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STIMULATION OF THE GASSERIAN GANGLION FOR THE TREATMENT OF REFRACTORY TRIGEMINAL NEURALGIA. TWO CASE REPORTS

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- Background:** Treatment of trigeminal neuralgia (TN) can be challenging for many physicians; patients who do not respond to conventional treatments and traditional surgical approaches often continue to suffer with pain. The peripheral nerve stimulator has been used to treat many chronic pain conditions, but few reports exist about its use to treat refractory TN through the stimulation of the Gasserian ganglion (GG).
- Case Report:** We present 2 cases of patients with refractory TN who failed conventional medical and surgical management. Both patients were suitable candidates for a trial of peripheral nerve stimulation of the GG, both patients had positive results with the trials, and proceeded with permanent placement of the GG stimulator. In both cases we used deep brain stimulator leads, which were placed under fluoroscopy guidance through the foramen ovale onto the GG, and tunneled through the postauricular area to a pocket in the upper chest wall under the clavicle for the implantable pulse generator. Both of our patients experienced a significant symptomatic and functional improvement in their symptoms. The second patient was successfully weaned off her opioid pain medications after 6 months of treatment.
- Conclusion:** Percutaneous stimulation of the GG is a promising technique for the treatment of refractory trigeminal neuropathic pain. More studies and experiences with this technique are needed to better demonstrate the efficacy and the safety profile, which potentially could allow this procedure to be considered ahead of the more invasive neurodestructive surgical treatments.
- Key words:** Trigeminal neuralgia, Gasserian ganglion, peripheral nerve stimulator

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BACKGROUND

Treatment of trigeminal neuralgia (TN) can be challenging; patients who do not respond to conventional treatments and traditional surgical approaches often continue to suffer with pain. Peripheral nerve stimulator (PNS) has been used to treat many chronic pain conditions, but few reports exist about its use to treat TN.

TN, also called tic douloureux, is a chronic pain condition characterized by either sudden, severe, brief, stabbing or lancinating, recurrent episodes of pain in the distribution of one or more branches of the trigeminal nerve (type I), or it can present as a constant aching, burning, or stabbing pain (type II) (1). According to the American Association of Neurological Surgeons, TN is diagnosed in 150,000 individuals each year, with female gender and age > 50 years being 2 common risk factors (2).

Pharmacologic therapy is usually the first line of treatment. Anticonvulsant medications are the medications of choice to treat TN. These drugs include carbamazepine, oxcarbazepine, topiramate, gabapentin, pregabalin, clonazepam, phenytoin, lamotrigine, and valproic acid. Tricyclic antidepressants, such as amitriptyline or nortriptyline, can be used to treat pain, as well as muscle relaxants like baclofen. When these medications fail to achieve relief, cause unfavorable side effects, or their therapeutic effects start to fade, primary health care providers tend to prescribe opioids in conjunction with other medications. However, longstanding use of opioids is associated with tolerance, dependence, and although it is not particularly helpful with neuropathic pain, it is also associated with a dose escalation over time to maintain analgesic effects. Chronic opioid use has been associated with misuse, addiction, opioid-induced hyperalgesia, and lack of proven efficacy (3,4).

When medication therapy is not effective, surgery historically has been the second line of treatment to provide a solution to the problem. The most common surgical approach is a posterior fossa craniotomy with microvascular decompression, that surgically separates the arteriole from the Gasserian ganglion (GG). This surgical approach is effective, but a significant number of people have only short-term relief, requiring other options (5). Other surgical options include neurodestructive procedures like rhizotomies that purport to selectively ablate pain fibers. These include glycerol injection, balloon compression, or thermal lesioning. These procedures attempt to selectively lesion the trigeminal nerve to achieve pain relief. Side effects include facial numbness with the attendant risk of anes-

thesia dolorosa, a condition characterized by persistent, painful anesthesia or hyperesthesia in the denervated region, which can be more intolerable than the pain from TN itself, and long-term efficacy is not proven (5-7). Another option is Gamma knife radiosurgery, which uses focused radiotherapy to ablate the GG. Pain relief typically begins weeks after the procedure (5).

