Neurol Sci (2017) 38 (Suppl 1):S51–S55
DOI 10.1007/s10072-017-2909-6

FACIAL PAIN

Treatments of glossopharyngeal neuralgia: towards standard procedures

Andrea Franzini[1] · Giuseppe Messina[1] · Angelo Franzini[1] · Marcello Marchetti[2] · Paolo Ferroli[1] · Laura Fariselli[2] · Giovanni Broggi[1]

Abstract The degree of disability due to glossopharyngeal neuralgia (GN) refractory to conservative treatments justifies surgical procedures as second-line treatments. Since the first description of this facial pain disorders, many surgical options have been described either via a percutaneous or an open surgical way. Actually, when a neurovascular conflict on root entry zone (REZ) or cisternal portion of the ninth and tenth cranial nerves is identified, microvascular decompression (MVD) is the first surgical option to consider. Many studies have demonstrated its efficacy and safety for the treatment of GN. Recently, stereotactic radiosurgery has gained space in the treatment of selected cases of GN. We provide an overview of the surgical procedures for the treatment of GN and of our own experience.

✉ Andrea Franzini
andrea.franzini1@hotmail.it

Giuseppe Messina
Giusmex@gmail.com

Angelo Franzini
bsvjf@tin.it

Marcello Marchetti
marcello.marchetti@istituto-besta.it

Paolo Ferroli
pferroli@istituto-besta.it

Laura Fariselli
lfariselli@istituto-besta.it

Giovanni Broggi
gbroggi@gmail.com

[1] Neurosurgery Department, Fondazione IRCCS Istituto Neurologico Carlo Besta, Via Celoria 11, 20133 Milan, Italy

[2] Radiosurgery Department, Fondazione IRCCS Istituto Neurologico Carlo Besta, Milan, Italy

Keywords Glossopharyngeal neuralgia · Microvascular decompression · Percutaneous thermorizotomy · Radiosurgery

Introduction

First described by Weisenburg in 1910 in a patient with a cerebellopontine angle tumor [1] glossopharyngeal neuralgia (GN) is a rare facial pain syndrome which overall incidence is estimated to be between 0.2 and 0.7 per 100,000 individuals per year [2, 3]. It is characterized by severe paroxysmal episodes of electric shock-like lancinating pain referred to the external ear canal, the base of the ipsilateral tongue, the tonsil, or the area beneath the angle of the jaw. Pain usually starts in the region of the ear, and then irradiates to the ipsilateral throat region or vice versa; it is triggered by yawning, swallowing, talking, and coughing. It may be accompanied by severe cardiovascular issues, such as life-threatening syncopal episodes, hypotension, bradycardia, or even asystole due to the concomitant involvement of the vagal nerve (which supplies the carotid sinus [4, 5]).

The majority of GN patients have no underlying cause or associated neurological deficit and the syndrome in this case is termed "classic" or idiopathic, while a smaller group is "symptomatic", due to the presence of a structural lesion affecting the distribution of the ninth and tenth cranial nerves [6].

Since the first attempts of sectioning the glossopharyngeal nerve extracranially by Sicard and Rubineau in 1920 [7], many different pharmacological and surgical treatment modalities have been applied to treat GN. In particular, surgery should be considered when a situation of drug intolerance or refractoriness develops [8, 9].

Conservative treatment

Several drugs are used to treat or prevent GN. The pharmacological lines of treatment include anticonvulsants, analgesics, steroids, and antidepressants, which can be helpful as a single agent or in combination [4]. Carbamazepine is recognized as the best available drug for GN and is the first-line agent used by most physicians. Among other anticonvulsants, the most frequently used is phenytoin, lamotrigine, oxcarbazepine, gabapentin, or pregabalin. However, the efficacy of these drugs is variable and could decline over time [4, 10]. When an important cardiovascular component is associated to pain, the administration of atropine can be considered to prevent the possible life-threatening cardiac phenomena [4].

