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Research

A Single Center Retrospective Study: Evaluation of Demographic Structure, Pain Characteristics, Early and Late Results, and Complications in 214 Trigeminal Neuralgia Patients Treated with Radiofrequency Thermocoagulation

Tek Merkezli Retrospektif Bir Çalışma: Radyofrekans Termokoagülasyon Yöntemi ile Tedavi Edilen 214 Trigeminal Nevralji Hastasının Demografik Yapısı, Ağrı Özellikleri, Erken ve Geç Dönem Sonuçları ile Komplikasyonlarının Değerlendirilmesi

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ABSTRACT

Objective: Gasser's ganglion blockade with radiofrequency thermocoagulation is a treatment option for trigeminal neuralgia. The aim of this study was to investigate the early and late treatment results of patients with idiopathic trigeminal neuralgia who underwent Gasser's ganglion blockade with percutaneous radiofrequency thermocoagulation and to evaluate the possibilities and limitations of this treatment method.

Methods: Between January 2005 and October 2020, 214 patients admitted to our clinic with a diagnosis of trigeminal neuralgia were included in this study. These patients were evaluated in terms of age, sex, involved side, involved branch, early intervention results, pain-free periods, and complications.

Results: Two hundred and seventy five procedures were performed in 214 patients. Of the patients, 125 (58.41%) were female and 89 (41.59%) were male. The mean age was 58.48±14.07 years. Pain was predominantly on the right side (61.68%). The most commonly involved trigeminal nerve branch group was V2-V3 (35.98%). The early success rate after radiofrequency thermocoagulation was 93.09%. At the end of the 36-month follow-up, 78.12% of the patients had no recurrence of pain.

Conclusion: Although there were some differences in the involved branch of the trigeminal nerve, the results were concentrated on V2 and V2-V3. Early results were consistent with those reported in the literature. When the late-term results were evaluated, differences were observed in the follow-up periods. The complications were consistent with those reported in the literature. In conclusion, radiofrequency thermocoagulation in trigeminal neuralgia is a safe, low complication rate, and recurrent treatment method with correct indication and application.

Keywords: Foramen ovale, facial pain, trigeminal neuralgia, radiofrequency thermocoagulation

ÖZ

Amaç: Radyofrekans termokoagülasyon yöntemi ile Gasser ganglion blokajı trigeminal nevralji için tedavi seçeneklerinden biridir. Bu çalışmanın amacı, perkütan radyofrekans termokoagülasyon ile Gasser ganglion blokajı uygulanan idiyopatik trigeminal nevraljili hastaların erken ve geç tedavi sonuçlarını araştırmak ve bu tedavi yönteminin olanaklarını ve kısıtlılıklarını değerlendirmektir.

Gereç ve Yöntem: Ocak 2005 ile Ekim 2020 tarihleri arasında kliniğimize trigeminal nevralji tanısı ile başvuran 214 hasta çalışmaya dahil edildi. Bu hastalar yaş, cinsiyet, tutulan taraf, tutulan dal, erken müdahale sonuçları, ağrısız dönemler ve komplikasyonlar açısından değerlendirildi.

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Bulgular: İki yüz on dört hastaya 275 prosedür uygulanmıştır. Hastaların 125'i (%58,41) kadın ve 89'u (%41,59) erkekti. Ortalama yaş 58,48±14,07 idi. Ağrı ağırlıklı olarak sağ taraftaydı (%61,68). En sık tutulan trigeminal sinir dal grubu V2-V3 (%35,98) idi. Radyofrekans termokoagülasyon sonrası erken başarı oranı %93,09 idi. Hastaların %78,12'sinde 36 aylık takip sonunda ağrı nüksü görülmedi.

Sonuç: Trigeminal sinirin tutulan dalında bazı farklılıklar olmasına rağmen, sonuçlar V2 ve V2-V3 üzerinde yoğunlaşmıştır. Erken dönem sonuçları literatür ile uyumlu idi. Geç dönem sonuçlar değerlendirildiğinde takip sürelerinde farklılıklar gözlendi. Komplikasyonlar literatürde bildirilenlerle uyumluydu. Sonuç olarak trigeminal nevraljide radyofrekans termokoagülasyon güvenli, komplikasyon oranı düşük, doğru endikasyon ve doğru uygulama ile tekrar uygulanabilir bir tedavi yöntemidir.

