TRIGEMINAL NEURALGIA

A REVIEW OF SIX HUNDRED AND EIGHTY-NINE CASES WITH A FOLLOW-UP STUDY ON SIXTY-FIVE PER CENT OF THE GROUP*

MAX M. PEET, M.D.,† AND RICHARD C. SCHNEIDER, M.D.

Section of Neurosurgery, Department of Surgery, University Hospital, Ann Arbor, Michigan

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Trigeminal neuralgia may be treated with gratifying results by rhizotomy or its symptoms may frequently be relieved temporarily by alcohol injection of the divisions of the Gasserian ganglion. Usually any surgical therapy directed toward the relief of pain is accomplished only at the expense of a minor degree of new neurologic deficit, and that is particularly true in this condition. Success depends not only on the technical ability of the surgeon, but also on an understanding referring physician and a properly enlightened patient. Preoperatively all should have a clear insight into the postoperative problems that may confront the patient, such as crawling or burning paresthesias, numbness, and the possibility of corneal anesthesia and its dangers. There are numerous articles in the trigeminal neuralgia literature written by competent observers but no complete follow-up reports on any large series of cases have been found. In most instances there is a tendency to recall vaguely the number of patients who have been relieved of their tic pain or remember a low mortality rate, but actual percentages of unpleasant postoperative sensations sustained by the patient are too frequently omitted.

The vast majority of patients with typical trigeminal neuralgia will accept these sensations and be extremely grateful for the relief of their sharp knife-like tic pain, provided they have been forewarned.

In this paper we wish to present the data on 689 cases of trigeminal neuralgia which were examined at the University Hospital during the 10-year period from January 1, 1938, to January 1, 1948: (I) 553 patients had a trigeminal rhizotomy; (II) 49 individuals had only alcohol injections; and (III) 87 were diagnosed as having trigeminal neuralgia, but no procedure, either rhizotomy or injection, was performed.

A follow-up questionnaire was sent to all of these patients, and we were gratified to have 65 per cent of them reply. We regard this as an excellent response for patients having a lesion that characteristically occurs most frequently in the older age groups.

In a statistical survey of this magnitude it is impractical to attempt to

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* This study was begun in January 1948, and was approximately half completed at the time of the death of the senior author in March 1949. Dr. Peet had reviewed the work and made several suggestions and corrections just preceding this date. The material was then laid aside for a period of two years at which time Dr. Edgar A. Kahn encouraged completion of the study.

† Deceased March 25, 1949.
compare the many figures of this study with data found in reviews of the topic by other neurological surgeons. For comparative analyses the reader is therefore referred to the comprehensive articles by Adson, Coleman, Meredith and Troland, Cushing, Davis and Naffziger, Frazier and Russell, Harris, Horrax and Poppen, and Kirschner.

Age. In our series of 689 cases, 74 per cent of the patients were over 50 years of age at the time of the initial examination; 34 per cent were over 65 years of age; and 10 per cent were over 75. In the group over 80 years, there was a total of 28 individuals. The youngest patient was 15 years and the oldest, 91. However, the 2 youngest, 15 and 19 years, respectively, were found at operation to have the fibers of the Gasserian ganglion matted together, suggesting an inflammatory process as the etiology for their pain. The youngest patient in whom the ganglion appeared normal was 21.

Sex Incidence. There was a 4:3 ratio of involvement in the female compared to the male.

Side of Involvement. The right side was involved more frequently than the left in a ratio of 8:5. At the time of the original examination 2.7 per cent of the patients had bilateral tic pain, but when the follow-up study was included, the incidence of bilateral involvement rose to 5.9 per cent. This figure is important in emphasizing that a patient may eventually require a bilateral rhizotomy, and therefore the motor root should be carefully identified and spared at each operation. Bilateral paralysis of the muscles of mastication supplied by the trigeminal nerve would cause the distressing problem of inability to close the mouth.

Duration of Symptoms. Slightly more than 17 per cent of the patients had had their tic pain for a period of over 10 years, 9.2 per cent had had their complaints for 15 years, and 4.7 per cent had had their difficulty for over 20 years. The lives of some of these patients were completely warped by their illness, for 8 had had the agonizing pain over a span of 30 years and a single patient had suffered for 40 years before coming to rhizotomy.

Division Involved.

