Percutaneous microcompression of the trigeminal ganglion for trigeminal neuralgia

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Fifty patients were treated for trigeminal neuralgia by percutaneous microcompression of the trigeminal ganglion. A No. 4 Fogarty balloon catheter was inserted under brief general anesthesia, using biplane fluoroscopy. This procedure is essentially a percutaneous simplification of the older Taarnhøj-Sheldon-Pudenz operation. The follow-up period ranged from 0.5 to 4.5 years. Pain recurred in 12% of cases during that time, and it is anticipated that within 5 years the recurrence rate will reach 20%, which is approximately the same rate as for the alternative established procedures. The advantages of this technique are freedom from discomfort on the part of the patient, a remarkable ease of performance on the part of the operator, absence of associated mortality, and a minimal morbidity rate.

KEY WORDS • trigeminal nerve • trigeminal neuralgia • tic douloureux • Gasserian ganglion • nerve compression

For many years alcohol injection and partial retrogasserian section remained the standard methods of treatment of trigeminal neuralgia. Although they relieved the lancinating pain, they were unsatisfactory in that they produced a deep anesthesia in all instances, an uncomfortable paresthesia in some, and a distressing analgesia dolorosa in a few. These complications, together with an incidence of keratitis in those who had denervation of the first division, led to an ongoing search for a better method.

Historical Review

In 1937, Lee suggested that trigeminal neuralgia might be caused by compression of the nerve root in the posterior fossa. Taarnhøj decompressed the ganglion and its root by dividing the dura and the overlying superior petrosal sinus. His early successful results were reported in 1952. Shelden, et al., acting independently, decompressed the nerve more distally at the foramen ovale and foramen rotundum. This was also successful. Recognizing that his results and those of Taarnhøj were similar, in that both relieved pain without producing a sensory loss, Shelden concluded that some compression of the ganglion was probably the common denominator of the two procedures. He then went ahead and compressed the ganglion, achieving the anticipated relief. The problem from the onset with the compression and decompression methods was the incidence of recurrence. Deliberate compression was more long-lasting than the decompression, and it was possible that those patients who experienced a slight temporary numbness had a better prognosis than those who had no numbness.

In 1954, Love and Sven reported on their experience using a modified Taarnhøj procedure in 100 cases: of 30 patients followed for 12 to 22 months there was a recurrence in 19, and the authors stated that some sensory loss did not preclude recurrence. In 1959, the same authors reported again on this series of 100 patients after a further 4 years of observation. Ninety-one patients were available for study: 69 patients had a recurrence of pain, and in 55 pain had recurred before 18 months after decompression surgery. Among the 65 in whom there was no sensory loss, 55 had recurrence of pain. In 15 with subjective sensory loss there were 10 recurrences, but in 11 with objective loss there were only four. The authors concluded that some degree of trauma was essential for worthwhile results. At about the same time, Gardner and Miklos reported on 200 patients with decompressive surgery who were followed for 3 to 6 years; 62% had lasting relief. They did not find any difference in rate of recurrence between those who did or did not have sensory loss.

Stender and Grumme reviewing almost 1000 cases in the literature in 1969, found a recurrence rate of about 30%. This was highest (12% to 75%) in those operations based upon decompression and lowest (8%...
dominated treatment in the 1970's. However, it has become evident that the RF method is not free from coagulation technique promulgated by Sweet and Wepsic. Our procedure was first carried out in mid-1978, and is extended beyond the foramen into Meckel's cave, a technique using a percutaneous needle which did not seem to offer an appropriately safe compressing tool. For this technique, we use general anesthesia in order to make it a totally pain-free experience for the patient. Intubation is essential so that the airway is maintained during the extreme retroflexion of the neck that is necessary for prolonged relief, that this method may be manifest within 5 years but mostly within 18 months, and that it would possibly be lower in those who had some objective initial numbness than in those who had no numbness. The significant variations in reported technique and follow-up period do not permit a more rigid estimate. Since the nerve was not divided, by definition there was, in the total experience, no case of analgesia and therefore no analgesia dolorosa. More significantly, there was no reported case of intractable dysesthesia and no keratitis.