Percutaneous surgical methods

The first percutaneous radiofrequency thermocoagulation for GN has been reported in 1974 by Lazorthes and Verdie [11, 12]. Since then, many authors have described series of patients treated for GN with percutaneous radiofrequency coagulation of the petrous ganglion and nerves inside the jugular foramen [3, 13–18]. The aim of this procedure is to selectively destroy the pain fibers through an inserted electrode by thermocoagulation at, or, above 65 °C. As described by Giorgi and Broggi, the entry site for cannulation of the jugular foramen is a point 3.5 cm lateral to the labial commissure. The rigid electrode is then introduced along a trajectory at 12° laterally to the sagittal plane and at 40° inferior to a plane passing through the internal auditory meatus and the inferior margin of the orbit [13]. Lateral fluoroscopic images in this procedure are important to track the advancing of the needle, and to avoid entering other cranial foramina with possible devastating consequences due to the lesion of vascular and nervous structures. When the electrode tip has reached the jugular foramen, electrophysiology is important to check that the "pars nervosa" of the foramen has been correctly cannulated. If it occurs, low-voltage stimulation elicits paraesthesias in the distribution of the ninth cranial nerve. A continuous monitoring of the systemic pressure and heart rate during the procedure is important to interrupt the coagulation in case that signs of tenth nerve involvement (such as bradycardia or hypotension) appear. This technique was adopted at our institution in a series of 14 patients with medically refractory GN, which was published in 1984 by one of the senior authors (G.B.). This report shows that the procedure was efficacious in abolishing pain, even though all patients had permanent reduction of touch sensation in the pharynx and tonsillar pillar, reduction or abolition of gag reflex, dryness of the oral cavity, and ageusia on the affected side. In one case, persistent swallowing impairment was present after surgery [13].

Even if efficacious in relieving pain, percutaneous radiofrequency thermocoagulation can be hampered by severe morbidity (in particular lower cranial nerves deficits), and could imply significant discomfort for the patient, who is awake during the procedure. Some recent reports disagree with this statement and demonstrate its safety and efficacy, if performed with CT guidance, in a large population and with a long follow-up [3].

Nevertheless, due to the high incidence of side effects and variable effectiveness, this technique has been progressively abandoned in favor of surgical microvascular decompression (MVD) and, more recently, of radiosurgical procedures [19].

Open surgical methods

As well as percutaneous procedures, most open surgical treatments for GN focused on the lesion of the ninth and tenth cranial nerve fibers and nuclei [9]. Following the first surgical experience of Sicard and Rubineau of extracranial nerve avulsion [7], many other open surgical procedures have been described, both at central and peripheral sites, in an intracranial or extracranial location (direct extracranial surgical neurotomies, direct section of glossopharyngeal or vagal nerve in the cerebellopontine angle, and open trigeminal tractotomy-nucleotomy) [9, 12, 19–28].

All these surgical approaches are based on the lesioning of the glossopharyngeal and vagus nerves' neural pathways, and can be hindered by severe side effects, in particular, when upper vagal rootlets are included in the rhyzotomy (dysphagia, dysphonia, dysarthria, hoarseness, and other lower cranial nerves disorders) [29]. As a general principle, lesional procedures for pain should be avoided when alternative and safer treatments are available. Today, the refinement of microsurgical and anesthesiological techniques made microvascular decompression (MVD) one of the most widely used surgical options for GN. So far, this surgical option can be performed with a very low complication rate [9, 29–31].

The first description of an anomalous arterial loop in a patient affected by GN was produced by Lillie and Craig in 1936 [32], but it was Jannetta who recognized that GN was caused by vascular compression and popularized MVD for treating cranial neuralgias [33, 34]. Since then, MVD has become a standard surgical treatment for cranial nerves' compression syndromes, such as trigeminal neuralgia (TN), GN, or hemifacial spasm [35]. MVD is a surgical procedure which purpose is to separate an offending vessel from a compressed nerve. This conflict is a well-established cause of TN and hemifacial spasm, though controversies still exist on the role of neurovascular conflict in the pathogenesis of GN [35].

