial pain relief ratio (%)	20	93.25	6.34	20	81.5	29.2	0.093
Start of pain relief (days)	20	6.65	2.83	19	20.16	12.03	**0.001**
Follow up duration (years)	20	3	1.09	20	2	0.91	**0.002**
Dose of tegretol after procedure (mg)	20	600	227.11	17	353	328.09	**0.011**
Time to pain recurrence (years)	16	2.24	1.16	15	1.09	0.72	**0.003**

4. DISCUSSION

Radiofrequency is very safe procedure no death reported , the longest follow up time in 2 year. In this study of 40 cases taken in two groups ,shown that there is a significant difference between a study group and the start of pain relief. Group1 had earlier pain relief ,while in group no2 had late pain relief. Also there is a significant difference in dose of tegretol each patient needs after procedure ,cases in group no.1 on average 600 mg while in group no.2353mg so group no.1 on higher dose.

According to this study ,there is a significant difference in mean time to pain recurrence of both groups , group 1 after 2 years while group 2 after 1 year. If see the initial or immediate pain relief in group 2 only 50% had immediate pain relief , p value 0.001.

Problems that facing during this study is failed procedure means the patient not get any benefit pain not decreased even in small percentage more than 92.5%had no failed procedure ,and about other complications related to procedure only 10% got anesthesia dolorosa which is becoming good by time.

Broggi et el. reported long-term results and prognostic factors in 1000 patients with TN who underwent RFT after a follow up period range3-10 years .They reported that76% of the patients are completely pain free without medication, 5% are pain free with a dosage of the drugs in a dosage lower than pre-operative period and 15% needs higher dosage of the drug(28).

The radiofrequency temperature is important factor that affects the outcomes of RFT, although no current standard radiofrequency temperature exists for requiring TN, however, previous studies suggested and investigated different cutoff points for these temperatures; ***Yuan-Zhang et al.*** (29) concluded that optimal radiofrequency temperature of 75°C produced the maximum pain relief and minimum facial numbness or dysesthesia. From other point of view, there is a wide variation in the temperatures used in these procedures, and the optimal value determined mainly according to the experience and decision of doctors, hence, different tempratures were reported in previous studies ranged between 55-90 °C (30–32)

Duransoy et al. (33) ***and Lan et al.*** (34) found predominance of females than males in patients suffering from which agreed our findings, however, in our study there is no significant difference between both genders and this could be attributed to small sample size in each group.

Previous studies 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. **Chua et al**. (35) reported that 73.5% of patients had excellent pain relief at early and late follow up period of 2-12 months and that 67.6% of patients reported satisfied pain relief after an average of 2.3 years after RF

Koning HN reported that pain recurrence rates are between 25% and 60% after TRF with high incidence of side effects (36).

Fortunately, none of our patients developed any serious complication which indicated the safety and feasibility of this procedure in treatment of TN

5. CONCLUSIONS

In conclusion, resistant cases to medical therapy of trigeminal neuralgia can get high initial pain relief rate and long interval pain free after pulse radiofrequency with steroid and xylocaine injection in comparison with thermal radiofrequency alone

Ethical Clearance : The study protocol approved by the Scientific Council of the Arab Board of Health Specialization. Verbal and Signed consents obtained from all patients. Data collection was in accordance with World Medical Association Declaration of Helsinki , 2013, for the ethical principles of researches that involve human. Data kept confidentially and merely used for the purpose of this research.

Conflict of interest: Authors declared none

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