Despite a complete elimination of the distressing consequences of nerve damage and nerve interruption, disappointment with the recurrence rate paved the way for the favorable reception of the radiofrequency (RF) coagulation technique promulgated by Sweet and Wepsic and for the posterior fossa microdecompression procedure advocated by Jannetta, both of which dominated treatment in the 1970's. However, it has become evident that the RF method is not free from problems. In particular, it is clear that analgesia is necessary for prolonged relief, that this method may create analgesia dolorosa or hypalgesia dolorosa, and that extracocular nerve damage, keratitis, and carotid puncture are more remote but real dangers. Posterior fossa microdecompression does carry a mortality rate (despite Dandy's record of no deaths among 150 cases) and a recurrence rate which is not clear from published reports but which probably approximates 20% over a 5-year period.

It therefore seemed appropriate to look again at Taarnhøj's and Shielden's admirably simple concepts, to try to refine the simplicity of their techniques, and, if possible, to lower the recurrence rate. We believed that a technique using a percutaneous needle which did not penetrate beyond the foramen ovale would be free from morbidity and mortality. A Fogarty-type balloon which extended beyond the foramen into Meckel's cave seemed to offer an appropriately safe compressing tool. Our procedure was first carried out in mid-1978, and is described here.

Operative Technique

For this technique, we use general anesthesia in order to make it a totally pain-free experience for the patient. Biplane fluoroscopy speeds the procedure, although biplane conventional radiographs are adequate. Not all fluoroscopic machines are capable of defining the foramen ovale in all patients and, if fluoroscopy fails, one falls back upon the use of conventional radiographs. This procedure is carried out in the radiographic suite or in the operating room. For anesthetic convenience we prefer the latter. Initially, the patient was positioned supine with the head hanging down, but we have now come to prefer the semi-sitting position, with the head retroflexed, so that the submental vertical x-ray beam, which views the foramen ovale, is exactly horizontal.

The instruments consist of a large needle, a No. 4 Fogarty catheter, a stopcock, a tuberculin syringe, and some contrast material. A standard liver-biopsy needle is suitable and is readily available in most operating rooms. The contrast material generally used is 50% Conray, diluted to reduce its viscosity for easier balloon filling and emptying. The indicated balloon capacity is 0.75 ml, but it readily expands to 1.0 ml without bursting in a normal Meckel's cave; however, if kinked or inserted into a scarred cave it may burst at any capacity. Such bursting has produced no recognizable complication.

Before the catheter is used, its air space should be replaced by contrast material. The catheter should be advanced until it reaches the needle tip before the needle is inserted. A marker is then placed on the catheter flush with the proximal end of the needle and another placed 1 cm proximal to it so that when it is in situ the operator will know when the catheter has advanced 1 cm distal to the needle tip.

The point of the needle's entry into the skin is approximately 1 cm external to and slightly above the lateral angle of the mouth, but it varies with facial contour. (In a very fat face this large needle leaves an opening that "pouts" and produces a recognizable puncture mark for a few weeks. For such patients, it is possible to evert the angle of the mouth and have the needle enter the cheek from within the mucosa of the mouth.) The needle is then guided under fluoroscopic control until it engages in the foramen ovale. It is unnecessary to penetrate beyond the foramen. The needle simply remains in the foramen (Fig. 1). The catheter is then gripped and advanced against some resistance to a depth of 1 cm. It should then be in Meckel's cave. Slight distension under fluoroscopy will confirm its position. Further advance of the deflated catheter through the entrance of Meckel's cave into the posterior fossa can take place without any sense of resistance and must be guarded against. The balloon is slowly inflated under fluoroscopic control to an arbitrary degree and held in that position for an arbitrary time. The cave varies in size, and it is our current opinion that the balloon should be distended until it begins to assume a pear-shape, indicating that it is beginning to protrude out of the cave toward the posterior fossa. This signifies that a good squeeze has been achieved. This usually requires about 0.7 ml of injected contrast material, with a range of 0.5 to 1.0 ml (Fig. 1).
Percutaneous compression of trigeminal ganglion

The duration of compression has varied from 3 to 10 minutes, but most commonly it is applied for 5 to 7 minutes. A single 30-second compression in one patient with multiple sclerosis was ineffective. (We are now investigating the 1- and 2-minute compressions in an attempt to eliminate any incidence of dysesthesia.)