The procedure described here has also been described in previous reports [9, 19]. The patient is placed in a supine position with the head rotated to the opposite side of the neuralgia and the ipsilateral shoulder slightly elevated. Exposure of the ipsilateral cerebellopontine and cerebellomedullary cisterns is performed through a retromastoid craniectomy centered on the asterion and extended in a way to be able to expose the medial margin of sigmoid sinus and the inferior margin of transverse sinus. Dura is opened inferior and medially to these sites, and subsequent microsurgical opening of the arachnoid of the cerebellomedullary cistern allows to expose vagal and glossopharyngeal nerves including their root entry zone in the retro-olivar sulcus. The vessel that most commonly is found to be responsible of the compression is the posterior-inferior cerebellar artery, followed by vertebral artery (Fig. 1). Paying attention to respect the perforating vessels, compressive arteries are kept away and fixed far from the nerves as well as their root entry zone in the brainstem by interposing little pieces of muscle or fibrillar surgicel, veins are electrocoagulated and cut.

We critically reviewed 20 patients with idiopathic GN who received MVD at our institution between 1990 and 2017.

Experience at our institution

In our institution, 20 consecutive patients with GN have been treated with MVD since 1990. All of these patients were refractory to medications or experienced persistent side effects at the effective dosage. In all cases, contrast-enhanced MRI or CT showed neurovascular compression and excluded cerebellopontine angle masses and signs of demyelinating disease. Duration of pre-operative symptoms ranged between 45 days and 20 years. One patient received section of stylomastoid ligament for suspected Eagle's syndrome, whereas another patient had undergone two percutaneous rhizotomy of the ninth nerve with no result. The follow-up period after MVD ranged from 11 months to 20 years. In 18 patients out of 20, pain

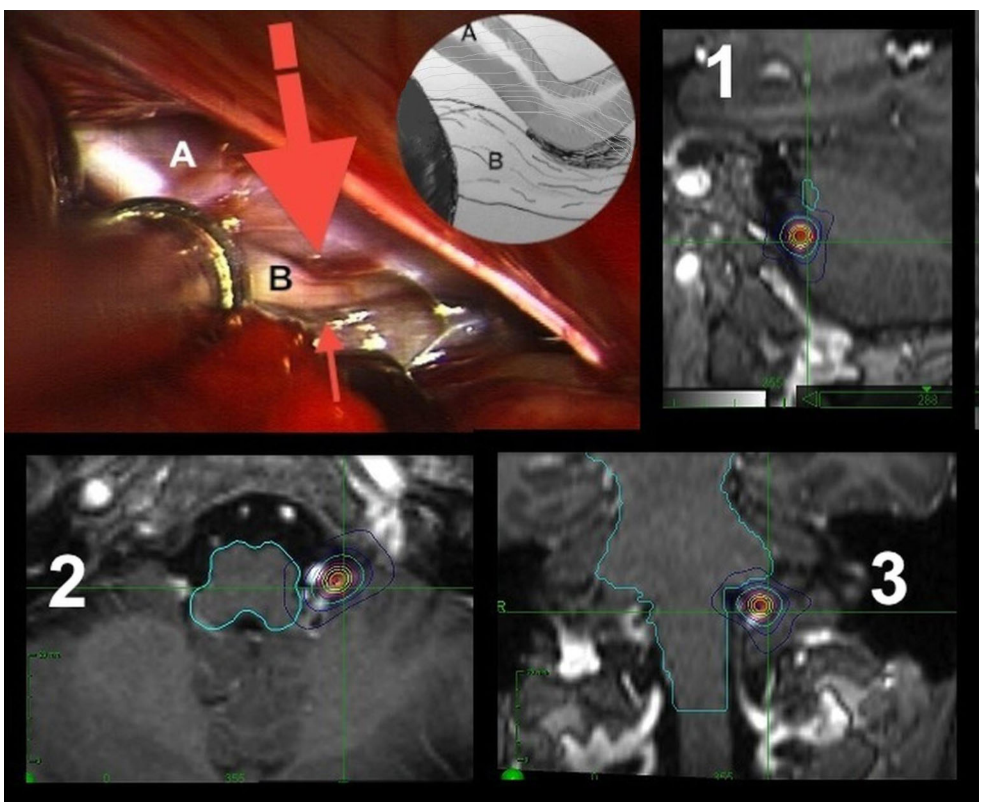

Fig. 1 *Upper left* microsurgical view of the neurovascular conflict between the glossopharyngeal nerve and the vertebral artery; in the *black* and *white circle,* the schematic drawing of the conflict with surgifoam inserted to separate the artery from the nerve sheat (the tip of the microsurgical suction device is included in the *left* of both *pictures*). *Upper right* relationship between the radiosurgical target on the glossopharyngeal nerve and the cerebellum in sagittal MRI picture (T1). *Lower left* and *lower right* the radiosurgical target on the glossopharyngeal nerve in axial (*2*) and coronal (*3*) MRI pictures (T1) showing the relationships with the brainstem