Because the common treatment options lack long-term efficacy in significant numbers of patients, alternative interventional therapies have been developed, including trigeminal and or Gasserian nerve stimulators. We report 2 cases of refractory TN that failed medical and surgical management but benefited from neuro-modulation of the GG.

CASE 1

The patient was a 67-year-old woman with a past medical history significant for hypertension who presented to our clinic with a chief complain of chronic right TN pain. The pain started 4 years ago after an endoscopy procedure in which the patient developed burning mouth syndrome. Patient described her pain as constant burning pain in the right upper face (V2 distribution) and was 8/10 on the Visual Analog Scale (VAS). The pain was better in the morning and worse later in the day, and was exacerbated with chewing and brushing her teeth. There was no weakness in the right side of her face. Her medications were: Acetylsalicylic Acid (ASA) 81 mg once a day, Atenolol 25 mg twice a day, Alprazolam 1 mg once a day, Gabapentin 1200 mg three times a day, Topiramate 100 mg three times a day, Sertraline 100 mg once a day and a compound medication (ASA 325mg + Butalbital 50 mg + Caffeine 40 mg) 1 tablet every 4 hours as needed for headache. She is allergic to nitroglycerin, penicillin, sulfa, baclofen, and ibuprofen. Physical examination was nonfocal. Previous diagnostic studies were significant for magnetic resonance imaging of the head, which showed no evidence of crossing vessel or other abnormalities along the right trigeminal nerve to explain the neuralgia.

Interventions

(1) Medications: patient had previously failed carbamazepine, oxcarbazepine, baclofen, and tricyclic antidepressants, either because of ineffectiveness or intolerance. (2) Pain procedures: patient had multiple right trigeminal nerve blocks (total of 4) and one right GG block; all of them with minimal relief lasting approximately 1 to 2 weeks. (3) Surgeries: patient underwent Gamma knife radiosurgery of the right trigeminal nerve

with minimal and short-lasting relief. (4) Nerve stimulation: a decision was made to trial peripheral nerve stimulation of the right trigeminal nerve. After the patient passed the psychiatric evaluation, she was scheduled for the trial. Medtronic peripheral lead was placed under fluoroscopy guidance onto the GG and connected to the generator and taped below the right clavicle. One week after the trial, the patient was very satisfied with the results, burning sensation was 100% reduced, and pain was 75% reduced. The patient wanted to proceed with permanent stimulator placement. Under monitored anesthesia care (MAC) sedation with fluoroscopic guidance, a stimulator lead (Medtronic 33875-40 STIMLOC DBS) was placed onto the GG with testing to confirm placement and tunneled through the postauricular area; a pocket was created in the right upper chest wall under the clavicle for the implantable pulse generator (Medtronic, Inc., Dublin, Ireland). The stimulator lead

was then pulled through the subcutaneous tunnel and connected to the implantable pulse generator. The patient tolerated the procedure well (Fig. 1). At her 6-month and 1-year follow-ups, she stated that her pain had improved overall (2/10 on the VAS), and is satisfied with the device. She was able to function her daily activities and able to sleep. She continues to take gabapentin, topiramate, and Zoloft.

CASE 2

The patient was a 53-year-old woman with a past medical history significant for asthma, chronic obstructive pulmonary disease, and chronic-refractory left-sided facial pain who was referred by her primary care provider to our clinic for further management. The pain originally started 3 years ago without inciting event, although she was assaulted 9 months prior to the pain starting in which she had her head punched and was strangled. She