<table>
<thead>
<tr>
<th>Division Involved</th>
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<tr>
<td>Ophthalmic involvement alone</td>
<td>24</td>
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<tr>
<td>Maxillary involvement alone</td>
<td>114</td>
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<tr>
<td>Mandibular involvement alone</td>
<td>109</td>
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<tr>
<td>Ophthalmic and maxillary combined</td>
<td>96</td>
</tr>
<tr>
<td>Maxillary and mandibular combined</td>
<td>257</td>
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<tr>
<td>All three divisions combined</td>
<td>88</td>
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<td>Ophthalmic and mandibular combined</td>
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On summary, the ophthalmic division was involved in a total of 30.1 per cent of all cases, the maxillary in 80.4 per cent, and the mandibular in 65.9 per cent. Thus differential section with sparing of the ophthalmic division could have been attempted in 70 per cent of all the cases.

Trigger Zone. From the available data, 218 patients, or 31.6 per cent, had one or more trigger zones. The commonest sites were: the upper lip—52, ala nasae—42, angle of the mouth—30, nasolabial fold—22, lower lip—21, malar eminence—18, lower jaw—14. Only 17, or 2.4 per cent, of all the patients, had a trigger zone limited to the ophthalmic division. In 2 cases
the lobe of the ear seemed to be the trigger mechanism. From our experience we would be inclined to feel that more people had a trigger point than has been recorded above.

I. TRIGEMINAL RHIZOTOMIES

Preoperative Problems. Preoperative problems, not related to trigeminal neuralgia, were present in many cases. In most instances these were related to the older age group in which trigeminal neuralgia is prone to occur. In a few cases aggravation of these conditions was the cause of death. By far the greatest number of complications was associated with heart and kidney disease. There were 182 patients, 26 per cent, who were known to have hypertension, and another 41 patients were listed as having organic heart disease. Arteriosclerosis was sufficiently severe in 34 cases to make special note of it. Preoperatively hemiplegia was present in 6 individuals.

Inflammatory lesions such as syphilis were noted in 13 patients, multiple sclerosis in 8, and tuberculosis in 4. Diabetes presented a problem in 6 individuals. Deafness was present in 15 cases, blindness in 3, facial tic in 2, a 3rd nerve palsy in 1 and a 6th nerve lesion in another. In the latter two instances one would have suspected the presence of an aneurysm or tumor but none was demonstrated at operation through the lateral approach.

There were 24 patients who complained preoperatively of considerable loss in weight from inability to eat because of severe tic pain. This loss varied from 15 pounds within 2 or 3 weeks to 60 pounds over a period of 1\(\frac{1}{2}\) years. One patient, 84 years of age, lost 30 pounds so that her preoperative weight was only 78 pounds. Another patient stated that she had been on a liquid diet for 9 months and was unable to eat even semisolid foods. Starvation is an important problem which should be dealt with preoperatively if some of the older aged patients are to have a satisfactory postoperative course. Some neurological surgeons believe that one of the benefits of alcohol injections is transient relief of pain enabling the patient to eat and permitting development of a better physiologic balance preoperatively.

Operations. Fourteen surgeons performed the 553 trigeminal rhizotomies. The senior author operated upon 53.5 per cent of the patients. The remainder were treated surgically by other members of the permanent and resident staffs.

Preoperatively the patients were well sedated with morphine and scopolamine. All operations by the temporal approach were performed in the upright or sitting position, but the few suboccipital craniotomies were done in the prone position. Local metycaine or procaine infiltration anesthesia was used in 534 cases or 96.5 per cent. In only 1 instance was 1\(\frac{1}{2}\) per cent cocaine employed. Eighteen patients had general anesthesia. Frazier's temporal approach was used in 544 cases, and in only 9 cases was Dandy's posterior fossa operation employed. In 7 of the latter procedures both the 5th and 9th nerves were sectioned. In only 2 instances was this approach used for trigeminal rhizotomy alone.

Immediate Complications. One of the most interesting aspects of this
study was an evaluation of the problems encountered at the operating table. Since the upright or sitting position was employed almost exclusively, vasopressor agents had to be used or antigravity measures occasionally had to be taken to combat a drop in blood pressure. In 25 cases there was a sudden pronounced hypotension with pressures reaching shock levels or being unobtainable so that cerebrovascular accidents occurred in 7 patients. One of these individuals had had a moderate hypertension preoperatively and died on the table. It should be noted that during the past few years since this study local infiltration anesthesia has been supplemented with intravenous sodium pentothal, and not as much hypotension has been observed. In this way pain and fear stimuli are abolished and there is less tendency for shock to occur. These are important factors in an emotionally labile individual.

