

Brief Communications

Percutaneous Balloon Compression for Trigeminal Neuralgias and Autonomic Cephalalgia

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Objective.—This prospective study aimed to evaluate the results of percutaneous trigeminal ganglion balloon compression (BC) in patients with various types of trigeminal neuralgia (TN) and autonomic cephalalgia.

Methods.—Twenty-five consecutive patients underwent BC and were followed up for 27-60 months. They were divided into 2 groups: group A (n = 18) patients with idiopathic TN and group B (n = 7) patients with secondary TN (n = 5) and trigeminal autonomic cephalalgia (TAC) (n = 2).

Results.—Postoperatively, 15 patients in group A experienced pain relief, one required medication and 2 had no response; in group B, 6 were free of pain, including the 2 patients with TAC, and one required medication. Complications in both groups were either functionally trivial or infrequent. None of the patients developed keratitis or anesthesia dolorosa. Pain recurrence occurred early (<6 months) in one patient from group B, and late in 2 patients from group A.

Conclusion.—Balloon compression is a minimally invasive procedure that seems to be comparably successful for idiopathic and secondary TN, as well as TAC. However, further studies are deemed necessary to establish it as the first-line treatment in medically resistant trigeminal pain.

Key words: balloon compression, trigeminal neuralgia, trigeminal autonomic cephalalgia, cluster headache, facial pain

Abbreviations: BC balloon compression, ITN idiopathic trigeminal neuralgia, MS multiple sclerosis, STN secondary trigeminal neuralgia, TAC trigeminal autonomic cephalalgia, TN trigeminal neuralgia

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INTRODUCTION

Idiopathic trigeminal neuralgia (ITN) is a painful condition of the face that is confined to the somatosensory distribution of one or more branches of the trigeminal nerve and is characterized by a paroxysmal, lancinating, shock-like pain, lasting a few seconds, often triggered by sensory stimuli.¹ Pain in the distribution of the trigeminal nerve because of a

structural lesion, demonstrated with brain imaging, is known as secondary TN (STN). According to the second edition of the International Classification of Headache Disorders (ICHD-II),² pain attacks in trigeminal pain with certain characteristics such as conjunctival injection, lacrimation, nasal congestion, rhinorrhea, miosis, ptosis, and facial sweating are classified as trigeminal autonomic cephalalgias (TAC).

Conservative treatment is the first choice for TN although several neurosurgical procedures have been developed for the control of medically refractory pain. These procedures range from open surgical procedures (vascular decompression of the trigeminal root in the brainstem) to percutaneous procedures

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(radiofrequency trigeminal rhizotomy, glycerol rhizolysis, balloon compression [BC], and stereotactic radiosurgery), which are more routinely used today.^{3,4} Unlike TN, pain in TAC is often resistant to medical treatment (including anti-inflammatory drugs, lamotrigine, and corticosteroids). Surgical interventions for TAC have been described in only few reports in the literature^{5,6} and no consensus about surgical options in these patients exists.

The neurosurgical clinic of our institution has been involved in the treatment of various facial pain syndromes, including ITN, TN associated to multiple sclerosis (MS), STN, and TAC. We designed a prospective analysis of our patients receiving percutaneous trigeminal ganglion BC over a 4-year period aiming to compare the outcome and possible complications using this method in different types of TN, with particular emphasis in TAC.

METHODS

From December 2001 to December 2005, 25 consecutive patients underwent BC for intractable trigeminal pain in the neurosurgical clinic of our institution. Eighteen patients (group A) suffered from ITN, whereas the rest (group B, $n = 7$) suffered from other types of facial pain: 4 patients with STN because of MS, 1 patient with STN because of a benign posterior fossa brain tumor, and 2 patients with TAC. General characteristics of the study

population are presented in Table 1. Two women, 68 and 74 years old, with medically refractory TAC were included in group B. Five patients who decided to receive initial treatment with microvascular decompression and 9 patients who had received treatment with glycerol rhizolysis were excluded from the study.

Only patients whose disorder was refractory to the medications (intractable pain or severe side effects) were offered surgical alternatives. All patients received brain magnetic resonance imaging preoperatively, in order to identify any lesion or tumor causing TN. They were gradually tapered off the dosage after the operation, aiming discontinuation within a month.