Anahtar Kelimeler: Foramen ovale, yüz ağrısı, trigeminal nevralji, radyofrekans termokoagülasyon

INTRODUCTION

The aim of this study was to analyze the early and late treatment results of patients with idiopathic trigeminal neuralgia (TN) who underwent Gasser ganglion blockade with percutaneous radiofrequency thermocoagulation (RFT) and to evaluate the possibilities and limitations of this treatment method. According to the third edition of the International Classification of Headache Disorders, TN is a disorder characterized by recurrent unilateral short electric shock-like pain limited to the distribution of one or more sections of the trigeminal nerve, with sudden onset and termination, and triggered by innocuous stimuli. It may develop for no obvious reason or may result from another diagnosed disorder (1,2).

The incidence of TN is 2 to 5 patients per 100,000 people (3-6). TN is evaluated in three etiological categories: 1) Idiopathic TN develops without any recognized cause; 2) classic TN occurs as a result of vascular compression of the trigeminal nerve root; and 3) secondary TN occurs due to a secondary cause such as multiple sclerosis or cerebellopontine angle tumor (7).

The first-step treatment of idiopathic TN is medical. Pain can be kept under control for a long time in this way, and even surgical intervention may not be needed (8). However, the effect of the drugs administered may decrease over time or side effects may develop. In this case, percutaneous methods or microvascular decompression in the presence of vascular compression may be considered. Percutaneous methods include radiofrequency thermocoagulation, glycerol rhizotomy, and balloon compression. Radiosurgery is another treatment method.

In 1913, Härtel (9) first described percutaneous access to Meckel's Cave through the foramen ovale for treating TN (10-12). In 1973, Sweet and Wepsic (13) used radiofrequency-based thermal energy to destroy preganglionic trigeminal rootlets in Meckel's cave.

METHODS

University of Health Sciences Türkiye, Prof. Dr. Mazhar Osman Psychiatric and Neurological Diseases Training and Research Hospital Ethics Committee approval was obtained for this study (decision no: 514, date: 12.01.2016).

The patients included in this study had the pain type defined by the International Headache Committee for typical TN. Patients with atypical headache were excluded from the study. In addition, patients with vascular compression of the 5th nerve on magnetic resonance imaging and those with secondary pain characteristics (intracranial tumor multiple sclerosis, etc.) were excluded from the study. The expert opinion of a neurologist was obtained for all patients who underwent intervention. First, it was ensured that drug treatment was administered under the control of a neurologist. Between January 2005 and October 2020, 275 interventions were performed in 214 patients who met these criteria. These patients were evaluated in terms of age, sex, involved side, involved branch, early intervention results, pain-free periods, and complications. Early results after RFT were evaluated according to the Barrow Neurological Institute (BNI) pain intensity scale (Table 1) (14).

Early postoperative outcomes and complications were documented for each intervention and not on a patient-by-patient basis. This is because multiple interventions may have been performed for the same patient. For standardization the follow-up period was limited to 36 months, and pain-free periods during this period were evaluated using Kaplan-Meier survival curves.

Statistical Analysis

The IBM SPSS version 22 statistical program was used to evaluate the mean values, standard deviations (SDs), percentages, and cumulative survival processes of the

Table 1. Barrow Neurological Institute pain intensity scale

Pain score	Definition
I	No trigeminal pain, no medication
II	Occasional pain, not requiring medication
III	Some pain, adequately controlled with medication
IV	Some pain, not adequately controlled with medication
V	Severe pain, no pain relief

results obtained. Microsoft Office Excel 2010 was used to create all graphs except the Kaplan-Meier survival curve.

Surgical Procedure

The patient is placed on the operating table in the supine position. The position is adjusted such that the orbital roofs and anterior clinoid processes overlap. Härtel's anatomical points are used for percutaneous application to Gasser's ganglion. The entry point is 2.5 cm lateral to the edge of the mouth. The #18 needle cannula is advanced along the medial aspect of the coronoid process of the mandible. It is advanced along the zygomatic arch and just medial to the pupil up to the intersecting plane 30 mm anterior to the external acoustic meatus. To prevent perforation of the buccal mucosa, the needle is aimed at the foramen ovale with a free hand technique with the index finger inside the mouth. This process was monitored by fluoroscopy (Figure 1).

After the needle has passed the foramen ovale in the correct position, cerebrospinal fluid can be seen coming from the distal end of the cannula. This observation is evidence that Meckel's cavity has been reached, but it must be confirmed using an electrode placed in the cannula. Sensory (2 MHz) and motor stimuli (75 MHz) are given to the area with the radiofrequency lesion generator connected to the electrode. The intervention is continued according to the results. Ineffective results may require repositioning of the needle. Simultaneously, the sensory stimuli we give show us whether the V1 branch of the trigeminal nerve is affected or not. Affection of the V1 branch may result in loss of the corneal reflex and consequently an increased risk of keratitis. Once localization is confirmed, a maximum of 70 °C heat can be applied for 1 min. The procedure can be repeated two or three times with 0.3 cm position changes, stimulus controls, and corneal reflex monitoring.

