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REVIEW

Analysis of short-term efficacy of radiofrequency thermocoagulation in the treatment of classic trigeminal neuralgia

Klasik trigeminal nevralji tedavisinde radyofrekans termokoagülasyonun kısa süreli etkinliğinin analizi

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Summary

The objectives of the study were to explore the short-term efficacy of radiofrequency thermocoagulation for the treatment of classic trigeminal neuralgia (TGN). A retrospective analysis of 58 patients with classical TGN treated with radiofrequency thermocoagulation at our institution between 2016 and 2019, including 23 men and 35 women. The mean age of all patients was 62.1±10.9 years, the duration of the disease ranged from 2 months to 360 months, and the mean duration of the disease was 80.1±77.9 months. Patients were divided into three groups, V2, V3, and V2+V3, according to the site of symptom presentation. Treatment effectiveness was evaluated by observing patients' before surgery, after surgery, and 1-year after surgery visual pain simulation (VAS) scores. The clinical efficacy was evaluated by calculating the percentage of patients whose net improvement in VAS scores of the three groups of patients V2, V3, and V2+V3 reached the minimal clinically important differences MCID value of TGN. Patients' after surgery VAS scores and 1-year after surgery VAS scores all showed meaningful improvement ($p<0.001$) compared with pre-operative VAS scores, and after surgery VAS scores showed meaningful change ($p<0.05$) compared with 1-year after surgery VAS scores. About 84.62%, 95.45%, and 86.96% of patients in V2, V3, and V2+V3 groups showed net improvement in after surgery VAS scores to MCID values, and 69.2%, 86.4%, and 74.0% of patients in 1-year after surgery VAS scores showed net improvement to MCID values, respectively. The early efficacy of radiofrequency thermocoagulation for classic TGN is significant, but patients have a tendency to have recurrence of pain symptoms 1 year after surgery.

Keywords: Interventional therapy; minimally invasive; radiofrequency thermocoagulation therapy; trigeminal neuralgia.

Özet

Klasik trigeminal nevralji tedavisinde radyofrekans termokoagülasyonun kısa vadeli etkinliğini araştırmak. 2016–2019 yılları arasında kurumumuzda radyofrekans termokoagülasyon ile tedavi edilen 23'ü erkek ve 35'i kadın olmak üzere klasik trigeminal nevraljili 58 hastanın retrospektif analizi incelendi. Hastaların ortalama yaşı 62,1±10,9 yıl, hastalık süresi ise 2 ay ile 360 ay arasında değişmekte olup, ortalama hastalık süresi 80,1±77,9 ay idi. Hastalar semptomların ortaya çıktığı bölgeye göre V2, V3, V2+V3 olmak üzere üç gruba ayrıldı. Tedavi etkinliği, hastaların ameliyat öncesi, ameliyat sonrası ve ameliyattan 1 yıl sonrası görsel ağrı simülasyon skorları (VAS) gözlemlenerek değerlendirildi. Klinik etkinlik, V2, V3 ve V2+V3 hasta gruplarının VAS skorlarındaki net iyileşme, trigeminal nevraljide en küçük klinik önemli değişim (MCID) değerine ulaşan hastaların yüzdesi hesaplanarak değerlendirildi. Ameliyat sonrası VAS skorları ve ameliyattan 1 yıl sonraki VAS skorlarının tümü, ameliyat öncesi VAS skorlarına kıyasla anlamlı iyileşme gösterdi ($p<0,001$); ve ameliyat sonrası VAS skorları, ameliyattan 1 yıl sonraki VAS skorları ile karşılaştırıldığında anlamlı bir değişiklik gösterdi ($p<0,05$). V2, V3, V2+V3 gruplarındaki hastaların sırasıyla %84.62, %95.45, %86.96'sı, ameliyat sonrası VAS skorlarında MCID değerlerine ulaşarak net iyileşme gösterdi; ve hastaların sırasıyla %69.2, %86.4 ve 74.0%'ünde, ameliyat sonrası 1 yıllık VAS skorlarında MCID değerlerine ulaşarak net iyileşme gözlendi. Klasik trigeminal nevralji için radyofrekans termokoagülasyonun erken dönem etkinliği anlamlıdır, ancak hastalarda ameliyattan 1 yıl sonra ağrı semptomlarının tekrarlama eğilimi vardır.

Anahtar sözcükler: Girişimsel tedavi; minimal invaziv; radyofrekans termokoagülasyon tedavisi; trigeminal nevralji.