disappeared immediately after surgery. In the two remaining patients, it faded in the following 2 weeks. After 2 and 5 years, two patients required repeated surgery for recurrence of pain. In one patient, pain recurred 11 months following MVD after a laryngitis. He was treated with Cyberknife radiosurgery and actually is pain free. A total of 17 patients were pain free at long-term follow-up (11 months–20 years). We did not observe mortality or long-term surgical morbidity in our series, although about one-third of patients had transitory cranial nerve deficit. Of three patients experiencing CSF rhinorrhea, two were successfully treated with few days of external lumbar drainage, and one developed a meningitis, thus requiring revision surgery to seal the fistula. Cephalea and nausea were common in the immediate post-operative period, due to deliquoration and intracranial hypotension.

Our experience is in agreement with a recent literature review on 28 patient series which shows that MVD is a safe and effective procedure to treat GN with a overall relief from pain varying from 50 to 100% of patients, and with lower recurrences and morbidity rates than percutaneous thermorizotomy [12]. An experienced team and intra-operative neurophysiological monitoring and endoscopic assistance could be useful to achieve excellent results with MVD [36].

Radiosurgery

Stereotactic gamma knife radiosurgery (GKR) was first reported for the treatment of TN by Leksell in 1971 [37]. Its use, however, became widely used only after the mid-1990s in conjunction with advancements in neuroimaging, such as MRI. Since then, the efficacy of GKR for TN, as reported in the literature, has resulted to be comparable to that of MVD. As far as the pathophysiology of GN is considered to be similar to that of TN, the use of GKR was extended to the treatment of GN. Some series have been reported concerning the radiosurgical treatment of GN with radiosurgery devices with satisfactory results despite a higher recurrence rate than in MVD is observed [12, 38–41].

Indications to radiosurgery (RS) are mainly clinical. Contrary to MVD, the presence of an MRI evidence of a neurovascular conflict is not mandatory. Particularly RS would be indicated for all the patients who are less than ideal candidates for open surgery, due to the age or relevant comorbidity. Moreover, the patient's preference can also be considered.

In general, the RS target is a little portion of the intracisternal portion of the glossopharyngeal nerve. The glossopharyngeal meatus of the foramen lacerum could also be considered [38].

The precise radiation dose to obtain a pain relief is not defined yet, and it may widely change according to the considered device. In general, the dose ranges from 55 to 90 Gy, delivered in single fraction [38–41].

At our institution, Cyberknife has been available since March 2004 and it is commonly and effectively used so far to treat patients suffering for a trigeminal neuralgia [42].

Three patients with refractory GN have been treated with CK so far. Our results are still to b considered preliminary. However, the potential of this treatment modality (together with the observed absence of toxicities and the patients comfort) suggests a concrete future development.

Discussion and conclusions

Because of the high incidence of side effects, such as dysphagia, vocal cord paralysis, and impaired gag reflex [12], and the high risk of lesioning important vascular structures (such as the internal carotid artery and the internal jugular vein, in proximity to the foramen lacerum), percutaneous thermal rhizotomy is too dangerous and unpredictable and should not be recommended anymore. Otherwise, in the future, better imaging techniques and technology to accurately track instruments according to images, such as frameless stereotaxy, may favor the resurgence of this procedure.

As stated, MVD is a functional, safe, and efficacious procedure, and according to the pain treatment policy of our institution, it is the first treatment of choice for patients, whose age is under 70, and who can tolerate open surgery in general anesthesia.

Cyberknife and stereotactic radiosurgery should be reserved to patients who are unable to tolerate intracranial procedures because of old age or comorbidities, who refuse open surgery, or who did not benefit from MVD, or to recurrent patients.

