

Trigeminal Neuralgia: Role and Neurosurgical Indications of Peripheral Alcohol Injections, Controlled Radiofrequency Thermocoagulation, Gasserian Ganglion Compression with Balloon and Microvascular Decompression in Posterior Cranial Fossa. Experience in 437 Patients

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Abstract

Introduction: Trigeminal neuralgia is a common cause of facial pain. Many therapies are accomplishable; purpose of the study is to evaluate the role and the indications, in our experience, of peripheral alcohol injections, controlled radiofrequency thermocoagulation, gasserian ganglion compression with balloon and microvascular decompression in posterior cranial fossa.

Methods: A series of 437 patients treated with various surgical methods for idiopathic trigeminal neuralgia refractory to medical therapy is presented. The treatments were performed according to the interested trigeminal division, the gravity of the neuralgia, the age and the general conditions of the patients. Moreover, the role of radiosurgery is underlined.

Results: Peripheral alcohol injections resulted very effective for temporary control of dolorific attacks. Thermocoagulation resulted a very effective and stable method for isolated III division trigeminal neuralgia; balloon compression was very effective for pain control but entire hemifacial anesthesia was necessary to obtain a good outcome; microvascular decompression resulted affective but was reserved for young healthy patients (trigeminal neuralgia is predominant in advanced age).

Conclusions: In our opinion, each treatment should be indicated according to neuralgia (interested trigeminal division, gravity) and patient (age, general conditions) characteristics, to perform the best treatment for each patient.

Keywords: Trigeminal neuralgia; Peripheral alcohol injections; Thermocoagulation; Microvascular; Decompression; Ganglion balloon compression; Radiosurgery

Introduction

Trigeminal neuralgia (TN) is a common cause of facial pain. Current supposed pathophysiology is that primary trigeminal neuralgia is caused by demyelination of trigeminal sensory fibers and that it often results from compression by an overlying artery or vein. Causes of symptomatic trigeminal neuralgia include multiple sclerosis and compressive space-occupying masses in the posterior fossa [1].

Because of the lack of an unique therapeutic approach effective at the same way for all the patients affected from trigeminal neuralgia, many therapies are accomplishable, from pharmacological ones [2-4] to minor or major surgical procedures [5-12]; recently, radiosurgical therapies have an important role, too [13-17]. Pharmacological therapies should be the first therapeutic approach. In the study we report the surgical treatments which have been performed in a series of patients affected by TN.

The aim of the presented study is to underline that TN not responsive to medical therapy should be approached with different surgical therapies according to neuralgia (interested division, gravity) and patient's characteristics (age and general conditions). We consider mandatory this analysis in order to achieve the best result performing in each patient the most appropriate therapeutic option.

Materials and Methods

Four-hundred-thirty-seven patients affected from TN refractory to every previously performed medical therapy are presented; all the patients were affected from primary TN according to the criteria of the

International Classification of Headache disorders [18]: paroxysmal attacks of pain lasting from a fraction of a second to 2 minutes, affecting one or more divisions of the trigeminal nerve; intense, sharp, superficial or stabbing pain precipitated from trigger areas or by trigger factors; attacks stereotyped in the individual patient; no clinically evident neurological deficit; neuralgia not attributed to another disorder. Patients affected from TN in multiple sclerosis, or affected from atypical facial pain, or however not in accordance with the above mentioned criteria were not considered in this study.

Patients were treated from 1990 through to 2006 with peripheral alcohol injections, thermocoagulation of Gasserian Ganglion, gasserian ganglion compression with balloon catheter and microvascular decompression in posterior cranial fossa.

Forty patients were affected from TN in I division, 196 in II division, 169 in III division, 11 in I and II, 21 in II and III division

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(Table 1). Two-hundred-sixteen patients were female, two-hundred-twenty-one were male; patients age ranged from 46 to 91 years (average 71,4 years). The average length of the clinical history was 8,4 years and all the patients had been treated with medical therapy; in all cases carbamazepine was performed, which resulted effective for an average period of 4,7 years. Twenty-three percent of patients were treated with successive medical therapy of gabapentin and 16% with medical therapy of pregabalin; 12% of patients were treated with association of more than one drug (oxcarbazepine/pregabalin, carbamazepine/gabapentin): all these therapies resulted partially and/or only temporary effective (average 8,3 months).

Pain outcome was assessed by the BNI Pain intensity scale [12]. Class I patients were defined as success. Class II patients had occasional pain, but did not need medication. Class IIIa patients had no pain, but continued to take medication. Class IIIb patients had pain that was adequately controlled with medication. Class IV patients had some reduction in their pain, but considered the pain relief to be inadequate. Class V was defined as failure [19].