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Introduction

Trigeminal neuralgia (TGN) is one of the most severe facial pains in humans. It is mainly characterized by paroxysmal, electric shock-like pains in the facial area innervated by the trigeminal nerves V2 or V3.[1,2] The vast majority of patients have significant trigger points and have severe paroxysmal pain when they speak, wash their face, brush their teeth, or even walk, causing great inconvenience to their lives.[3–5] The treatment of TGN is an important thing because of the unpredictability of the onset time of TGN, which severely affects the qualities of lives and productivities of the patients. Some patients can control TGN with medication. However, about half of the patients have difficulty in controlling pain with drugs, and some patients cannot tolerate the side effects of drugs, so they cannot control their pain by taking drugs for a long time. These patients ultimately need surgery to relieve their pain.

Context[6]

Although for classic TGN, the surgical method of microvascular decompression is usually the treatment of choice, but for those patients who are unwilling to undergo craniotomy, the effectiveness of trigeminal nerve radiofrequency thermocoagulation as an alternative therapy has not been clarified. Certainly, there is no research on the possibility of short-term recurrence after surgery.

The purpose of this study was to explore the short-term efficacy of radiofrequency thermocoagulation in the treatment of classic TGN and to predict whether there is a possibility of recurrence in patients after surgery.

Material and Methods

Material

A total of 105 patients underwent radiofrequency thermocoagulation of the trigeminal semilunar ganglion between 2016 and 2019 in our department. All patients participated in pre-operative education and signed informed consent. This study was approved by the ethics committee of our hospital. Cases inclusion criteria: (1) Patients with classic TGN who have been treated conservatively with drugs for more than 2 months or have obvious adverse reactions to drug treatment; (2) the patients have no contraindications to surgery; and (3) the patient's transcranial MRI examination ruled out diseases such as intracranial tumors, and the trigeminal nerve MRI examination showed that the trigeminal nerve vessel was compressed. Cases exclusion criteria: (1) The cases are not patients with classic TGN; (2) patients have mental illnesses; and (3) patients have severe organismic diseases.

A total of 58 patients with classical TGN were included in the study, and 47 patients were excluded for 43 patients with primary TGN, two patients with tumors, one patient with psychiatric disorder, and one patient with severe organismic disorder.

Methods

The patient lied supine on the operating bed with the neck extending and the pupils looking straight up. Two lines determined the puncture point, one horizontal through the orifice and the other vertical through the ipsilateral outer orbital margin. The direction of the puncture was determined by the intersecting lines of the two faces, the surgical puncture point was marked as point A, the central lower part of the pupil was marked as point B, the front 2–3 cm of the external auditory canal was point C, the line between points A and B was AB, the line between points A and C was AC, the face consisting of AB and the puncture needle, and the face consisting of AC and the puncture needle were perpendicular to each other, and the intersecting line between the two faces was AD. Local anesthesia was completed at point A, the puncture needle was fed from point A, and the needle was punctured 5–6 cm along the direction of AD (Fig. 1), when the tip of needle reached the flatter bone surface in front of the foramen ovale at the basis cranii, continued to slide along the bone surface until the needle tip slide into the foramen ovale. The depth of the puncture needle into the foramen ovale was determined according to the patient's pain site and the anatomical features of the semilunar ganglion: The outer edge of the foramen ovale is the starting point. When treating the V3 nerve branch, the puncture needle needs to enter the foramen ovale to a depth of 8–10 mm. When treating the V2 nerve branch, the puncture needle needs to enter the foramen ovale to a depth of 12–15 mm to treat the V1 nerve. The puncture needle needs to enter the foramen ovale at a depth greater than 15 mm, but the needle tip should not exceed

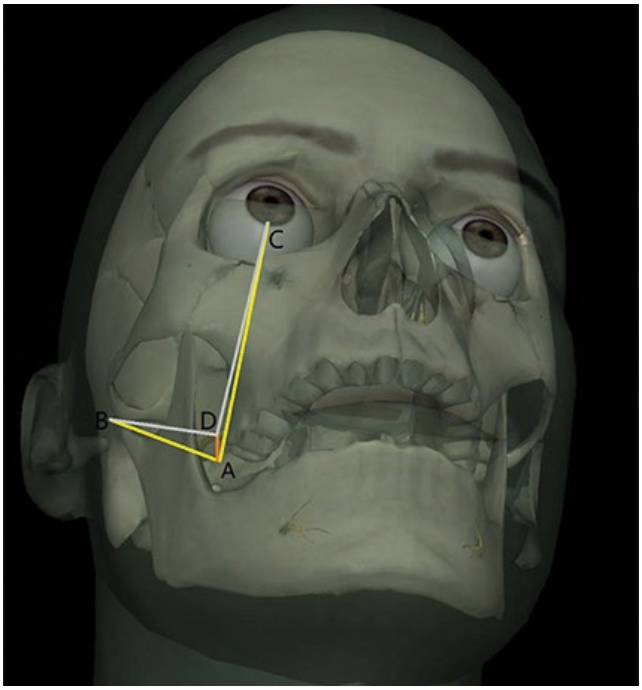

Figure 1. Schematic diagram of puncture.