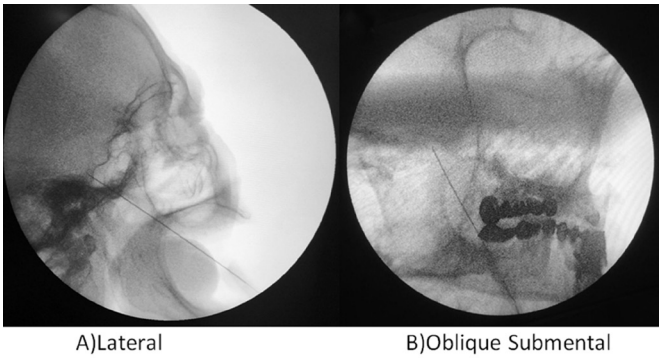

Figure 1. Trajectory of the catheter needle in lateral (A) and oblique submental (B) cranial radiograph images. Permission to publish the images was obtained from the authors of the accompanying article. The figure is based on original photographs from the author's archive (15)

RESULTS

Sex, Age, Painful Side, Involved Nerve Branch, Pain History

The patient group consisted of 125 (58.41%) females and 89 (41.59%) males. The age distribution was between 27 and 89 years. The mean age was 58.48±14.07 years. The mean symptom duration in patients with TN was 78.26 months (SD: ±86.13). Pain was on the right side in 132 (61.68%) and left side in 79 (36.92%) patients. Three (1.40%) patients complained of bilateral pain. When we analyzed the involved branch of the trigeminal nerve, we observed that 1 (0.47%) patient had V1, 48 (22.43%) patients had V2, 42 (19.63%) patients had V3, 16 (7.48%) patients had V1 and V2, 77 (35.98%) patients had V2 and V3, and 25 (11.68%) patients had V1, V2, and V3. In our retrospective study, we could not determine which branch was affected in 5 patients (2.34%) (Table 2). The duration of symptoms ranged from 2 to 720 months. The mean age at the onset of symptoms was 51.93 years (SD: ±14.55).

Early Results After the Interventions

Of the 214 patients who underwent RFT, 167 underwent one intervention (78.04%), 35 underwent two interventions (16.35%), 11 underwent three interventions (5.14%), and 1 underwent five interventions (0.47%) (Figure 2). After 275 procedures were performed in 214 patients, early results were evaluated according to the BNI pain intensity scale. Of the 275 procedures, 256 were considered grade 1, 2, and 3 (93.09%), and 19 procedures were considered grade 4 and 5 (6.91%). Of the 256 successful procedures, 164 were grade 1 (59.64%), 43 were grade 2 (15.64%), and 49 were grade 3 (17.82%). Of the 19 unsuccessful attempts, 14 were grade 4 (5.09%) and 5 were grade 5 (1.82%) (Figure 3).

Table 2. Demographic characteristics and pain localization distribution of patients with trigeminal neuralgia treated with percutaneous radiofrequency thermocoagulation

Characteristic	Value
Total patients (n=214)	
Age (years)	58.48±14.07 (27-89)
Sex, F:M	125 (58.41): 89 (41.59)
Affected side, R:L:B	132 (61.68%): 79 (36.92%): 3 (1.40%)
Involved branch	V1 (0.47%): V2 (22.43%): V3 (19.63%): V1-V2 (7.48%): V2-V3 (35.98%): V1-V2-V3 (11.68%): Unknown (2.34%)

Values are presented as mean values ± standard deviation (range) or number (%).
F: Female, M: Male, R: Right, L: Left, B: Bilateral

Follow-up and Recurrence of Pain

During the 36-month follow-up period, the mean pain-free period of 256 patients was 30.83 months. Of the 256 patients who were evaluated as BNI grade 1, 2, and 3, pain recurred in 37 (14.45%) patients within 1 to 12 months, 14 (5.47%) patients within 13-24 months, and 5 (1.95%) patients within 25-35 months. In total, 200 (78.12%) patients were pain free at the end of the 36th month (Figure 4).

Pain-controlled periods after 256 interventions that were considered successful were graphed using Kaplan-Meier survival curves (Figure 5).

Complications

After 275 procedures, 23 patients had intrabuccal haematoma (8.36%), 15 patients had corneal hypoesthesia and reflex loss (5.45%), 6 patients had masseter muscle weakness (2.18%), 6 patients had dysesthesia (2.18%), 1 patient had temporal muscle atrophy (0.36%), and 1 patient had a 1 cm RF lesion in the temporal lobe (0.36%) (Table 3).

