Trigeminal neuralgia treated by radiofrequency coagulation

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 Ninety-six patients underwent percutaneous radiofrequency coagulation (RC) of the Gasserian ganglion for relief of trigeminal neuralgia between 1973 and 1978. Fifty-two percent of patients who were followed for 5 years were free of recurrence after a single RC procedure. Factors predicting clinical results were sought from initial historical and demographic data. Age, sex, duration of illness, and previous response to medication were unrelated to outcome. Patients previously treated by open surgery appeared to receive less benefit from subsequent RC. The RC procedure seemed more effective in the treatment of patients with classical tic douloureux than in those with atypical features. The degree of sensory loss created by RC was associated with the clinical outcome. Patients acquiring dense sensory deficits demonstrated a reduced risk of recurrence (p = 0.006): 25% of patients with dense sensory loss and 55% of those with a partial deficit developed a recurrence by 5 years, whereas all patients without initial sensory loss suffered a recurrence by 5 years.

KEY WORDS • trigeminal neuralgia • radiofrequency coagulation • thermocoagulation • Gasserian ganglion • corneal anesthesia

MANY clinicians employ percutaneous radiofrequency coagulation (RC) when treating patients whose tic douloureux is no longer responsive to medication. Radiofrequency coagulation in these patients is associated with reduced length of hospitalization, successful short-term results, avoidance of general endotracheal anesthesia, and low morbidity and mortality rates. The long-term results of this procedure have been less well defined. The object of this study was to investigate the long-term results from RC in patients with trigeminal neuralgia.

Clinical Material and Methods

Patient Population

Information concerning the 96 patients who underwent RC at the Cleveland Clinic between 1973 and 1978 was obtained from three sources: 72 of the patients were interviewed either in person or by telephone; information concerning 14 deceased patients was obtained through telephone conversations with knowledgeable family members; and, although efforts to contact the remaining 10 patients or families were unsuccessful, our clinical records for these patients were updated with information obtained through the cooperation of the referring physicians. The patient population consisted of 29 men and 67 women. Ages ranged from 28 to 90 years, with a mean age of 64 years. The patients were followed for up to 8 years, with an average follow-up period of 5 years.

To facilitate analysis, “classical” tic douloureux was defined as paroxysmal lancinating pain confined to the trigeminal area, evoked by a trigger mechanism, and lasting 1 to 2 seconds. Cases were considered “nonclassical” if the patient’s history varied in any way from this rigid definition. Most patients reported that the onset of symptoms occurred 5 or more years prior to RC (Fig. 1). During this time, many had been treated by other modalities, as listed in Table 1.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>acupuncture</td>
<td>3</td>
</tr>
<tr>
<td>dental procedures</td>
<td>20</td>
</tr>
<tr>
<td>alcohol nerve block</td>
<td>19</td>
</tr>
<tr>
<td>infraorbital nerve section</td>
<td>6</td>
</tr>
<tr>
<td>temporal craniotomy &amp; neurolysis</td>
<td>19</td>
</tr>
<tr>
<td>suboccipital craniectomy &amp; vascular decompression</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 1: Treatment modalities used prior to radiofrequency coagulation
Data regarding patients' previous response to medication(s) were also obtained (Table 2). Nearly all patients had been given carbamazepine (Tegretol), and most had tried phenytoin prior to RC. Patients were considered "intolerant" to medication if side effects were present at the lowest effective dose. Cases were classified as "intractable" if the pain persisted, even at near-toxic levels. Affected trigeminal divisions are listed in Table 3.

Preoperative diagnostic studies were performed on selected patients. This group consisted of older patients with atypical pain and young patients. Studies included computerized tomography head scanning in 50 cases and skull x-ray films, tomography, or selected angiography in 25 cases. Complications were documented during routine follow-up appointments and actively sought in recent interviews. Recurrences were liberally defined and included a temporary return to medication, the need for subsequent therapeutic procedures, or acknowledgment of infrequent sharp pains in the ipsilateral trigeminal division.