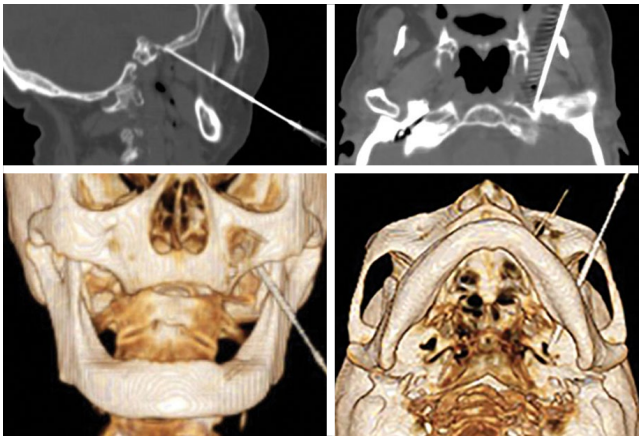

Figure 2. Intraoperative images.

the clivus. After the puncture was completed (Fig. 2), the test electrode was placed for testing. When the test impedance was 200–300 Ω, under 100 Hz, 0.3 mA electrical stimulation, the skin surface area innervated by the corresponding branch of the trigeminal nerve would produce pain. Electrical stimulation of 2 Hz and 2 V caused slight muscle tremor in the area innervated by the corresponding branch of the trigeminal nerve, but there was no tremor in the occlusal muscles. After the stimulation probe was completed, performed a feasible local nerve anesthesia to verify the accuracy of the site, slowly inject 0.25% lidocaine, and observed whether the patient had numbness at the painful site. After verifying that the position was accurate, adjusted the temperature of the radiofrequency needle at 70–75°C, and performed thermocoagulation treatment on the target, held it for 60 s and treated it 3 times. During treatment, the patient's nociceptive and tactile changes in the innervated area of the lesion were tested by acupuncture, and the treatment was stopped when the patient's nociceptive and tactile dullness in the lesion area appeared.

Clinical evaluation

The observational indicators in this study included: (1) General patients materials; (2) clinical efficacy evaluation by visual pain simulation score (VAS), all data were obtained from the post-operative follow-up questionnaires; and (3) patients were divided into three groups V2, V3, and V2+V3 according to the sites of symptom presentation. The minimum clinically significant difference in TGN was 4.49,[7] and the proportion of patients with a net improvement in after surgery VAS score and 1-year after surgery VAS score that reached minimal clinically important differences (MCID) were calculated in the V2, V3, and V2+V3 groups to evaluate clinical efficacy.

Statistical analysis

Before surgery and after surgery pain VAS scores were compared by rank sum test. The results were analyzed by SPSS 25.0 statistical software. $P \leq 0.05$ was considered statistically significant. Age, disease course, and follow-up time were expressed as mean±standard deviation.

Results

The basic information and clinical characteristics of the patients are shown in Table 1. Fifty-eight patients were included, of whom 23 were men (39.7%) and 35 were women (60.3%). Among all patients, the minimum age was 34 years and the maximum age was 85 years, with a mean age of 61±10.9 years. The shortest duration of illness was 2 months and the longest 360 months, with a mean duration of 80.1±77.9 months. All patients were divided into three groups, V2 group had 13 cases, accounting for 22.4%, V3 group had 22 cases, accounting for 37.9%, and V2+V3 group had 23 cases, accounting for 39.7%. All included cases completed surgical treatment and all patients were followed up for a maximum of 4 years and a minimum of 1 year, with a mean follow-up of 1.62±0.85 years, with 13 patients missing after 1 year.