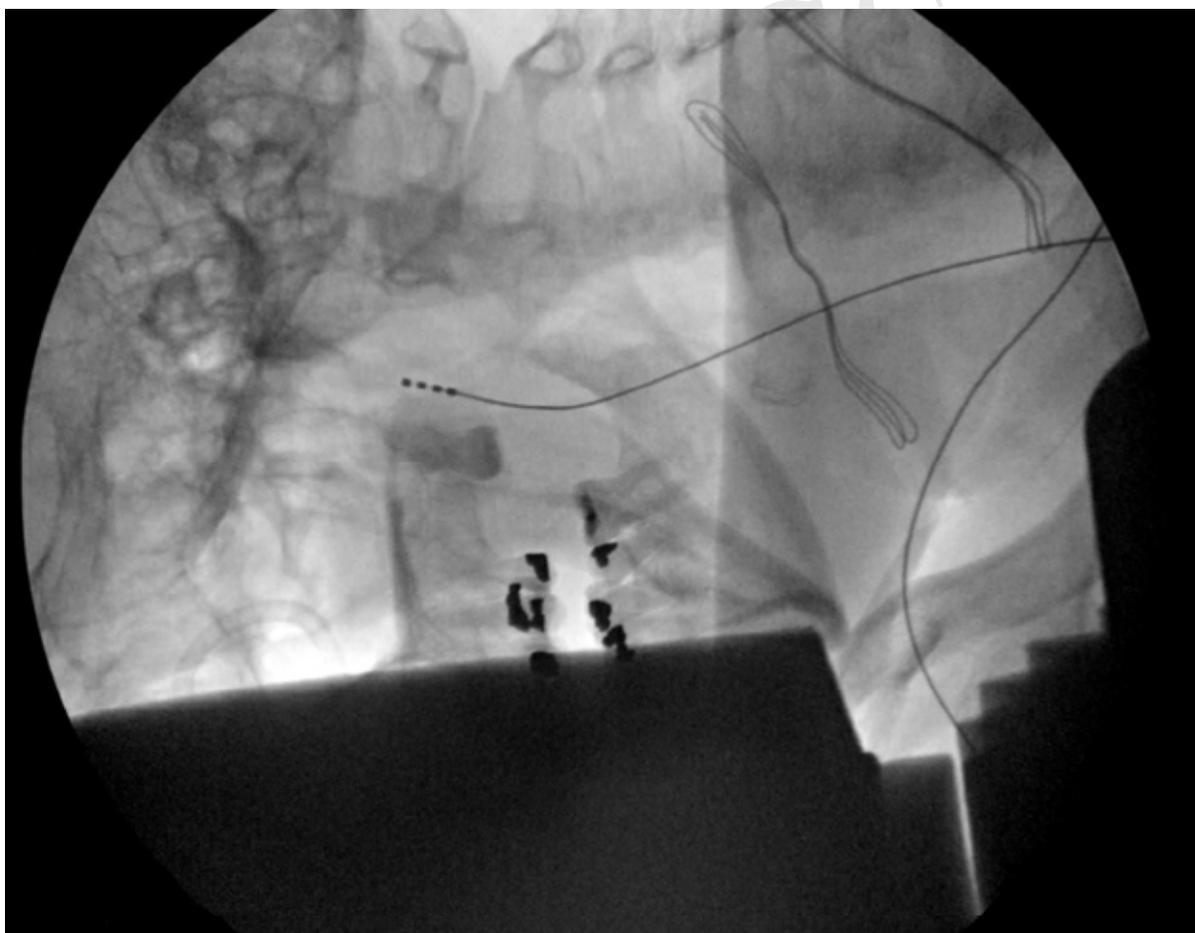


Fig. 1. X-ray of the stimulator lead at the Gasserian Ganglion

was diagnosed with TN and underwent microvascular decompression 1 year ago without improvement in her symptoms. The pain was constant, deep-burning, mixed with sharp-electric pain, predominantly around the left eye (V1 distribution), midface, and side of the face. Pain scored 5/10 on the VAS but sometimes was up to 9/10. The pain was exacerbated with wind, touch, or doing her hair. Physical examination was significant for tender to palpation along inside of left cheek, positive for allodynia. Palpation of left temporal artery was lightly tender. Current medications were baclofen 20 mg 3 times a day, clonazepam 0.5 mg once a day, gabapentin 900 mg 3 times a day, morphine immediate-release 15 mg every 4 hours as needed for pain and oxycodone 15 mg every 3 hours as needed for pain. She is allergic to sulfa drugs.