The development of hypertension during operation was a problem in 4 patients, and 1 of these had a cerebrovascular accident. In another of this group the elevation of blood pressure occurred when the suboccipital approach was used and the 9th nerve sectioned.

The next most common problem was a tendency of the sensory root to be matted together so that the divisions could not be readily dissected out and identified. This occurred in 23 patients. Three ganglia were described as being unduly large, two or three times normal size. Another ganglion was yellow in color and the operator suggested the possibility of hemosiderosis from a leaking aneurysm or multiple sclerosis, but there was no clinical evidence to substantiate either diagnosis. In 1 case the Gasserian ganglion was never identified.

The dura was markedly adherent in 11 cases, and in 1 of these cases firmly calcified plaques, which were imbedded in the dura, hindered the operator’s progress. Heterotopic protrusions of the dura extending through the skull markedly hampered the exposure in another case.

Bleeding was troublesome in 7 patients. In 1 the diploë were extremely large and bled profusely. In 2 the cavernous sinus was a problem due to the marked adherence of the roots to its lateral wall; upon attempting to free them the sinus was entered, with marked hemorrhage resulting. In 1 patient there was profuse bleeding from an aberrant vessel at the hiatus fallopii. Transfusion in these cases was rarely necessary. In 1 case the carotid artery was opened through a dehiscence in the bone of the middle fossa. The patient recovered with transfusion.

The temporal lobe was lacerated by pressure of the retractor in 1 instance, and in another case it became necrotic due to cortical thromboses.

Tumor was encountered in 4 cases. In 1 there were carcinomatous nodules just posterior to the foramen rotundum, and in 1 a meningioma was found on the petrous ridge dipping into both posterior and middle fossae. It was necessary to close the incision in the temporal region and resort to a suboccipital approach. In the third case a carcinoma of the nasopharynx was found which had infiltrated upward and posteriorly into the Gasserian
ganglion. The fourth tumor observed was dark blue and pulsating, and was regarded as a true aneurysm.

There were a number of interesting anomalies which were somewhat disconcerting to the surgeons because of the alteration of customary landmarks in the middle fossa. In 2 patients the facial nerve was visualized. In 1 it lay free just anterior to the petrous ridge, and upon stimulation there were contractions of the orbicularis oris and oculi. In the other the facial nerve was seen to protrude from the dura medially and proceed forward and outward through the foramen spinosum. Fortunately, in both cases the nerve was preserved. In 1 case the 6th nerve was identified in an aberrant position and fortunately was spared.

Occasionally the bony structure at the base of the skull was abnormal. One patient had a large opening from the middle fossa into the middle ear. In another there was an anomaly of the petrous ridge with an atypical venous sinus replacing the middle meningeal artery. In 1 case a bony ridge separated the fibers of the 2nd division into two bundles and in another a bony spicule was noted extending forward from the petrous ridge splitting the motor root.

There was bony dehiscence at the base of the skull with exposure of the carotid artery in 3 cases, and in 1 of them the artery was opened.

**Postoperative Problems.** In 86 per cent of the 411 uncomplicated cases the patients were discharged within 1 week, most of them going home on the 6th postoperative day. Two of these patients left the hospital as early as the 2nd day.

There were significant postoperative problems in 142 cases. These ranged from continued pain requiring reoperation, abnormally severe herpes, minimal or major eye problems, and facial nerve palsies to cerebrovascular accidents and death.

Only 3 of the 553 patients had to be reoperated upon immediately after the initial procedure in order to accomplish a more extensive sectioning of the root fibers because the original differential section had not been sufficiently complete.

A moderate to severe degree of keratitis was observed in 84 patients (15.1 per cent of those operated upon), but in 41 this presented no problem in treatment. Forty-three of the keratitis patients (7.9 per cent of those operated upon) required a tarsorrhaphy. Of the 84 patients with keratitis the 1st division of the 5th nerve had been sectioned or damaged in all but 8. Therefore in only 9.5 per cent of the individuals with keratitis had the 1st division been preserved. Six patients of this latter group required tarsorrhaphy. These figures indicate the importance of preserving the 1st division whenever possible in order to prevent this unfortunate complication. There was one tragic case in which the keratitis was neglected, and the patient subsequently came to enucleation of the eye.

