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Percutaneous Radiofrequency Thermocoagulation for the Treatment of Different Types of Trigeminal Neuralgia: Evaluation of Quality of Life and Outcomes*

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Summary: Radiofrequency thermocoagulation (RFT) of the gasserian ganglion is a routine and effective technique for the treatment of classical trigeminal neuralgia (CTN). In this study we compared its efficacy in patients with CTN and atypically symptomatic or mixed trigeminal neuralgia (MTN). Fifty-seven patients were treated with RFT for trigeminal neuralgia from June 2006 to February 2009. Thirty patients had CTN, and 27 had MTN. Outcomes were measured by using the visual analog pain scale (VAS) and patients' reports of quality of life (QOL), medication usage, and complications over a follow-up period of up to 3 years. Our results showed that the patients with MTN were younger, tended to have bilaterial involvement of the first division, and were unresponsive to treatment. All surgeries were completed smoothly. About 86.7% CTN patients and 48.1% MTN patients responded immediately to RFT. The VAS scores were significantly higher in the CTN group than in MTN group (P<0.05). Kaplan-Meier curves showed that 1-year, 2-year, and 3-year pain relief rates were 76.7%, 73.3%, and 73.3% in the CTN group and 46.6%, 41.4%, and 41.4% in the MTN group, respectively. The rates of pain relief for both groups leveled off at 2 years. Complications included numbness, dysesthesia, and anesthesia dolorosa. RFT did not cause any deaths and complications were low. The treatment was very effective for CTN and, to some degrees, effective for MTN. If numbness, dysesthesia, and anesthesia dolorosa are limited to the trigger area, QOL will be greatly improved.
Key words: facial pain; trigeminal neuralgia; classical trigeminal neuralgia; mixed trigeminal neuralgia; quality of life

Trigeminal neuralgia (TN) is a neuropathic pain involving one or more trigeminal nerves. The classical TN is characterized by a unilateral, episodic, electric shock-like pain. This pain might be ascribed to a blood vessel compressing the trigeminal nerve at root entry zone, and microvascular decompression (MVD) had be proved to be effective for the treatment of the conditon[1–3]. But in some cases, patients complain a persistent, dull, burning pain between paroxysms. Such pain of trigeminal nerve is known as "atypical" or "mixed" trigeminal neuralgia (MTN)[4]. The underlying mechanisms of the disease remains unknown, and patients with MTN are often more refractory to treatment[5].

Since the modification of radiofrequency thermocoagulation (RFT) in the 1970s, this technique has been used as a procedure of choice[6–8]. This procedure can achieve pain relief in 90% of patients and 50% of patients remain pain-free 5 years after the operation[9]. But RFT may cause significant sensory dysfunction postoperatively, which affects the quality of life (QOL) of these patients[10, 11].

Over the past years, few studies focused on the effectiveness of RFT in the patients with MTN. In the present study, we compared the outcomes of RFT, including immediate relief of pain, rates of recurrence of pain, and QOL in patients with CTN and MTN. We also attempted to identify clinical factors associated with improved or decreased QOL after RFT.

1 MATERIALS AND METHODS

1.1 Patient Data

All 57 patients who were admitted to the Beijing Xuanwu Hospital Pain Therapeutic Center with a diagnosis of TN from June 2006 to February 2009 were enrolled in this study. The patients were divided two groups: 30 with classical TN (CTN) and 27 with MTN. Our definition of CTN followed the International Headache Society criteria 12, included (1) paroxysmal attacks, lasting from 1 s to 2 min, affecting one or more divisions of the trigeminal nerve; (2) pain that is intense, sharp, superficial, or stabbing, precipitated from trigged areas

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or factors; (3) attacks stereotyped in the individual patient; (4) absence of clinically evident neurological deficit; and (5) pain not attributed to another disorder. The criteria for MTN diagnosis included, apart from manifestations above, (1) pain described as boring, aching, or nagging; and (2) pain that did not fully respond to anti-neuralgic therapy[4].