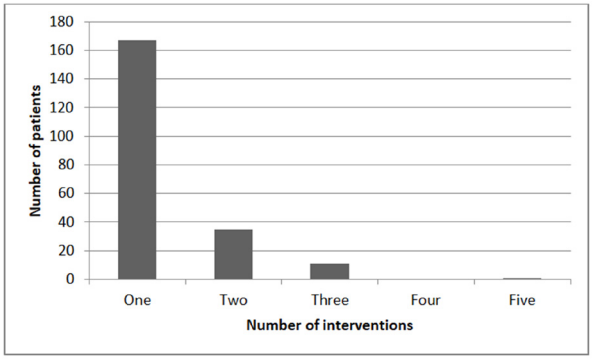

Figure 2. Number of interventions performed for each trigeminal neuralgia patient. The x-axis denotes number of procedures and the y-axis denotes number of patients

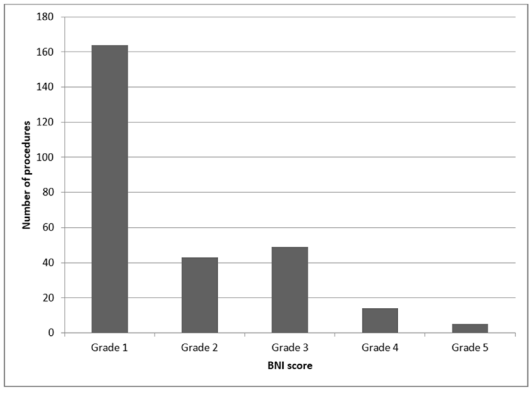

Figure 3. Early period results according to the Barrow Neurological Institute (BNI) pain intensity scale. The x-axis denotes BNI pain intensity score and the y-axis denotes number of procedures

DISCUSSION

Sex and Age

58.41% of our patients were female. In Bendtsen et al. (16), it was reported that TN affected 60% of women, although the cause was not clear (17,18).

In this study, the mean age was 58.48±14.07. The mean age range in the literature is 53-57 (17,18). However, although the mean age of the patients who applied to us was 58.48

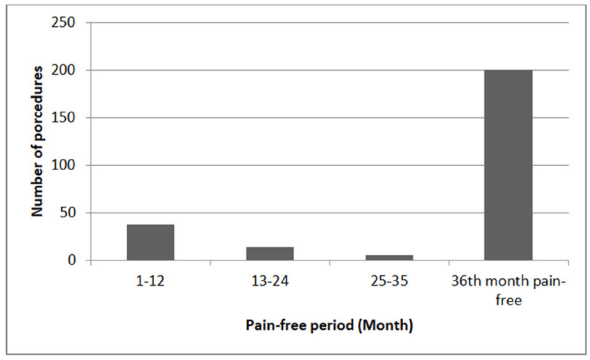

Figure 4. Pain recurrence at 36 months after 256 interventions. The x-axis denotes time and the y-axis shows number of procedures

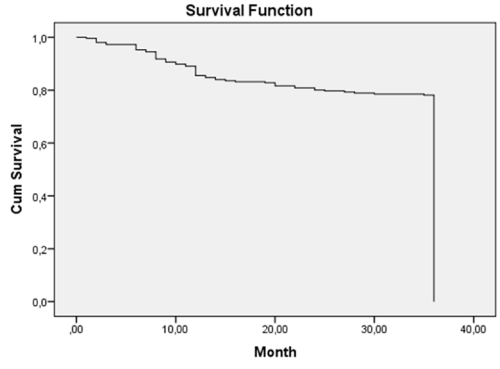

Figure 5. A graph showing Kaplan-Meier analysis of the pain-free survival rate of 256 successful surgical procedures with trigeminal neuralgia treated by radiofrequency thermocoagulation. The x-axis denotes pain-free survival in months and the y-axis denotes cumulative survival

Table 3. Complications occured due to intervention in 275 procedures

Complication	Total (n=275)
Intrabuccal hematoma	23 (8.36)
Corneal hypoesthesia and reflex deficit	15 (5.45)
Dysestesia	6 (2.18)
Masseter muscle weakness	6 (2.18)
Atrophy of temporal muscle	1 (0.36)
RF lesion in temporal lobe	1 (0.36)

Values presented as number (%). RF: Radiofrequency

years, the age distribution covered a wide range from 27 to 89 years. We should also consider a group of patients who had received medical treatment for a long time before surgical treatment or who had not been diagnosed with trigeminal treatment for a long time. Therefore, the mean date of onset of the complaints was 76.26 months before the patients were admitted to our clinic. In addition, the SD of these data was very large (SD: ±86.13). Taking all this into account, the age of onset of the disease was calculated as 51.93 years.