Inadequate records were kept on the postoperative testing of the motor root so that a fair evaluation of this problem is not possible. However,
we have been fortunate enough to have had no cases of bilateral impairment of the motor root function postoperatively in patients who have had rhizotomies for bilateral tic pain.*

In 16 patients, 2.8 per cent, there was an immediate complete facial palsy. In 21 cases, 3.7 per cent, a delayed facial palsy occurred; 18 of the latter appeared within the first 4 days postoperatively while the other 3 occurred as late as 10, 11, and 14 days after operation.

Two patients had a complete 6th nerve palsy postoperatively.

Minor postoperative problems may be recorded. Ten patients were transiently disoriented and another patient continued to suffer from an organic brain syndrome. In 4 cases there were wound infections and in 2 others there was moderate wound separation. Cardiac failure occurred in 2, pulmonary tuberculosis flared up in 1, parotid abscess was present in 1, hysteria in 1 and urinary infection was a problem in 4.

Deaths. The operative mortality rate was 1.6 per cent, with 9 deaths, which we do not regard as too high when one considers the age group involved, the numerous preoperative complications and the number of surgeons. One hypertensive patient, 56 years of age, succumbed on the operating table, and another, 84 years old, with marked cerebral arteriosclerosis, died 45 days postoperatively. Both had suffered cerebrovascular accidents. The remaining 7 patients died within 3 days of operation. Preoperatively 5 had hypertension (1 had syphilis in addition), and their blood pressures fell precipitously during the procedure with subsequent cerebral thrombosis. Another of these 7, aged 77, suffered a laceration of the temporal lobe, followed by intraventricular hemorrhage and death. The most tragic death was that of a 36-year-old woman in whom a softening of the temporal lobe developed, probably from too marked retraction of the lobe by the assistant during the operative procedure. She died 3 days postoperatively.

With the exception of this patient the others who had succumbed were over 50 years of age and had been troubled with cardiac, cerebral, or luetic disease preoperatively. It is believed that at present we are decreasing our mortality rate by using intravenous sodium pentothal as an adjunct to local anesthesia, thereby abolishing the shocking pain stimulus which tends to cause hypotension. The application of bladder tourniquets to the extremities or an antigravity suit might also prevent sudden drops in pressure since all of these patients were operated upon in the upright position. This would be more satisfactory than the use of vasoconstrictors where there is danger of a hyperresponse to the medication. The latter group of drugs should be reserved for acute precipitous hypotensive episodes.

Follow-up on Rhizotomies.

Since many of our patients were elderly and lived at great distances, the follow-up study had to be carried out by means of questionnaire. This

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* Dr. Peet’s closest associates do not recall ever seeing him divide a motor root where the ganglion was not infiltrated by tumor.—R.C.S.
attack upon the problem is not an ideal one, but by careful selection of questions, we believe that we learned a number of interesting things.

Of the 689 patients who had been examined in this 10-year-period for their trigeminal neuralgia, replies were received concerning 447, or 65 per cent. Of the 553 patients who had had trigeminal rhizotomies, 338 answered their questionnaires and another 44 had died but were reported upon by their relatives, a response of 69 per cent.

*Time Elapsed since Operation.* Of the 553 patients, 160 reported within the first 4 years after operation; there were 25 additional patients who had succumbed, but about whom we had information postoperatively. Replies were received from 145 individuals who had been operated upon 5 to 10 years before; 13 others in the group died, but were reported upon. Thirty-two were in their 11th postoperative year; 7 other patients falling in this category had died but reports had been returned concerning their postoperative condition.

*Age.* There were 111 patients who were alive and over 60 years of age. Sixty individuals were over 75 years, 6 were over 85 years, and one man was over 90 years of age. Those who were over 85 years old had been operated upon 2, 3, 4, 5, and 7 years prior to the questionnaire. The patient over 90 years of age reported 5 years postoperatively. These figures tend to indicate that relief of symptoms by operations is justified and worthwhile even in the late seventies or eighties.

*Relief of Pain.* Complete relief of all types of discomfort, including the unpleasantness of any type of paresthesia, was accomplished in 111, or 29 per cent of the 382 patients who had had rhizotomy and replied to the questionnaire.

*Paresthesias.* Crawling and drawing sensations were complained of by 213 patients, or 55.7 per cent of the 382 operated upon. There were 116, or 30.4 per cent, who had burning pain. It is interesting to observe that only 16 individuals, 4.1 per cent, complained of numbness in their face, but this was regarded by them as minimal compared to the tic pains. This figure suggests that the importance of preoperative injection with alcohol to determine whether the patient will complain of numbness postoperatively has been overemphasized, but it does permit the evaluation of possible future paresthesias.