A radiograph is taken for the record and, when the planned compression has been achieved, the balloon is decompressed. Then the balloon and needle are withdrawn. Firm digital pressure is placed upon the skin of the cheek and maintained for 5 minutes to prevent hematoma. The same type pressure is applied if intermittent bleeding occurs during insertion. If active bleeding occurs it is desirable to compress above the zygoma as well as below the maxilla, as hematoma sometimes accumulates in the subtemporal compartment. This is very rare.

It is of some interest that at the moment of engagement of the needle in the foramen and again on distending the balloon there is usually a significant bradycardia of short duration. In patients with heart disorders it might be advisable to guard against this by administration of atropine. In others, it is a useful physiological confirmation of penetration and distension. Once the nerve has been compressed, bradycardia will not appear on repeat compression. This response might be of value in determining when adequate compression has been achieved, but we have not investigated this possibility. After satisfactory compression there is not infrequently some reddening of the ipsilateral conjunctiva as though a temporary sympathetic nerve relaxation had occurred.

Summary of Cases

Patient Population

Since 1978, 50 patients have undergone this procedure. The patients ranged in age from 16 to 88 years; 28 were female and 22 were male. All had typical trigeminal neuralgia, and two had multiple sclerosis. Pain was bilateral in four, but the second side was symptomatic during the period of study in only one. In two further patients (one previously alcoholic, and one with Paget's disease) penetration of the foramen ovale was not accomplished. In three patients the initial compression was not successful, but was repeated successfully a few days later. In one patient with multiple sclerosis who had bilateral pain, a second compression was not successful, and this patient had a posterior fossa partial section. These were both very gentle compressions, the standard procedure having produced excessive numbness (as well as complete relief from pain) on the initially symptomatic side.

Previous Treatment

Twenty-four patients had undergone previous (sometimes multiple) treatments. Sixteen had alcohol injections of the ganglion (a few more than once for the same side). Two had RF coagulation, and one had middle fossa section of the opposite side with lasting relief. One patient underwent middle fossa compression. Five patients had posterior fossa decompression, one twice for the same side. Another patient had a compressing cholesteatoma removed without relief.
Two patients had mandibular nerve resection or avulsion. In several cases there was a combination of previous methods. In 26 there was no previous treatment.

Operative Results

Postoperatively, the patient awakens quickly from the short and light anesthetic. There is, for a few days, some cheek discomfort from the needle track since the nerve has not been anesthetized, as with alcohol injection or the RF current. There is a subjective ipsilateral numbness. The ipsilateral masseter muscle is paralyzed. There may or may not be an objective hypesthesia or hypalgesia, depending upon the degree of compression and the presence or absence of previous operation, whether alcohol injection, RF coagulation, or operative section. A healthy young patient aged 40 to 50 years may leave the hospital on the same day; an aged and feeble one may remain 2 to 5 days. When the average patient is next seen, 3 or 4 weeks postoperatively, any objective sensory loss that was present immediately after compression is absent or much diminished. Subjective loss is usually still present but diminished. Motor weakness persists. When the patient is seen next, 4 to 6 months later, there is full recovery of motor and objective sensory function in almost all instances. Minimal subjective sensory difference may persist in a few cases. Patients who live at a distance were not seen after the first few weeks, but communication has been maintained with all. There has been no loss to follow-up review except in one patient who resides abroad. One patient died 1 year later of cardiac disease and one died 4 months later of multiple sclerosis; one elderly patient died 34 months later of undisclosed natural causes. The follow-up period ranged from 6 months to 4½ years.

Recurrence of Pain

Initial relief was obtained in all except one patient. Recurrence has taken place in six who were the second, fifth, sixth, 10th, 19th, and 26th patients in the series at the 6th, 2nd, 31st, 23rd, 6th, and 31st postoperative month, respectively. A repeat compression was performed in three patients, with persisting relief to date. One had a partial posterior fossa section with relief of pain. One was given relief by posterior fossa decompression only, and in one pain was controlled by a small amount of Tegretol (carbamazepine).