Coagulation Technique

Radiofrequency coagulation was always performed in the operating theater by the same surgeon (R.W.H.). In addition to local anesthesia, intravenous sodium methohexitol (Brevital) and fentanyl (Sublimaze) were given during each thermocoagulation and just prior to penetration of the foramen ovale. We attempted to minimize sensory loss when creating each lesion. Our approach to the foramen ovale and method of electrode placement is similar to that described by Sweet and Wespic, and has been reported previously.

Data Analysis

Survival analysis was used to evaluate the time intervals from initial RC to recurrent neuralgia. "Time to first recurrence," a measure of the efficacy of the procedure, was estimated by the product-limit method. A generalized Wilcoxon method tested equality of time-to-first-recurrence distributions. The proportional hazards regression model of Cox was used to examine the relationship between the patient's age and the effectiveness of the procedure. Response to medications, historical characteristics, and single-division versus multi-division neuralgia were examined by Fisher's exact test. Chi-square analysis evaluated classical and nonclassical trigeminal neuralgia in relation to duration of disease.

Results

Six procedures were aborted due to difficulty in electrode positioning or patient anxiety. These were rescheduled 1 day to 1 week later and were completed successfully; the rescheduled procedure was treated as the patient's first.

Complications are listed in Table 4. Masseter paresis was a significant finding in five patients. While pares-
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Fig. 2. Left: Time to first recurrence for the 96 patients in this series. Right: Time to second recurrence after the second radiofrequency coagulation in 30 patients.

Thesias and dysesthesias were present in a number of patients, these were not thought to be of consequence except in the two patients with anesthesia dolorosa. Reduced corneal sensation resulted in keratitis in all but three patients.

The cumulative proportion of patients who were free of recurrence at yearly intervals following RC is graphically presented in Fig. 2 left. Recurrent neuralgia occurred most frequently during the 1st postoperative month. Recurrences were infrequent during the 3rd, 4th, and 5th years following initial RC. Recurrences developed in 48 patients, of whom 30 underwent another thermocoagulation procedure (Table 5). Among those treated by a second RC, only 11 are known to have suffered a second recurrence. Fifty-five percent of these patients remained free of recurrence 3 years later (Fig. 2 right).

Patients were assigned to one of four groups on the basis of onset of symptoms: that is, 1 to 2 years, 3 to 5 years, 6 to 10 years, or more than 10 years prior to RC. No significant difference (p = 0.70) emerged between duration of disease and follow-up after RC as measured by recurrence-time distributions. Chi-square analysis ($\chi^2 = 1.12, DF = 3, p = 0.77$) did not demonstrate any relationship between duration of symptoms prior to RC and nonclassical or classical trigeminal neuralgia.

Response to medications failed to predict long-term results in patients treated by RC. Patients whose pain was intractable to carbamazepine fared no worse after thermocoagulation than those intolerant of the drug (p = 0.62). Likewise, there was no significant difference between RC efficacy and patients' response to phenytoin (p = 0.49).

A history of previous therapeutic procedures had negligible impact on clinical outcome. Patients previously treated by peripheral alcohol nerve blocks fared no differently after RC than patients without alcohol injections (p = 0.45). Patients who had undergone prior craniotomy and neurolysis had a higher recurrence rate than nonsurgical patients (Fig. 3 left). However, this difference was not statistically significant (p = 0.17). Also, there was no relationship between age and clinical outcome following RC (p = 0.78).

There were 38 patients with neuralgia confined to one trigeminal division and 58 with multi-division pain. No association was found between multi-division trigeminal neuralgia and nonclassical symptoms (p = 0.68). Results from RC-treated multi-division pain appeared to be superior to single-division tic (p = 0.02, Fig. 3 right).