*Recurrence of Pain.* Fifty-four of the 382 patients who replied stated that they had had recurrence of their tic pain. Since differential section was frequently performed, in 33 of these instances the discomfort appeared to be in the distribution of the fibers that were regarded as intact at operation, and pain probably occurred in these residual fibers.

It would appear that in 21 instances, or in 5.4 per cent of the cases, there was recurrence of the pain from which the patient had suffered preoperatively. There are probably several reasons why this figure is so high. Since the questionnaire there has been an opportunity to re-evaluate a few of these people very carefully, and it has been discovered that they had
misinterpreted paresthesias as tic pains. In a few instances there may have been erroneous diagnoses of trigeminal neuralgia which should have been called atypical facial pain.

Facial Palsy. In 37 patients, 6.5 per cent, some degree of facial palsy developed. In 16 of these patients the palsy was immediate and complete, but in the remaining 21 the paralysis was delayed, and 6 of the latter group showed only a paresis.

Upon follow-up, 8, or 50 per cent, of the patients with immediate complete facial palsy had fully recovered and 1 had improved markedly. The remaining 7 in this group did not respond to questionnaire, and it was discovered later that 2 had died.

Fourteen patients, 66 per cent, with delayed facial palsies had recovered completely, and 1 had improved. There were 6 others in this category upon whom we are unable to report because 3 had succumbed and 3 others did not answer.

These findings indicate that an immediate complete facial palsy postoperatively does not necessarily imply that the disability will be a permanent one. In no instance were we informed that a complete facial palsy remained, but perhaps the persistence of this complication was the reason that the remaining 8 of the group of 37 had left their questionnaires unanswered.

II. ALCOHOL INJECTIONS

The various aspects of alcohol injection should be considered separately. In general the policy of this clinic was one of recommending operation rather than alcohol injection feeling that the former procedure correctly performed caused no greater discomfort than injection and that permanent rather than temporary relief was advisable. The patients have been divided into two categories: Group A—those who had injections only; and Group B—those who had been injected previously but later were operated upon at the University Hospital.

Group A. (Injection Only)

Forty-nine patients were injected at the time of their initial examination at University Hospital, and were not operated upon. These injections were carried out by 6 neurosurgeons, but 50 per cent of them were performed by one man. A total of 72 injections was made. If the first one gave only transient or no relief, further injections were frequently performed so that some patients had multiple ones.

Complications. Diplopia developed in 1 patient when the ganglion was accidently injected. There were no corneal complications or deaths.

Immediate Results. In 7, 14.2 per cent of the 49 patients, there was complete failure to relieve the pain. The remaining 42 had at least temporary relief.
Follow-Up

Twenty-seven patients, 55 per cent, responded to the questionnaire.

Duration of Relief. Six had relief of pain for less than 1 week; 7 more had recurrence of pain in less than 2 months. Thus including the 7 initial failures, 20, or 74 per cent, of those upon whom we have data, had relief for less than 2 months. However, 6 patients were relieved for 1 or 2 years, 5 for 3 to 5 years, and 1 for over 9 years.

Recurrence of Tic Pain. Actually in 25 of the 27 injected patients who replied to the follow-up letter there was return of sharp tic pain, but in 2 of these cases the discomfort was in the distribution of fibers that had not been previously injected. Therefore, 23 patients, 85 per cent of this group, had recurrence of their tic pain by the time they had answered their questionnaire.

Paresthesias. As a result of alcohol injection alone, 13 individuals, 48 per cent of those who responded, had crawling sensations; 9, 33 per cent, had burning discomfort; and only 1, 3.7 per cent, complained of numbness of the face. This is a small series but is comparable on a percentage basis with rhizotomies.

Group B. (Injection Preoperatively)

Of the 553 patients who had rhizotomies 199, 34.3 per cent, had a total of 355 injections preoperatively. Forty-five had had 2 injections, and 47 others had been injected 3 or more times.

Neurosurgeons at University Hospital injected 51 of these patients; qualified neurosurgeons in other institutions performed 20 injections; dentists carried out the procedure on 18 individuals, and the remaining 266 injections were made by the patients' physicians.