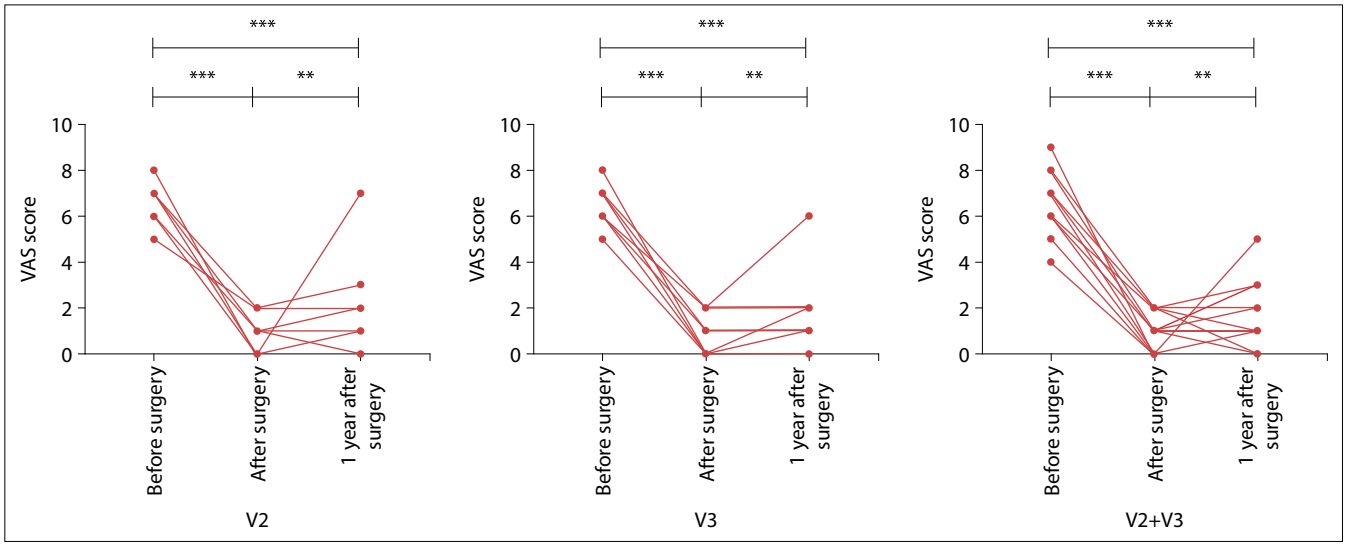

Figure 3. Before surgery, after surgery, and 1-year after surgery pain VAS.

***: p<0.001; **: p<0.05. *: Statistically significant differences between before surgery and after surgery measurements as determined by Wilcoxon signed-rank test. Statistically significant differences between before surgery and 1-year after surgery measurements as determined by the Wilcoxon signed-rank test. Statistically significant differences between after surgery and 1-year after surgery measurements as determined by the Wilcoxon signed-rank test.

Table 1. Basic information and clinical characteristics of patients

Variable	n=58
Gender, n (%)	
Male	23 (39.7)
Female	35 (60.3)
Age (years)	62.1±10.9
Disease course (m)	80.1±77.9
Follow-up time (years)	1.62±0.85
Nerve, n (%)	
V2	13 (22.4)
V3	22 (37.9)
V2+V3	23 (39.7)

*: The above data are expressed as mean±standard deviation, unless otherwise stated.

The before surgery, after surgery, and 1-year after surgery patients' VAS scores are shown in Figure 3. After surgery VAS scores and 1-year after surgery VAS scores were meaningfully improved compared to before surgery ($p<0.001$) and after surgery VAS scores which were meaningfully changed compared to 1-year after surgery VAS scores ($p<0.05$). In the V2, V3, and V2+V3 groups, the percentages of patients with a net improvement in VAS score to MCID after surgery were 84.62%, 95.45%, and 86.96%, respectively, and the percentages of patients with a net improvement in VAS score to MCID at 1-year after surgery were 69.2%, 86.4%, and 74.0%, respectively.

Among the patients with pain in the area dominated by V2, one patient developed mild keratitis after the operation, and the keratitis disappeared after drug treatment; 32 patients with facial numbness after the operation, of which six cases disappeared within 6 months after the operation, nine cases disappeared within 1 year after operation, and four cases continued to experience numbness within 1 year after operation. One year later, three patients had recurrence of pain, and the pain was significantly relieved after another operation.

Discussion

TGN is the most common neurological disorder of the brain and its incidence increases with age, with a higher prevalence in women than in men.[8–11] The pain is periodic and usually lasts for a few seconds or minutes, with intermittent episodes as in normal people.[3] Most patients have a sensitive area of the face and touching this area can trigger a TGN attack.[1,12] In clinical practice, the treatments of patients with TGN are difficult, and patients who have failed conservative drug therapy or who cannot tolerate drug side effects often require surgery.[2,13] Although classical TGN patients are preferred for microvascular decompression surgery, interventional treatment of pain can be an alternative treatment for some patients who are reluctant to undergo craniotomy surgery.