The clinical characteristics of the patients are listed in table 1. The subjects included 12 men and 18 women and their age of the patients in the CTN group ranged from 39 to 88 years with a median of 64 year. Twenty-one of these patients had pain on the right side and 9 had the pain located on the left side. None had bilateral symptoms. The age of the patients in the MTN group ranged from 18 to 77 year with a median of 61 year, with 12 men and 15 women included. Fourteen of these patients had pain on the right side, 11 had pain located on the left side, and 2 had bilateral symptoms. Before surgery, written informed consent was obtained from all the patients.

Table 1 Clinical characteristic of 57 TN patients

Variables		CTN	MTN
Age at treatment (year)		64 (39–88)	61 (18–77)
Gender	Female	19	15
	Male	11	12
Side	Right	21	14
	Left	9	11
	Both	0	2
Pain distribution	V1	1	1
	V2	11	12
	V3	6	9
	V1 +V2	1	0
	V2 +V3	11	5
	V1+ V2+V3	0	0

1.2 Surgical Technique

The RFT technique for trigeminal neuralgia was based on Sweet & Wepsic's description which has been well described[6]. All the patients were treated under guidance of computed tomography (CT). First, the lateral scanning was used to verify the initial trajectory of the needle. The treatment target was the Gasserian ganglion, which is radiologically presented as the junction of the lines joining the clivus and petrous apex[7]. With the patient put under local anesthesia and sedation, a straight-tipped needle was inserted according to the parameters from CT, with care taken to avoid damaging the oral mucous membrane. Then the axial scanning was used to check the position of the needle. When the needle had been advanced into the foramen, electrical stimulation was used to check the position of the needle tip. If the tip was correctly positioned, the patient would feel paresthesia in the appropriate trigeminal division. If not, the needle was adjusted. Once satisfactory positioning was confirmed, anesthesia was induced intravenously, usually with propofol, fentanyl, or remifentanil. Then, a laryngeal mask was used to control the airway of patients, and blood pressure (BP), heart rate (HR), ECG tracings, and SpO_2 were recorded during the procedure. Thermocoagulation was performed at a temperature of 70°C for 180 s.

1.3 Evaluation of Outcomes

Scores using the visual analog pain scale (VAS) were reported by the patients before and after the procedure. Recurrence, defined as the return of pain with pre-operative characteristics and severity, was evaluated, as was the need for regular medication to control the pain. The QOL was assessed by patients' self-reporting of the degree to which they felt this procedure improved their QOL, on a scale ranging from 0–100 (table 2)[13, 14]. Interviews were conducted once a year to score these outcomes during visits in which the interviewers were blind to the patients' condition.

Table 2 QOL assessment

1	In general would you consider the procedure to be a successful treatment in your case? Yes (1), no (2), not sure (3)
2	Has your QOL been improved since the procedure? Yes (1), no (2), not sure (3)
3	Please evaluate the degree (as a percent from 0–100%) to which you feel this procedure improve or reduce your QOL.
4	Please point out the main factors that affect your QOL.

1.4 Statistical Analysis

The statistical analysis was performed by employing SPSS Ver. 15.0 (SPSS Inc., Chicago, IL, USA). The quantitative data were expressed as median and range. The comparisons of the clinical data between the two groups were made by using the two-tailed independent samples *t* test. The comparisons of data before and after the procedure were done by using the paired *t* test. The duration of pain relief after surgery in the two groups was compared by utilizing the Kaplan-Meier method, and the survival curves were drawn by using SPSS software package.

2 RESULTS

2.1 Response to Treatment

In this study, complete postoperative pain relief was achieved in 23 (76.7%) patients in the CTN group, and partial postoperative pain relief was accomplished in 3 (10%) patients who needed further medication. Overall, 26 (86.7%) patients in the CTN group reported the improvement after RFT. In the MTN group, 9 (33.3%) patients achieved complete postoperative pain relief after RFT, and 4 (14.8%) patients attained some postoperative pain relief but still needed medication. Overall, 13 (48.1%) of the patients in the MTN group reported improvement after RFT.

Paired testing analysis of VAS scores revealed that, in the CTN group, VAS score decreased significantly from a preoperative mean of 8.0 to a mean of 2.3 after RFT (P<0.05). In the MTN group, the VAS score also dropped significantly from a mean of 7.3 before the procedure to a mean of 4.4 after the operation (P<0.05). Two-tailed independent samples t test showed that VAS scores were decreased more in the CTN group than in the MTN group (P<0.05).