Responses to phenytoin and carbamazepine showed no correlation with classical or nonclassical symptoms (p = 0.69 and p = 1.00, respectively). The RC results

<p>| TABLE 5 |
| Treatment for recurrence |</p>
<table>
<thead>
<tr>
<th>Treatment*</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>total no. of cases</td>
<td>48</td>
</tr>
<tr>
<td>neurovascular decompression via suboccipital craniectomy</td>
<td>8</td>
</tr>
<tr>
<td>radiofrequency coagulation</td>
<td>30†</td>
</tr>
<tr>
<td>carbamazepine and/or phenytoin</td>
<td>26</td>
</tr>
<tr>
<td>peripheral neurolysis</td>
<td>1</td>
</tr>
<tr>
<td>alcohol injection</td>
<td>1</td>
</tr>
</tbody>
</table>

*Some patients received more than one treatment. Peripheral neurolysis and alcohol injection were performed at another institution.
†Ten of the 30 patients were treated unsuccessfully by medication before the second radiofrequency coagulation.
patients with classical tic appeared superior to the results for patients with nonclassical trigeminal neuralgia ($p = 0.05$, Fig. 4 left).

Patients were assigned to one of three categories on the basis of sensory loss produced after initial RC. Patients in whom the lesion created analgesia or anesthesia in their symptomatic division(s), or hypalgiesia in combination with analgesia or anesthesia, were considered to have a substantial sensory deficit. Patients made only hypalgiesia in affected divisions were considered to have a moderate deficit. The patients with the substantial sensory deficit from RC were more likely to remain recurrence-free than those in whom a moderate deficit was created ($p = 0.006$, Fig. 4 right). A statistically significant difference was found between the group of patients with a substantial sensory loss and a third category of patients in whom no permanent sensory deficit was created in one or more symptomatic trigeminal divisions ($p = 0.006$). This latter group was also more likely to experience a recurrence than patients with a moderate sensory loss ($p = 0.02$). The cumulative proportion of patients free of recurrence 5 years after RC with substantial, moderate, or no permanent deficit is 74%, 46%, and 0%, respectively.

**Discussion**

Trigeminal neuralgia has been associated with other diseases. Five of our patients had multiple sclerosis and trigeminal neuralgia. This parallels the findings of another series in which multiple sclerosis occurred in 4% of patients. Bilateral trigeminal neuralgia has also been

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**Fig. 3.** Left: Time to first recurrence after temporal craniotomy and neurolysis in 19 of the 96 patients. Right: Time to first recurrence after treatment of pain in a single nerve division (38 patients) versus multiple divisions (58 patients).

**Fig. 4.** Left: Time to first recurrence in patients with "classical" (52 cases) versus "nonclassical" (44 cases) trigeminal neuralgia. Right: Time to first recurrence in patients with a "substantial" sensory deficit (29 cases) versus a "moderate" deficit (53 patients) or no permanent deficit (17 cases). See text for definition of terms.
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observed in multiple sclerosis.\textsuperscript{21} It is noteworthy that one of our patients developed facial pain on the previously asymptomatic side. Hereditary interstitial neuropathy has been linked to a small number of cases of trigeminal neuralgia,\textsuperscript{24} and our series includes two previously reported cases with this condition.\textsuperscript{7} Another patient with trigeminal neuralgia has been found to have biopsy-proven interstitial neuropathy confined to the trigeminal nerve.\textsuperscript{2}

Complications resulting from RC are not infrequent. Among the most common complications is corneal anesthesia, which has a reported incidence as high as 22\% and as low as 7\%.\textsuperscript{16,27} Recognition and treatment of corneal sensory loss will reduce the risk of subsequent neuropathic keratitis, a condition that has been reported in 0\% to 5\% of all patients\textsuperscript{1,5,10,15,16,20,22,23,25,27} and that occurred in three of our patients. Keratitis was hardly noticed by one of these patients due to other unrelated ophthalmological problems. A second case developed in an apparently noncompliant patient. The final case occurred in spite of careful liaison between patient, referring physician, and consulting ophthalmologist.