Painful Side and Involved Nerve Branch

According to the study by Son et al. (19) the most commonly involved side was the right side and the most commonly involved branch was V3. In the study by Maarbjerg et al. (18) the most commonly involved side was the right side and the most commonly involved branches were V2-V3. In this study, 61.68% of the patients had right-sided pain. The most commonly involved branches were V2-V3 branches (35.98%). When the literature is analyzed, right-sided dominance is evident. As for the involved branches, V3 or V2-V3 became dominant.

Early Post-intervention Results

After 275 interventions in 214 patients, 256 (93.09%) were evaluated in grades 1, 2, and 3 according to the BNI pain intensity scale. Grade 1 was completely painless, did not require medication, and included 164 procedures (59.64%). Grade 2 did not require medication, but occasional pain was present. Forty three interventions were performed in this group (15.64%). Grade 3 had occasional pain but could be controlled with medication. This group included 49 attempts (17.82%). Grades 4 and 5 were considered unsuccessful (19, 6.91%). In these groups, medication was required, and pain was not completely controlled. When the literature was reviewed, Son et al. (19) obtained BNI grade 1 results with a rate of 81.6%. Kanpolat et al. (20) reported an early pain relief rate of 97.6%. Taha et al. also reported a 99% result for the same category (21).

Follow-up and Recurrence of Pain

In this study, 36 months were set as the follow-up limit. Setting a fixed time limit was a methodological choice. Thus, we could standardize the follow-up period. No patient with whom we lost contact within 36 months was included in the study group. However, all patients whose pain recurred during this period and who underwent RFT were included in the study. After each intervention, the 36-month follow-up period was restarted.

During the 36-month follow-up period, the mean pain-free period was 30.83 months. Of the 256 patients who underwent RFT and received BNI grade 1, 2, and 3 results, 14.45% had pain within the first 12 months, 5.47% within 13-24 months, and 1.95% within 24-35 months. In addition, 78.12% of the patients were pain-free at the end of the 36th month. Taha et al. (21) reported a 15% recurrence of pain within the first 5 years. Kanpolat et al. (20) reported a 25% recurrence rate in 1-25 years of follow-up, and Nugent (22) reported a 23% recurrence rate in 4.7 years of follow-up.

Complications

Intrabuccal haemotoma (8.36%), corneal hypesthesia and reflex loss (5.45%), masseter muscle weakness (2.18%), dysesthesia (2.18%), temporal muscle atrophy (0.36%), and a 1 cm RFT lesion in the temporal lobe (0.36%) were observed after the interventions. The RFT lesion in the temporal lobe was detected by cranial computed tomography and magnetic resonance imaging examinations performed 6 h after the intervention due to nausea and vomiting. Within 12 h, the patient's complaints completely regressed. No progression was detected in the control imaging studies. Complications have also been reported in different studies. The most common complications in the study by Broggi et al. (23) were corneal reflex loss and masseter muscle weakness without keratitis. The most common complications were the same as those in the series of Kanpolat et al. (20).

In this study, hypesthesia was observed after RFT in almost all patients in the BNI grade 1, 2, 3. This hypesthesia was defined as "not disturbing and not troublesome" and this was explained to all patients before the intervention. Donnet et al. (24) described this condition as the cost of pain relief. Other sensory changes were defined as a complication under the name of dysesthesia.

A follow-up period longer than 36 months would have provided more detailed results.

One of the shortcomings of this study is that the effects of other diseases associated with TN were not monitored. Hypertension, diabetes, and thyroid disorders are highly likely to trigger TN. The effects of these comorbidities on disease characteristics and treatment outcomes may be different.

CONCLUSION

In this study, the early success rate was 93.09%. During the 36-month follow-up period, 78.12% of the patients did not experience recurrence of pain. RFT in TN is an effective, repeatable, and low-complication treatment method. However, it is necessary to understand its limitations well. The points to be considered during patient selection and intervention can be summarized as follows: 1) Avoid applying

RFT to atypical TN; 2) avoid applying lesion to V1 branch; 3) avoid high temperature and prolonged application; and 4) try to find the correct localization with radiological imaging and pre-lesion stimuli during the procedure.

ETHICS

Ethics Committee Approval: University of Health Sciences Türkiye, Prof. Dr. Mazhar Osman Psychiatric and Neurological Diseases Training and Research Hospital Ethics Committee approval was obtained for this study (decision no: 514, date: 12.01.2016).

Informed Consent: Retrospective study.

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