All patients underwent a baseline examination and follow-up evaluations were performed by an independent neurologist (E.C.) every 3 months up to 18 months. Thereafter, the patients' condition was checked by phone interview every 3 months and clinical appointment when necessary. The classification of pain was performed in accordance to ICHD-II, provided by the International Headache Society in 2004.² Pain was evaluated by using the modified Barrow Neurological Institute (BNI) scale (scores I-V): I, no pain, II, occasional pain without medications, IIIa, no pain requiring medication, IIIb, some pain controlled by medications, IV, some pain not controlled by medications, V, severe pain and no pain relief. A score of IIIa or less was considered a favorable outcome.⁷

Table 1.—Demographic and Clinical Data of the Sample (n = 25)

	Group A: ITN (n = 18)	Group B: STN and TAC (n = 7)
Sex (M/F, n)	6/12	3/4
Age at surgery		
Mean \pm SD, years (range)	64.4 \pm 10.8 (42-78)	59.0 \pm 12.4 (43-74)
Duration of neuralgia		
Mean \pm SD, years (range)	6.8 \pm 6.2 (1-22)	4.1 \pm 2.6 (0.5-7)
Side (right/left, n)	7/11	3/4
Trigeminal branch (n)		
I/II/III	-/4/4	1/2/-
I and II/II and III/I, II, and III	2/6/2	2/-/2
Prior surgery for neuralgia (n)	2	1

F = female; ITN = idiopathic trigeminal neuralgia; M = male; STN = secondary trigeminal neuralgia; TAC = trigeminal autonomic cephalalgias.

The Student's *t*-test and the Pearson chi-square test were used for analyzing and comparing the data of the 2 groups. The difference between the survivals of the 2 designated groups was compared by Kaplan-Meier survival analysis. In order to perform this analysis, BNI scores were dichotomized as follows: BNI scores from I to IIIa were binned as pain free situations while BNI scores from IIIb to V were binned as painful situations.

Operative Technique.—The procedure of BC is performed with the patient in the supine position, under general anesthesia with an endotracheal tube. A 14-gauge needle with stylet is inserted, approximately 2 cm lateral to the angle of the mouth, of the unilateral pain distribution side, after a 2-mm incision of the skin with a scalpel. Once the needle has reached the skull base area, with the help of a C-arm fluoroscope, the needle is inserted through the foramen ovale, targeting, radiologically, for the junction point of the clivus and petrous apex lines. As soon as the tip of the needle is in the desired target area, the stylet is removed and a No. 4 Fogarty catheter is introduced through the needle. The balloon of the catheter is then inflated with 0.75 mL of contrast medium, while the inflation and the shape of the balloon are continuously monitored radiologically. Following 2-5 minutes of constant pressure application, the balloon is deflated and withdrawn together with the needle. Mechanical compression is then applied, for 5 minutes, at the point of incision on the cheek to prevent hematoma formation.

RESULTS

There was no significant difference in pain severity preoperatively between the 2 groups ($P = .34$). The duration of the compression ranged between 2 and 5 minutes and there was not statistically significant difference between the 2 groups (mean \pm SD 156 \pm 52 seconds in group A and 202 \pm 750 seconds in group B, $P = .27$). Mild to severe facial numbness accompanying by hypoesthesia and transient mastication weakness was found in all patients postoperatively, but all had resolved within the first 3-10 months. Corneal anesthesia and keratitis were not observed in any of the patients. One patient from group A developed transient abducens nerve palsy, which recovered after 2 months. Intraoperative bradycardia was observed in 2 patients, one from each group, because of the trigeminocardiac reflex.

The follow-up periods were similar in both groups ($P = .220$). Table 2 presents the results of pain relief, the duration of follow-up, and the cases with recurrent pain. The majority of patients postoperatively experienced adequate pain relief; there was no statistical difference of efficacy between the 2 groups ($P = .532$).

Pain recurrence occurred in 3 patients (12.5%) within a mean postoperative time of 7 months (Table 2). Early pain recurrence (<6 months) was observed in one patient (4%) from group B, whereas late pain recurrence (>6 months) was reported in 2 patients (8%) from group A, but the pain was easily tolerated with small doses of carbamazepine in

Table 2.—Postoperative Pain Relief in Different Forms of Facial Pain Treated With Percutaneous Balloon Compression

	Group A	Group B		
	ITN (n = 18)	Tumor – TN (n = 1)	MS – TN (n = 4)	TAC (n = 2)
Pain relief (BNI scale: I-IIIa)	15	1	3	2
Pain control with meds (BNI scale: IIIb)	1	–	1	–
No pain control (BNI scale: IV)	2	–	–	–
Postop. hypoesthesia (moderate and severe)	5	1	1	1
Follow-up, months Mean \pm SD (range)	36.6 \pm 12.3 (27-60)	24	30.8 \pm 5.7 (27-39)	24 and 30
Pain recurrence	2	0	1	0

BNI = Barrow Neurological Institute; ITN = idiopathic trigeminal neuralgia; MS = multiple sclerosis; TAC = trigeminal autonomic cephalalgias.