Peripheral alcohol injections

Second division alcohol injections: percutaneous procedure which is performed injecting 0.2-0,5 cc of absolute alcohol through the infraorbital foramen. The technique was performed 257 times in 182 patients; one-hundred-nineteen of them were more than 80 years old and were affected from a severe neuralgia; fifty-five patients were between 65 and 77 years old; the other 8 patients were less than 60 years old and in 3 of them a neurovascular conflict was evident at the MRI, but they however preferred this procedure.

First division alcohol injections: the same procedure was performed through the supraorbital foramen in thirty-four patients, all older than 78 years of age.

Thermocoagulation of gasserian ganglion

The procedure was performed in 172 patients in deep sedation (with propofol) without endotracheal intubation; 169 were affected from isolated III division TN and were treated through Gasserian ganglion and retrogasserian rootlets thermocoagulation of the only III trigeminal division. The procedure is performed introducing the electrode-needle through the foramen ovale, under fluoroscopic or CT control (Figure 1), as previously described [7]; selective anesthesia localized to the only third trigeminal division and regression of the neuralgia was achieved in all patients, with a very low rate of recurrence and complications [7]. Two patients, 86 and 91 years old respectively, were affected from an extremely serious II - III division TN; they chose this therapeutic solution because of the severity of the dolorific symptoms, rejecting the first suggested choice of radiosurgery because it usually allows pain relief during a period of several days or weeks, with a higher rate of unsuccess and recurrence than thermocoagulation, but with sparing of facial sensitivity. Another patient, 87 years old, who was affected from I and II division TN, preferred thermocoagulation for the same reasons of the above mentioned group. In these patients the procedure was performed with thermocoagulation at 95 centigrade degrees for a time of 1 to 3 minutes.

	Interested trigeminal division				
	I	II	III	I-II	II-III
Peripheral alcohol injection	34	182	-	-	-
Thermocoagulation	-	-	169	1	2
Gasserian ganglion balloon compression	-	-	-	9	16
Microvascular decompression	6	14	-	4	6

Table 1: Neurosurgical procedures performed according to the interested trigeminal division.

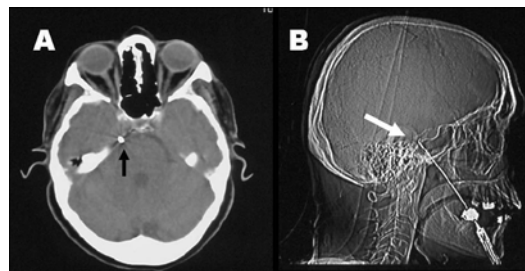


Figure 1: Position of the electrode in the foramen ovale during percutaneous thermocoagulation. A: procedure performed under CT control; the black arrow indicates the position of the electrode in the foramen ovale at axial CT image. B: procedure performed under fluoroscopic control (lateral cranial radiographic image): the white arrow indicates the retrosellar position of the electrode, used to achieve selective anesthesia localized to the only III trigeminal division.



Figure 2: Intraoperative cranial radiography during gasserian ganglion compression with balloon catheter: the retrosellar position of the inflated balloon in the gasserian cistern is visible; the balloon is inflated with iopamidol so that its classic "pear" shape is visible at the fluoroscopic control performed during the procedure. Black arrow: balloon inflated with iopamidol Short white arrow: sella turcica Long white arrow: 12 gauge needle guide crossing the foramen ovale

Percutaneous gasserian ganglion compression with balloon catheter

Nineteen patients were treated with percutaneous gasserian ganglion compression, using a 4-F balloon catheter with a capacity of 0,7 ml inserted into the foramen ovale through a 12 gauge teflon catheter guide (Figure 2). The patients were affected from I-II and from II-III TN in 6 and 13 cases respectively. The procedure was performed in all patients in deep sedation (with propofol) without endotracheal intubation.

Microvascular decompression in posterior cranial fossa

Microsurgery was performed in 30 patients affected by I, II, I-II and II-III TN respectively in 6, 14, 4 and 6 cases, all between 46 and 61 years old, in good general conditions. In all patients a clear neurovascular conflict was evident at the MRI: in 24 it was due to the superior cerebellar artery, in the other 6 to the antero-inferior cerebellar artery (AICA) (Figure 3). All patients were operated on by a retrosigmoid approach, finding a clear neurovascular conflict and apposing a piece of synthetic dura mater separating the trigeminal nerve from the vascular loop.