2.2 Recurrence of Pain

During the follow-up period, 8 patients with CTN had a recurrence of pain, with the mean duration of pain relief being 28.0 months (95% confidence limits: 23.2–32.8 months, SE: 2.46 months). In the MTN group, 15 patients had a recurrence and the mean duration of pain relief was 15.7 months (95% confidence limits: 9.2–22.2 months, SE: 3.32 months).

Estimation by Cumulative Proportion Surviving demonstrated that 1-year, 2-year, and 3-year rates of pain relief were 76.7%, 73.3%, and 73.3% in the CTN group and 46.6%, 41.4%, and 41.4% in the MTN group, respectively. All recurrence rates were calculated by using Kaplan-Meier plots (fig. 1). Statistical analysis revealed that patients with CTN had a lower risk of pain recurrence than their MTN counterparts (P<0.01).

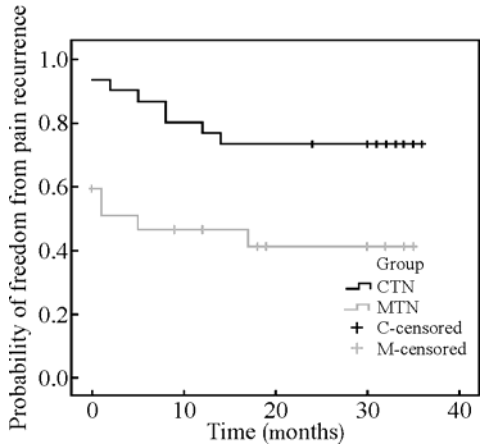

Fig. 1 Pain relief rates demonstrated by Kaplan-Meier plots

2.3 Complications

Some complications developed in both groups, and some persisted throughout the follow-up period. Numbness was the most common complication reported by patients after the RFT. In the CTN group, 25 patients (83.3%) reported numbness of varying degrees in the face; in the MTN group, 20 patients (74.1%) reported numbness. Dysesthesia or even anesthesia dolorosa also happened, and 8 patients (26.7%) in the CTN group and 4 patients (14.8%) in the MTN group reported dysesthesia. Two patients (6.7%) in the CTN group and 1 patient (3.7%) in the MTN group reported anesthesia dolorosa.

Keratitis was reported by 8 patients (26.7%) in the CTN group and 4 patients (14.8%) in the MTN group. The rate of mastication weakness was 50% (n=15) in the CTN group and 40.7% (n=11) in the MTN group.

2.4 QOL

The patients whose pain remained under control at the time of follow-up visit reported 91.6% improvement in their QOL on average, and 84.8% of these patients were satisfied with the result of the RFT. The patients who had a temporary control of their pain reported a 60% improvement in their QOL on average, and 70% of these patients were satisfied with the results of RFT. The patients who failed to respond to RFT reported a 2.6% improvement in their QOL, and none of them was satisfied with the results of the procedure.

3 DISCUSSION

The characteristics of the patients in our series, such as sex, affected side, and affected division, were consistent with those of previous reports[15–17]. In this study, patients were predominantly female (man-to-women ratio: 1:1.48), pain was mainly right-sided (left-right ratio: 1:1.75) and the maxillary-mandibular area was most affected (94.7%). The age of symptom onset ranged mostly between 50 and 60 year (mean age: 56.5 year), in both the patients with CTN and MTN. The mean age of symptom onset was younger in the MTN group than in the CTN group (55.7 *vs* 51.2 year). Two of the patients with MTN had bilateral symptoms, but none of the subjects with CTN did. Furthermore, 52.9% of the patients with MTN did not well respond to medications, and 51.9% of them did not respond to RFT very well.

In this series, 86.7% of the patients in the CTN group responded to RFT as indicated by their self-reported improvement in QOL. Excellent results were reported by 76.7% and good results by 10% of the patients. These results were comparable to some recently reported findings[18]. Our data and previous studies suggested that the success of RFT was similar to those of MVD[19]. When there is no vascular compression, a slight neurapraxia at trigeminal root is an effective management option[20], which is similar to RFT. Both RFT and MVD work at the first level of neurons, and RFT is effective in the presence or absence of vascular compression.