Acknowledgements This work was supported by IRCCS Fondazione Istituto Neurologico Carlo Besta, Milan, Italy.

Compliance with ethical standards

Conflict of interest This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Weisenburg TH (1910) Cerebello-pontine tumor diagnosed for six years as tic doloureux. The symptoms of irritation of the ninth and twelfth cranial nerves. JAMA 54:1600–1604
2. Pearce JM (2006) Glossopharyngeal neuralgia. Eur Neurol 55:49–52

3. Wang X, Tang Y, Zeng Y, Ni J (2016) Long-term outcomes of percutaneous radiofrequency thermocoagulation for glossopharyngeal neuralgia. Medicine 95(48):e5530
4. Blumenfeld A, Nikolskaya G (2013) Glossopharyngeal neuralgia. Curr Pain Headaches Rep 17:343
5. Ori C, Salar G, Giron GP (1985) Cardiovascular and cerebral complications during glossopharyngeal nerve thermocoagulation. Anaesthesia 40:433–437
6. The international classification of headache disorders, 2nd edn. (2004) Cephalalgia, pp 1–160
7. Sicard R, Robineau J (1920) Communications et presentations: Algie vèlo-pharyngèe essentielle. Traitement chirurgical. Rev Neurol 36:256–257
8. Ma Y, Li YF, Wang Q, Wang B, Huang H (2016) Neurosurgical treatment of glossopharyngeal neuralgia: analysis of 103 cases. J Neurosurg 124:1088–1092
9. Ferroli P, Fioravanti A, Schiariti M, Tringali G, Franzini A, Calbucci F, Broggi G (2009) Microvascular decompression for glossopharyngeal neuralgia: a long-term retrospectic review of the Milan-Bologna experience in 31 consecutive cases. Acta Neurochir 151:1245–1250
10. O'Neill F, Nurmikko T, Sommer C (2017) Other facial neuralgias. Cephalalgia 0(0):1–12
11. Lazorthes Y, Verdie JC (1979) Radiofrequency coagulation of the petrous ganglion in glossopharyngeal neuralgia. Neurosurgery 4:512–516
12. Jianqing C, Sindou M (2015) Vago-glossopharyngeal neuralgia: a literature review of neurosurgical experience. Acta Neurochir 157:311–321
13. Giorgi C, Broggi G (1984) Surgical treatment of glossopharyngeal neuralgia and pain from cancer of the nasopharynx. J Neurosurg 61:952–955
14. Arias MJ (1986) Percutaneous radio-frequency thermocoagulation with low temperature in the treatment of essential glossopharyngeal neuralgia. Surg Neurol 25:94–96
15. Isamat F, Ferran E, Acebes JJ (1981) Selective percutaneous thermocoagulation rhizotomy in essential glossopharyngeal neuralgia. J Neurosurgery 55:575–580
16. Sindou M, Henry JF, Blanchard P (1991) Idiopathic neuralgia of the glossopharyngeal nerve. Study of a series of 14 cases and review of the literature. Neurochirurgie 37:18–25
17. Oris C, Salar G, Giron G (1983) Percutaneous glossopharyngeal thermocoagulation complicated by syncope and seizures. Neurosurgery 13:427–429
18. Salar G, Ori C, Baratto V, Iob I, Mingrino S (1983) Selective percutaneous thermolesions of the ninth cranial nerve by lateral cervical approach: report of eight cases. Surg Neurol 20:276–279
19. Franzini A, Ferroli P, Messina G, Broggi G (2010) Surgical treatment of cranial neuralgias. Handb Clin Neurol 97:679–692
20. Bernard EJ, Nashold BS, Caputi F, Moossy JJ (1987) Nucleus caudalis DREZ lesions for facial pain. Br J Neurosurg 1:81–92
21. Crue BL, Carregal JA, Felsoory A (1972) Percutaneous stereotactic radiofrequency: trigeminal tractotomy with neurophysiological recordings. Confin Neurol 34:389–397
22. Hitchcock E (1970) Stereotactic trigeminal tractotomy. Ann Clin Res 2:131–135