Results

Peripheral alcohol injections

Second division alcohol injection: after the first procedure, anesthesia in the II division facial district and regression of the

	I division TN	II division TN	III division TN	I-II division TN	II-III division TN	Bilateral neuralgia
> 80 yrs	Stereotactic radiosurgery or Periferal alcholization	Periferal Alcholization or Stereotactic radiosurgery	Thermocoagulation	Stereotactic radiosurgery or Thermocoagulation	Stereotactic radiosurgery or Thermocoagulation	
< 65 (healty patients) yrs	MVD (if neurovascular conflict at MRI) or Stereotactic radiosurgery or Periferal alcholization	MVD (if neurovascular conflict at MRI) or Stereotactic radiosurgery or Periferal alcholization	Thermocoagulation or MVD (if neurovascular conflict at MRI) or Stereotactic radiosurgery	MVD (if neurovascular conflict at MRI) or Stereotactic radiosurgery	MVD (if neurovascular conflict at MRI) or Stereotactic radiosurgery	Stereotactic radiosurgery
>65 <80 yrs	Stereotactic radiosurgery or Periferal alcholization	Stereotactic radiosurgery or Periferal alcholization	Thermocoagulation or Stereotactic radiosurgery	Stereotactic radiosurgery	Stereotactic radiosurgery	Stereotactic radiosurgery

Table 2: Our protocol for the treatment of trigeminal neuralgia based on age of the patients and interested trigeminal division. The first, the second or even the third suggested therapeutic options are indicated in each patient. MVD = microvascular decompression in posterior cranial fossa TN= Trigeminal Neuralgia

neuralgia (Class I BNI pain score) were achieved in all patients for a median period of 2,9 years. The procedure was repeated for the second time in 65 patients, achieving anesthesia and regression of neuralgia in 55 patients (Class I BNI pain score), and hypoesthesia with marked improvement of the neuralgia in the other 10 (Class II BNI pain score); absence of neuralgia after repeated alcohol injection persisted for a median period of 1,3 years. In 10 patients who required the third procedure, hypoesthesia and improvement of the neuralgia was achieved in 8 of them (Class II BNI pain score) for a median period of 4,2 months; no improvement was registered in the 2 last patients (Class IV and Class V BNI respectively).

First division alcohol injection: anesthesia in I trigeminal division and regression of the neuralgia pain was achieved in all patients for a median period of 2,3 years (Class I BNI pain score). The procedure was repeated a second time in eleven patients, obtaining regression (Class I BNI pain score) and improvement (Class II BNI pain score) in 9 and 2 patients respectively, for a median period of 7,7 months. No complications occurred during these procedures.

Thermocoagulation of gasserian ganglion

Selective anesthesia limited to the third division and immediate pain relief was achieved in all the 169 patients affected from isolated III

division TN (Class I BNI pain score); hemifacial anesthesia and pain remission was achieved also in the other 3 patients affected from more than one division TN (Class I BNI pain score). No recurrence occurred during a median period of 7,8 years and all patients were very satisfied of the results although the presence of the above mentioned anesthesia.

Percutaneous gasserian ganglion compression with balloon catheter

In all the 25 treated patients, severe hemifacial hypoesthesia or anesthesia was achieved with immediate pain relief (class I BNI pain score); no patient complained for the hemifacial hypoesthesia or anesthesia. During a median period of 4,9 years, 3 patients presented pain recurrence together with a recovery of hemifacial sensitivity.

Microvascular decompression in posterior cranial fossa

All patients experienced a regression of the neuralgia without sensitive deficit (class I BNI pain score). During a median period of 5,6 years 4 patients, 2 affected from II – III and 2 other from I division TN, experienced pain recurrence after an average period of 4,6 years. In one patient, because of cerebellar oedema at the opening of the dura mater, amputation of the external third of the cerebellar hemisphere was necessary to expose the ponto-cerebellar angle. No mortality or complications occurred after surgery.

Discussion

According to the reported data and to our previously reported experiences [6,7], our indications for the choice of the most appropriate treatment of TN refractory to medical therapy are based on the neuralgia characteristics (interested division and gravity) and patients conditions (age and general conditions).

Microvascular decompression in posterior cranial fossa

A relative small number of this operations in our experience is due to the fact that it is indicated by us as the first therapeutic option only in patients who are in good general conditions and when a clear neurovascular conflict is present at the MRI. So that, considering that TN presents a higher frequency in the agedness [20] when usually concomitant medical problems are present, that a clear neurovascular conflict is not always detectable at the preoperative MRI and it is not always found at surgery [21,22], considering also that this treatment presents more important possible complications than the other

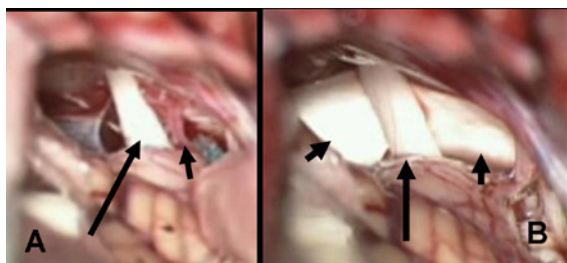


Figure 3: Operative view, at the operative microscope, of the vascular conflict between trigeminal nerve and anterior inferior cerebellar artery (A) and view of the trigeminal nerve separated from the artery (anymore visible) by a patch of synthetic dura mater (B)
A: long black arrow = trigeminal nerve; short black arrow = anterior inferior cerebellar artery (AICA)
B: long black arrow = trigeminal nerve; short black arrows = patch of synthetic dura mater which separates trigeminal nerve from AICA

procedures and a not rare rate of recurrence [23], it has been performed in a restricted and selected number of patients.