Current surgical interventions for TGN include percutaneous radiofrequency treatment (PRT), per-

cutaneous balloon compression, and stereotactic radiosurgery. PRT of the trigeminal meniscus nerve ganglion can provide the highest rate of complete pain relief, especially in patients who are at high risk for surgery or not suitable for other treatments.[3,14] PRT has the advantages of simple operation, no craniotomy, repeatability, low cost, etc.[15–17] The basic principle of PRT technology: Sensory nerve fibers are divided into two types: Myelinated type A fibers and unmyelinated type C fibers, and type A fibers are divided into four types: α, β, γ, and δ according to their thickness. Their conduction velocities differed in response to stimulation thresholds and sensitivity to anesthetic agents. Tactile sensation is conducted by fibers 9–16 μm in diameter and temperature sensation by fibers 5–8 μm in diameter. Aδ and C class fibers are highly sensitive to heat, and when the temperature is 60–70°C, this fiber is first destroyed, stopping the pain impulse conduction in the sensory nerves. Thus, PRT selective disruption blocks the nociceptive conduction of such fibers while preserving the tactile function to achieve pain relief.

The previous studies have shown that PRT with Gasserian ganglia significantly relieves pain in over 90% of patients.[4,18,19] Scrivani et al.[17] prospectively studied PRT in 2150 patients with an early (within 6 months) excellent outcome rate of 92%, a long-term excellent rate of 83%, and a pain recurrence rate of 27%. Kanpolat et al.[20] conducted a long-term follow-up of 1600 patients undergoing PRT and showed that the initial efficiency was 97.6–99.0% and ½-year efficiency was 83.3–89.9%. Our study showed that the after surgery VAS score and the 1-year after -surgery VAS score of all groups of patients were meaningful compared with the before surgery VAS score ($p<0.001$), indicating that the patients had immediate and sustained pain relief, and the after surgery VAS score changed meaningfully compared with the 1-year after surgery VAS score ($p<0.05$). The percentage of patients in all three groups with a net improvement in VAS score of MCID at 1 year after surgery decreased compared with the net improvement in VAS score of MCID after surgery, indicating that although the clinical symptoms at 1 year after surgery were more significant than before surgery, the patients already had a tendency of pain symptoms recurrence.

Compared with several other interventions, PRT has the lowest complication rate: 3.3% for facial numbness, 5.7–17.3% for corneal reflexes, 0.6–1.9% for keratitis, 32.4% for masticatory muscle weakness, and 0.6–0.8% for hypersensitivity.[20,21] In our study, 58 patients with classic TGN underwent radiofrequency thermocoagulation and all patients did not develop diminished corneal reflex, masseter weakness and paralysis, dysesthesia, and anesthesia dolorosa. Three patients (5.2%) whose pain recurred 1 year after surgery underwent reoperation, an outcome smaller than previously reported and possibly related to the small sample size. The recurrence of pain was not considered a serious event due to the high reproducibility of the surgery, and after repeated surgery, these three patients with recurrence also had significant pain relief. Postoperatively, 32 patients (55.2%) presented with facial numbness, of which 19 (59.4%) had numbness that resolved on its own 6 months postoperatively, 9 (28.1%) had numbness that resolved on its own after 1 year, and 4 (12.5%) had numbness that persisted for 1 year postoperatively, which was acceptable for patients with recoverable numbness after surgery compared to severe pain. It has been reported that when the end goal is V2, unintentional damage to V1 or V3 can lead to corresponding skin numbness, motionlessness, missing corneal reflexes or keratitis, or even permanent visual loss.[20,22–24] In our study, one patient developed a mild redness of the cornea during surgery, we adjusted the position of the puncture needle in time, and the patient showed mild keratitis after surgery, with no residual sequelae after medication. Therefore, we believe that the local anesthetic test before the radiofrequency thermocoagulation treatment and the timely observation of the patient's local manifestations during the radiofrequency thermocoagulation treatment and the timely adjustment of the positive puncture position can prevent the occurrence of such events.

Limitations

The disadvantages of the present study are as follows: (1) The follow-up time was short and (2) the sample size included in this study was small and not compared with primary TGN, so the group plans to expand the study and do another study in the future.

Conclusion

Radiofrequency thermocoagulation is a simple and safe technique for treating classic TGN, and its early efficacy is significant and can effectively relieve patients' pain. After surgery and 1-year after surgery efficacy of patients were significant compared to preoperative, but after 1 year patients had a tendency to recurrence of pain symptoms and required follow-up studies.

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Ethics Committee Approval: This study was approved by the local scientific research and clinical trial ethics committee (YXLL-2020-011).

Author Contributions: Concept – QW; Design – QW; Supervision – QW; Resource – QW; Materials – WD; Data Collection and/or Processing – WD; Analysis and/or Interpretation – QW, WD; Literature Search – QW, WD; Writing – QW; Critical Reviews – WD.

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