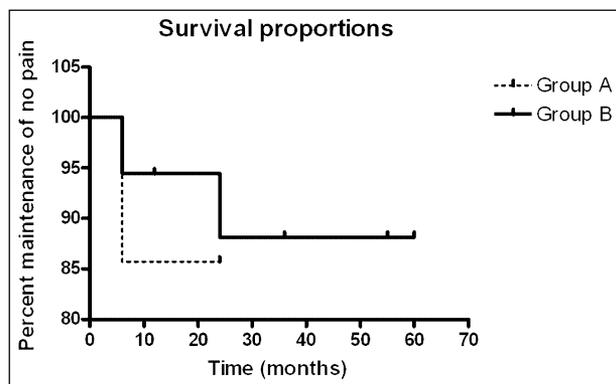


Figure.—Kaplan-Meier survival curves for the 2 designated groups: Group A, 18 patients with idiopathic trigeminal neuralgia and group B, 7 patients with other types of trigeminal neuralgias (4 with multiple sclerosis-related neuralgia, 1 with neuralgia caused by a benign tumor, and 2 with trigeminal autonomic cephalalgia).

one of them. No significant difference was found in pain recurrence between the 2 groups ($P = .921$). Kaplan-Meier survival analysis with respect to the follow-up on BNI score between the 2 groups depicted no statistical difference ($P = .841$) (Figure).

DISCUSSION

There is a variety of procedures developed and proposed for the treatment of drug resistant TN. BC was first published in 1983 by Mullan and Lichtor.⁸ Since then, it has been used as one of the alternative therapeutic approaches combining high rate of efficacy (with 93-99% initial pain relief), easy performance, and generally low morbidity.^{4,9} Corneal anesthesia and anesthesia dolorosa, which occurs with considerable frequency in other ablative techniques such as radiofrequency rhizotomy,^{1,3,4} are rare with BC treatment.⁴ Some authors consider that BC is the method of choice for patients with ophthalmic division involvement, whereas others recommend its use as the first line treatment in patients who are reluctant to have a major surgical operation such as microvascular decompression.¹⁰

In line with the literature, our results suggest that BC is effective with lower incidence of complications. None of our patients developed corneal anesthesia that could lead to keratitis and visual loss, anesthesia

dolorosa, difficulty in chewing or intolerance of facial numbness. In respect to the type of pain, the results in patients with STN and TAC (group B) were as good as in patients with ITN (group A). In the subgroup of MS patients in our series, no complications were observed. Our success rate (75% with score I and 25% with score IIIb of the BNI scale) and the pain recurrence rate (25%, one of the 4 patients who had a long follow-up) were comparable to those quoted in the literature both for ITN- or MS-related cases.^{3,11}

Several pieces of evidences from experimental studies as well as the reported coexistence of TN and TAC in single patients imply that these 2 entities are pathophysiologically connected.¹² This hypothesis could justify the recent exploration of the efficacy of various surgical procedures already applied for ITN in patients suffering with TAC. Hannerz reported excellent results in 2 patients, suffering from TAC, who were treated with repeated trials of glycerol rhizolysis and BC.⁵ In another study, glycerol rhizolysis resulted in pain relief in the majority of 18 patients with cluster headache (presently included in TAC type) after 1 or 2 injections, but pain recurred in 39% of patients.¹³ More sophisticated treatment alternatives, such as gamma knife radiosurgery or thalamic deep brain stimulation for medical resistant TAC have also been proposed but their application is limited because of high morbidity rates.¹⁴ In comparison to the above, BC has 2 advantages in patients with TAC. First, it is considered safer for first division trigeminal pain. The compression selectively injures medium and large myelinated fibers more than small myelinated and unmyelinated ones.⁹ BC rarely provokes corneal reflex disturbance as this reflex is mediated by small fibers. Second, the other percutaneous methods (radiofrequency, rhizotomy, and glycerol rhizolysis) often fail to alleviate pain in the distribution of the first trigeminal branch, because of technical difficulties.

We acknowledge the main limitation of this study that is the lack of control group and the employment of randomization. Other relative limitations are the small sample size and the heterogeneity of group B, which may have introduced selection bias. Even so, the effectiveness of BC appeared to be independent of the type of trigeminal pain, as the results in group

B did not differ from those of the homogeneous cases in group A.

In conclusion, BC used in our study proved to be equally effective for idiopathic and STN as well as TAC. This is particularly important for TAC, as there is no general consensus regarding the possible neurosurgical approach of patients suffering with medical refractory TAC. BC is a minimally invasive technique, combining efficacy and low complication rates and it is suggested as the first-line treatment in medically resistant facial pain.

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