Peripheral alcohol injections

Procedures of simple execution, performable for II or even I division TN, with very good transitory results especially for the II division in our experience; pain relief in our patients affected from II division TN continued for an average period of 2,3 years (1,3 – 4,7) after the first procedure. Nowadays these procedures are yet indicated [5,9], especially in aged (>75 years) and very suffering patients affected from II or I division TN; in our experience they are repeatable a second time, with shorter free pain period than the first procedure. The treatment aims to achieve anesthesia in the facial district of the interested trigeminal division (I or II division). In our experience it is also indicated in less aged patients (< 70 years) when the neuralgia is very severe and the patient refuses microsurgery or radiosurgery.

Percutaneous controlled thermocoagulation of gasserian ganglion and retrogasserian rootlets

Well known technique [7,10,12] performed in the past by us also for I and II division TN [6], it is actually indicated by us for the isolated III division TN. The technique aims to provoke a selective anesthesia localized to the only facial district of the third trigeminal division; this sensitive deficit is very well tolerated by all patients; it presents very high rate of success and very low rate of recurrence; it is efficaciously repeatable. Very good results with this method have been recently reported by us [7]. It is not actually suggestible as the first treatment for the I or the II division TN, because it is not possible to provoke a selective anesthesia localized to the isolated I or II trigeminal division facial district; in other words, in order to efficaciously treat a I or II division TN by this technique, it is necessary, in our experience, to determine anesthesia to the entire hemifacial territory: this sensitive deficit is usually not well tolerated by the patients. In our opinion, particular cases in which this procedure is indicated also for I and II division TN are those in which the neuralgia is very serious, the patient is very aged, when peripheral alcohol injections and eventual radiosurgery and also gasserian ganglion compression with balloon have already been performed without benefits: in these particular cases, a hemifacial anesthesia is usually tolerated thanks to pain relief. Percutaneous controlled thermocoagulation is, in our experience, more effective than gasserian glycerolization which is burden of a high rate of recurrence [6] and than percutaneous balloon compression which is not selective for example for the isolated third division TN.

Percutaneous gasserian ganglion compression with balloon catheter

This technique was used in this series and it is actually used by us only for selected cases of TN of more than one division, because hypo- or anesthesia of the entire hemifacial territory is necessary to achieve a good result, without possibility to determine a selective anesthesia only to the trigeminal division interested by the neuralgia. We performed this technique in selected patients because we observed that hemifacial anesthesia or hypoesthesia could be in part recovered after several months or years, differently from thermocoagulation in which the sensitivity recovery is very rare in our experience. So that, if the patients complained of hemifacial anesthesia or hypoesthesia after the treatment, this procedure allows a higher rate of sensitivity recovery than thermocoagulation, when the procedure is performed not inflating maximally the balloon during the procedure, so that performing less compression of the gasserian ganglion.

Radiosurgery and stereotactic radiotherapy

Stereotactic radiosurgery is a quite more recent therapeutic option, performable with Gamma-knife [13,17,23], Cyber-knife [16], or dedicated Linear Accelerator [14,15]. Its advantages are represented by the non invasiveness and by the preservation of facial sensitivity. The disadvantage is that it presents a success rate of about 70-80% (with withdrawal of pharmacological therapy) and its efficacy is not immediate but a period of several weeks is usually necessary to achieve pain relief. In our opinion it is indicated as first choice, considering patient's age and gravity of the syndrome, in I, II, I-II, II-III, I-II-III division and also in the very rare bilateral TN, and however in any patient who want to perform a non invasive treatment with preservation of facial sensitivity. In our recent not yet published experience with radiosurgery we observed that, in order to obtain high success rate and very low rate of complications (facial numbness), it was very important the identification of the target with fusion of imaging MR-CT, the position of the target (root entry zone, cisternal portion), the total dose delivered and the specific treatment performed (radiosurgery or hypofractionated stereotactic radiotherapy).

Regarding anesthesia dolorosa, in the presented study no patient experienced this complication.

Conclusion

In conclusion, the treatment of TN refractory to medical therapy provides many different options which present different advantages and disadvantages. In our opinion each treatment should be indicated according to neuralgia interested trigeminal division, gravity) and patient (age, general conditions) characteristics, to achieve the best treatment for each patient (tab 2). For that reason we think that TN not responsive to medical therapy should be treated by neurosurgeons experienced with all therapeutic options.

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