In this series, only 48.1% of the patients in the MTN group responded to RFT, with excellent outcomes achieved in 33.3% of the patients and good outcomes in 14.8%. Although technical factors could conceivably account for some of the variations in outcomes, it seems likely that difference in the mechanism of the two conditions might be an important contributor to the discrepancy. Several theories have been proposed for the pathogenesis of MTN. Some authors hypothesized that different facial pain syndromes represented sequential

stages of the same disease process[21], but others believed central sensitization or descending inhibition deficits in the patients is the culprit for atypical TN[22–24]. In our study, the persistent pain of one patient disappeared after the procedure but his "paroxysmal" pain remained. This patient was satisfied with the results of the operation because the "paroxysmal" pain could be controlled by medication. With another patient, the paroxysmal pain disappeared, but the persistent pain remained. He was also satisfied with the operation results because his mild persistent pain did not require medication. These patients probably suffered from two different disorders, and we preferred to call this condition "MTN" rather than atypical or systematic TN. Some scholars have focused on the classification of different TN and prediction of the outcomes of operative intervention[25, 26] and further study is still warranted.

In this study, 48.1% of the patients with MTN in this series did respond to RFT, suggesting that MTN might be an indication of RFT, which supports the notion put forward by Luke Bennetto *et al* that RFT can be used as a diagnostic procedure for atypical disease[5]. However, since the outcome of treatment is not certain, we recommend the thermocoagulation temperature be so set that complications can be minimized. The optimal temperature also awaits further study. Our study showed that if pain and complications are not well controlled, the patients' QOL will be substantially affected.

Recurrence of pain, as a result of revival of the nerve fibers injured during the RFT, was found in both the CTN and MTN groups across a follow-up period of up to 3 years. Overall, 8 patients with CTN and 15 with MTN had a pain recurrence during the follow-up period. Among these, 8 patients in the CTN group had recurrence within two months after the procedure, and 2 in the MTN group did. After 2 months, the relief of pain stabilized, and the recurrence rate in the CTN group was 18.5% (5/27) and the rate in the MTN group was 14.3% (2/14), showing that the recurrence rates were comparable in the two groups. The longest follow-up period in this series lasted 3 years. A recent study, however, demonstrated a recurrence rate of 7.6% over a follow-up period of 8.8 years[27]. In our patients, the rates of pain relief remained constant after the second year in both the CTN group (73.3% and 73.3% at 2 and 3 years, respectively) and the MTN group (41.4% and 41.4% at 2 and 3 years, respectively). This finding indicates that the RFT is relatively reliable with respect to duration of pain relief.

The RFT caused no deaths in this study, but complications developed in some cases. A total of 45 patients (78.9%) in both groups experienced numbness after the procedure, which was gradually alleviated over time in some cases. Twenty-five patients with CTN (83.3%) reported numbness of varying degrees in the face. Only 2 patients complained severe numbness. Twenty patients with MTN (74.1%) suffered from numbness. Six of these patients complained of severe numbness. Generally, the numbness was mild and tolerable. However, when the numbness area was larger than the trigger area, patients tended to complain about the symptom, especially when their pain could not be controlled effectively.

How to reduce these complications will be a primary target of RFT in future. Fortunately, new equipment has been used to improve the outcomes with some success[28, 29].

In evaluating the various treatments of TN, the weight of pain relief, recurrence rates, and risks of death, side effects, and complications should be carefully decided. Zakrzewska *et al* introduced the concept of "time-trade-off" to assist practitioners in making treatment decisions[30]. Simplified questionnaires can be used to obtain information on patient satisfaction and QOL has been shown to be associated with increased patients' compliance and understanding[13]. Wilson *et al* demonstrated that the length and complexity of the experimental instrument is proportional to problems with compliance[31]. The QOL assessment instrument in this study is simple, comprehensive, and easily understood and has been successfully used in patients with TN[14]. The QOL instrument can better distribute the weight of each measure, thereby better reflecting the outcomes of the RFT.

In summary, RFT under CT guidance is a proven technique. It is immediately effective for CTN, and the rate of recurrence is low. It is also effective with MTN, but different strategies should be adopted in MTN treatment. If numbness, dysesthesia, and anesthesia dolorosa can be confined to the trigger area, patients will be greatly satisfied with their QOL.

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