23. Isamat F, Ferran E, Acebes JJ (1981) Selective percutaneous thermocoagulation rhizotomy in essential glossopharyngeal nevralgia. J Neurosurg 55:575–580
24. Kanpolat Y, Savas A, Batay F, Sinav A (1998) Computer tomography-guided trigeminal tractotomy–nucleotomy in management of vagoglossopharyngeal and geniculate neuralgias. Neurosurgery 43:484–489
25. Kunz Z (1965) Treatment of essential neuralgia of the 9th nerve by selective tractotomy. J Neurosurg 23:494–500
26. Rushton JG, Stevens JC, Miller RH (1981) Glossopharyngeal (vagoglossopharyngeal) neuralgia: a study of 217 cases. Arch Neurol 38:201–205
27. Taha JM, Tew JM Jr (1995) Long-term results of treatment of idiopathic neuralgias of the glossopharyngeal and vagal nerves. Neurosurgery 36:926–931
28. Tew JM Jr, Tobler WD, Van Loveren H (1982) Percutaneous rhizotomy in the treatment of intractable facial pain. In: Schmidek HH, Sweet WH (eds) Operative neurosurgical techniques, vol 2. Grune and Stratton, New York, pp 1083–1106
29. Rey-Dios R, Cohen-Gadol AA (2013) Current neurosurgical management of glossopharyngeal neuralgia and technical nuances for microvascular decompression surgery. Neurosurg Focus 34:E8
30. Kandan SR, Khan S, Jeyaretna DS et al (2010) Neuralgia of the glossopharyngeal and vagal nerves: long-term outcome following surgical treatment and literature review. Br J Neurosurg 24:441–446
31. Patel A, Kassam A, Horowitz M et al (2002) Microvascular decompression in the management of glossopharyngeal neuralgia: analysis of 217 cases. Neurosurgery 50:705–711
32. Lillie H, Craig WM (1936) Anomalous vascular lesion in the cerebellopontine angle. Arch Otolaryngol 23:642–645
33. Laha RK, Jannetta PJ (1977) Glossopharyngeal neuralgia. J Neurosurg 47:316–320
34. Jannetta PJ (1977) Observation on the aetiology of trigeminal neuralgia, hemifacial spasm, acoustic nerve dysfunction and glossopharyngeal neuralgia. Definitive microsurgical treatment and result in 117 patients. Neurochirurgia (Stutt) 20:145–154
35. Xiong N, Zhao H, Zhang FC, Liu RE (2012) Vagoglossopharyngeal neuralgia treated by microvascular decompression and glossopharyngeal rhizotomy: clinical results of 21 cases. Stereotact Funct Neurosurg 90(1):45–50
36. Broggi G, Scaioli V, Brock S et al (1995) Neurophysiological monitoring of cranial nerves during posterior fossa surgery. Acta Neurochir Suppl 64:35–39
37. Leksell L (1971) Stereotaxic radiosurgery in trigeminal neuralgia. Acta Chir Scand 137(4):311–314
38. Stieber VW, Bourland JD, Ellis TL (2005) Glossopharyngeal neuralgia treated with gamma knife surgery: treatment outcome and failure analysis. Case report. J Neurosurg 102(Suppl):155–157
39. Leveque M, Park MC, Melhaoul A, Yomo S, Donnet A, Règis J (2011) Gamma knife radiosurgery for glossopharyngeal neuralgia: marseille experience. J Radiosurg SBRT 1:41–46
40. Martinez-Alvarez R, Martinez-Moreno N, Kusak ME, Rey-Portoles G (2014) Glossopharyngeal neuralgia and radiosurgery. J Neurosurg 121(Suppl):222–225
41. Kano H, Urgosik D, Liscak R, Pollock BE et al (2016) Stereotactic radiosurgery for idiopathic glossopharyngeal neuralgia: an international multicenter study. J Neurosurg 125(Suppl 1):147–153
42. Fariselli L, Marras C, De Santis M, Marchetti M, Milanesi I, Broggi G (2009) Cyberknife radiosurgery as a first treatment for idiopathic trigeminal neuralgia. Neurosurgery 64(2 Suppl):A96–A101