Follow-up

Complications. Two patients had residual burning pain in the tongue after the first injection, and this persisted after rhizotomy. Another patient (injected elsewhere) had a slough and excoriation of the face with cartilaginous destruction after the procedure, and a third had a transient facial paralysis.

Duration of Relief. All of the patients in Group B had recurrence of their tic pain causing them to resort to rhizotomy. Fifty patients had only very transient relief of pain after the injections. Twenty-one were pain-free from 1 to 4 weeks, 59 for less than 6 months, 17 from 1 to 2 years, and 9 for 3 or more years before recurrence caused them to seek operation. In the remaining 43 cases the duration of relief was not listed.

In 21 cases in which multiple injections had been given, the period of relief tended to be shorter after each successive procedure, but in 9 cases there was a progressively longer period of relief after each injection.

In 3 instances even though the patients had hypesthesia following
injection and total rhizotomy the tic pain persisted. One wonders whether the correct diagnosis had been made in these cases.

Comment on Injection versus Operation. In Groups A and B, a total of 248 patients had 427 injections. Twenty-three of the patients had relief for 1 to 2 years, 14 for 3 or more years, and the longest period of freedom from pain was 9 years for 1 person. Therefore, only 15.2 per cent of the patients who had injections were asymptomatic for a period of over 1 year.

III. UNTREATED PATIENTS

Follow-up

Of the 87 patients who were merely diagnosed as having trigeminal neuralgia, but who were untreated, 36, 41.3 per cent, answered the questionnaire.

Relief of Pain. Four patients had had complete spontaneous remission of their tic pain for 2, 2\(\frac{1}{2}\), 3 and 6 years, respectively after their initial visit.

Recurrence of Pain. Twenty patients, 55 per cent, had recurrence of their severe tic pain.

Rhizotomy. Three of the patients who had further tic pain were operated upon elsewhere with complete relief of all discomfort, although 1 had a partial residual facial palsy postoperatively.

Alcohol Injection. Nine patients had received alcohol injections elsewhere, and there was complete relief of all discomfort in 5 patients for periods of 1 to 3 years. In 3 others there was a 2-week, 6-month, and 8-month interval before recurrence of tic pain. In 1 case the patient suffered from diplopia for 6 months although he subsequently was completely relieved by rhizotomy.

Paresthesias. Burning and crawling paresthesias were troublesome to 5 of the 9 injected patients.

CONCLUSIONS

Trigeminal rhizotomy is a much more satisfactory procedure than alcohol injection in the average case of trigeminal neuralgia, for there has been complete relief of tic pain in all but 5.4 per cent of the patients operated upon. Alcohol injection, on the other hand, in our series relieved only 15.2 per cent of the patients with trigeminal neuralgia for a period of longer than 1 year.

The incidence of complaints of crawling paresthesias (56 per cent), of burning paresthesias (36 per cent), and of numbness (4 per cent) among the postoperative rhizotomy patients is much higher than frequently cited, and probably approximates the percentages of these symptoms after alcohol injection. The great majority of the patients are so overjoyed to have relief of their severe tic pain that they frequently do not voice complaints about these discomforts unless directly questioned about the symptoms.

It is our feeling that the tic douloureux patient is one of the most grateful in the entire field of medicine, provided he has been forewarned about the
unpleasant postoperative symptoms which may be expected in a fairly high percentage of cases.

It should also be reassuring to the referring physician that in only 6.5 per cent of the cases in which operation has been performed has facial palsy occurred, and in no known instance in this series has it been permanent. The operative mortality rate in our entire series has been 1.6 per cent, which is reasonable in a group in which 34 per cent of the patients are over 65 years of age and 10 per cent are over 75, when one considers that the procedures were carried out by 14 surgeons.

SUMMARY

The data on 689 cases of trigeminal neuralgia which were examined over a 10-year period are presented. The series includes 553 patients who had trigeminal rhizotomies, 49 individuals who had received only alcohol injections, and 87 others in whom the diagnosis was made but who remained untreated.

The data include: age, sex incidence, side of involvement, duration of symptoms, division involved, trigger zones, preoperative complications, operations, immediate complications, postoperative problems, and deaths.

Follow-up was accomplished by questionnaire with a 69 per cent response from the patients who had had trigeminal rhizotomy, a 55 per cent return from those who had had alcohol injections only, and a 41 per cent response from the patients who had been untreated, the diagnosis merely having been established. The replies included information on: the relief or recurrence of tic pain, crawling and burning paresthesias, numbness, the status of any postoperative complications, and any further therapy.

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