Anesthesia dolorosa, although an infrequent complication, causes a great deal of consternation among patients and physicians. Two patients developed this complication. Less troublesome dysesthesias affected 12 patients following initial RC. The reported incidence of this complication ranges from 1\% to 19\% of patients undergoing RC.\textsuperscript{1,5,10,15,16,20,23,25,27}

Motor-root injury is a frequent complication of RC: five patients in this series demonstrated significant postoperative masster weakness. Hearing deficits and a sensation of ear fullness have been reported following RC.\textsuperscript{13,16} Although we did not routinely perform audiometry, none of our patients mentioned a hearing difficulty after RC. Unintentional sensory loss created in asymptomatic trigeminal divisions has been reported in 15\% to 50\% of cases.\textsuperscript{9,15,16,23} In our study we unintentionally produced sensory loss, usually hypalgesia, in 42\% of patients after initial RC.

Rate of recurrence can be a reliable parameter when evaluating the success of RC. Unfortunately, the literature contains a variety of definitions of recurrence. These range from a strict definition which includes only patients returning for a subsequent RC, to less restrictive definitions encompassing all patients who undergo any further therapeutic procedure, or who have reported occasional use of medication or a transient return of vestigial symptoms. Varied rates of success may be explained by differing definitions of recurrence, demographic and etiological differences among patient populations, and variations in RC technique. Follow-up studies averaging 24 to 30 months have reported a 6\% to 46\% recurrence rate,\textsuperscript{1,7,15,20,21} and others with a follow-up period of 4 to 5 years\textsuperscript{14,22,23,25} indicate a 9\% to 53\% recurrence rate after RC. Studies with an average follow-up period of 7 to 8 years\textsuperscript{10,12,17} report a recurrence rate of 18\% to 22\%, whereas a longer-term study\textsuperscript{13} (12.7 years average follow-up period) found an 80\% rate of recurrence.

Most relapses occurred during the 1- to 2-year period after RC in the present series and other studies.\textsuperscript{12,16-18,20,22,26} We did not find that patients with recurrent neuralgia treated by a second RC were subject to a much greater risk of relapse after a 3-year follow-up period than all patients undergoing an initial RC.\textsuperscript{19}

Patient's age, duration of disease, and response to medication appear to have no bearing on results from RC. When patients' symptoms were compared in regard to recurrence distributions, patients with classical trigeminal neuralgia were found to have a lower relapse rate than those with nonclassical neuralgia. This finding is consistent with other reports.\textsuperscript{16,20,22} In this series, patients with multi-division neuralgia suffered fewer recurrences than those with single-division pain. This observation fails to receive support in the literature\textsuperscript{22} and does not achieve definite statistical significance but may warrant further examination.

We have presented statistical evidence confirming a tenet widely held in the literature; that is, greater sensory loss reduces the risk of relapse.\textsuperscript{13,14,16,23,28} In order to significantly minimize risk of recurrence, it seems important to create a permanent sensory deficit. Although an analgesic deficit insures a rate of recurrence that is lower than that seen with hypalgesia, the latter may be preferable to many patients. One must balance the degree of unpleasant sensory loss from RC and potential complications with the risk of recurrent neuralgia.

Postoperative dysesthesias and paresthesias tend to occur more frequently in patients with dense sensory deficits.\textsuperscript{14,16,21,26} This observation and the relative frequency of unintentionally produced sensory loss in asymptomatic trigeminal divisions favor hypalgesia rather than analgesia as a preferred end point during thermocoagulation.

We believe that either RC or microvascular decompression constitutes adequate and effective long-term surgical treatment for trigeminal neuralgia. In our practice, some patients elected to undergo microvascular decompression rather than risk a numb face and a higher relapse rate with RC. However, RC may be useful for any patient who is willing to accept permanent sensory loss. Radiofrequency Gasserian thermocoagulation may be offered to any patient unwilling to risk the possible morbidity and mortality associated with an open intracranial procedure, and is especially indicated for the older poor-risk patient.

Summary

We have reported the cases of 96 patients with trigeminal neuralgia treated by percutaneous RC. Of these, 52\% remained recurrence-free 5 years after a single procedure. Clinical outcome correlated with the degree of sensory deficit from RC. By 5 years, 25\% of those with a dense sensory loss and 55\% of patients with a partial deficit developed recurrent neuralgia. By con-
contrast, all patients without permanent sensory loss had experienced a recurrence by 5 years.

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References


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