Dysesthesia

Significant dysesthesia was experienced both before and after compression by two patients who had previously had multiple alcohol injections and by one who had had previous alcohol injections and RF rhizotomy. It was experienced by three patients who had no previous treatment. They were the 37th, 45th, and 48th patients in the series. In one of these, a fourth-nerve palsy developed 2 days after compression. Since this had not previously been noted, an arteriogram was performed revealing a small dural arteriovenous malformation (AVM) draining into the cavernous sinus. There was no objective or subjective bruit. After about 3 months, the fourth-nerve palsy disappeared but dysesthesia persists. The role of the dural AVM is uncertain. We have previously seen a patient with a somewhat more extensive AVM fed by an artery that penetrated the foramen ovale; in this patient, the trigeminal-like pain disappeared after obliteration of the fistula. In these three dysesthetic patients, the unpleasant sensation covered the entire face. It was not as distressing as the analgesia dolorosa that was seen in the past following subtotal root section, but for all three it was a significant problem. In five patients there was some minor degree of awareness of a numbness of sensation which was not distressing.

Density of Hypesthesia

A more dense hypesthesia than anticipated, almost amounting to an analgesia, occurred in four patients. Two had previously had multiple alcohol injections (and also had severe dysesthesia), one had lupus erythematosus, and one had multiple sclerosis. In both of the latter patients a good recovery took place within a year.

Technical Difficulty

We experienced some technical difficulty with four patients who had previously had alcohol injections. In one, we could not penetrate the foramen ovale. In another, the balloon distended too proximally and 6 months later we had to repeat the procedure, this time using slightly more force to advance the catheter. In two, as the balloon distended it migrated into the posterior fossa (Fig. 2). There were no posterior fossa complications, but both had a significantly increased hypesthesia (Fig. 2). One other technical problem occurred in failure to penetrate the foramen ovale in a patient with Paget's disease.

Discussion

As anticipated in design, the current experience and follow-up findings show that the percutaneous microcompression procedure involves little discomfort and only a brief hospitalization for the patient; it is not associated with mortality and has, up to the present, a relatively low incidence of recurrence (12%). This might be expected to rise to 20% over a total 5-year follow-up period, and therefore rank with the other procedures currently in use.

From the surgical point of view, this is a technically simple operation in that one placement (rather than selective divisional placements) relieves pain in any or all of the three divisions. Despite compressing the ophthalmic division in all patients, there has been no ocular dysfunction.

The problem is the incidence of dysesthesia. This was
not a subject of major comment in the reported series of Taarnhøj's technique and its modifications. One explanation might be that in an era when alcohol dysesthesia and root section dysesthesia were so prevalent, a small incidence was ignored. Before we got to our 36th case we had thought that the problem did not exist. However, by that time we had encountered early recurrences and, in an effort to lower that figure, had begun to inflate the balloon to 0.75 to 0.8 ml and keep it inflated for 7 minutes. It is therefore probably true to state that a light compression will eliminate dysesthesias, but will result in recurrences, whereas a firm compression will eliminate recurrences but give rise to dysesthesias. Our present choice would be to inflate the balloon only to the earliest appearance, rather than to the fully developed appearance, of the "pear" and to keep it inflated for only 1 or 2 minutes.

The first author has had considerable experience with treating patients with ganglionic injection of alcohol, phenol (5%), hot water, cold water, and the application of beta isotope necrosis, DC current, and RF current. He believes that the method described here is superior to any of the above techniques because of the patient's comfort and freedom from problems and because of the technical ease for the surgeon.

A major decision in managing each individual patient lies in advising whether to perform a percutaneous microcompression or posterior fossa decompression. The recurrence rate of the larger series of posterior decompressions is not yet available, but general experience indicates that it is considerable (five of these 50 unselected patients had already had the posterior fossa operation). If we assume that the recurrence rate will be somewhat similar, we must weigh the realistic mortality factor of the operative intervention against the dysesthetic risk of the percutaneous procedure, striving at both ends to bring these figures to zero. Our current policy is to explain both procedures fully to the patient and allow him to make the choice. When the patient prefers that we make the choice, then it is reasonable to offer the operative procedure to the younger patient since it does not involve any numbness or risk of dysesthesia, while reserving percutaneous compression if pain should recur. When the biological age of increased operative risk is arrived at, we advise the percutaneous method both for the initial and for the recurrent problem. If the younger patient chose the percutaneous procedure initially and pain recurred, but only minimal sensory loss was noted immediately after surgery, we would repeat the procedure. If sensory loss was significant initially and the operative risks were still low, we would then advise the operative method, lest accumulated sensory loss lead to eventual dysesthesia.

References


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