Interventions

(1) Injections: sphenopalantine block, trigeminal block, trigger points, Botox injection. (2) Surgeries: microvascular decompression. (3) Medications: carbamazepine, oxcarbamazepine, amitriptyline, and nortriptyline tried in the past with little or no improvement in symptoms. (4) Nerve stimulation: a decision was made to proceed with GG stimulator trial.

Medtronic peripheral lead was placed under fluoroscopy guidance through the foramen ovale onto the GG. The patient tolerated the procedure well, and 1 week following the trial her pain had then improved by > 70%. She noted waking up on her left side, which she has not done in many years. Patient proceeded into permanent GG stimulator placement. After administration of MAC sedation, the point of maximal paresthesia was elicited via patient response, and subsequently a neurostimulator needle was placed and advanced. Appropriate positioning of the stimulator lead (Medtronic 33875-40 STIMLOC DBS) was confirmed with fluoroscopy and patient feedback. The lead was tunneled over the left ear and to the left chest, and the electrodes were then connected to the generator in the left upper chest (Medtronic INS 99715 INTELLIS ADAPTIVESTIM PAIN) (Fig. 2). At 3 and 6 months follow-up, there was significant improvement of her facial pain down to 1-2/10 on the VAS. She reported that she is able to lie on her left side without pain. She continues to take gabapentin and baclofen, but she was weaned off her opioid pain medications.

DISCUSSION

In 1965, Melzack and Wall (8) formulated the Gate

Theory of Pain that predicted stimulation of large diameter cutaneous afferent fibers might reduce pain. One of the earliest references of electric stimulation for the treatment of facial pain dates to 1967, when Wall and Sweet (9) presented 8 cases of pain syndromes. One out of these 8 patients presented with severe facial pain, and TN, specifically the region of the hard palate behind the upper left incisors, was particularly sensitive and painful. As a trial, an electrode was inserted deep into the infraorbital foramen. The stimulation resulted in lasting pain suppression while the stimulator was active (9,10).

The better understanding of neuromodulation and the rapid advancement of nerve stimulators led to attempts of GG stimulation for treatment of refractory trigeminal neuropathic pain (TNP). Meyerson and Håkanson (11) through a bipolar plate sutured to the dura overlying the GG using an open craniotomy technique. This high-risk approach was eventually abandoned (11).

The use of PNS for craniofacial neuropathic pain through percutaneous approach was described in 1999 by Weiner and Reed (12), in which they described percutaneous electrode insertion in the vicinity of the occipital nerves. Soon after publication of that pioneering article, the use of the PNS approach in both the occipital and trigeminal regions became more common (10,12).

Mehrkens and Steude (13) described the first percutaneous technique for GG stimulation, but they still experienced a high incidence of electrode dislocation owing to the unique anatomy of the foramen ovale.

The US literature has multiple case reports of neuromodulation treatment of TNP, but it is usually confined to stimulation of the V1 and/or V2 branches (peripheral supraorbital and infraorbital lead placement only) of the trigeminal nerve (14-16). A review of prospectively collected data in 30 patients found that peripheral nerve stimulation of the trigeminal nerve (V1, V2) and occipital nerve was safe and effective for the treatment of craniofacial neuropathic pain (10).

The GG is often compared with the dorsal root ganglia (DRG). As with the DRG, the GG is somatotopically arranged, allowing stimulation of painful conditions in different areas of the face. DRG stimulation has been shown to be beneficial for peripheral neuropathic pain and is potentially a model for treating facial neuropathic pain using GG as the target (17-19).

Kustermans et al (17) developed a custom-made tripolar, bent, tined trigeminal ganglion stimulator (TGS) lead (Medtronic Model 09053) in collaboration with Medtronic, with a real-time 3-dimensional electromag-

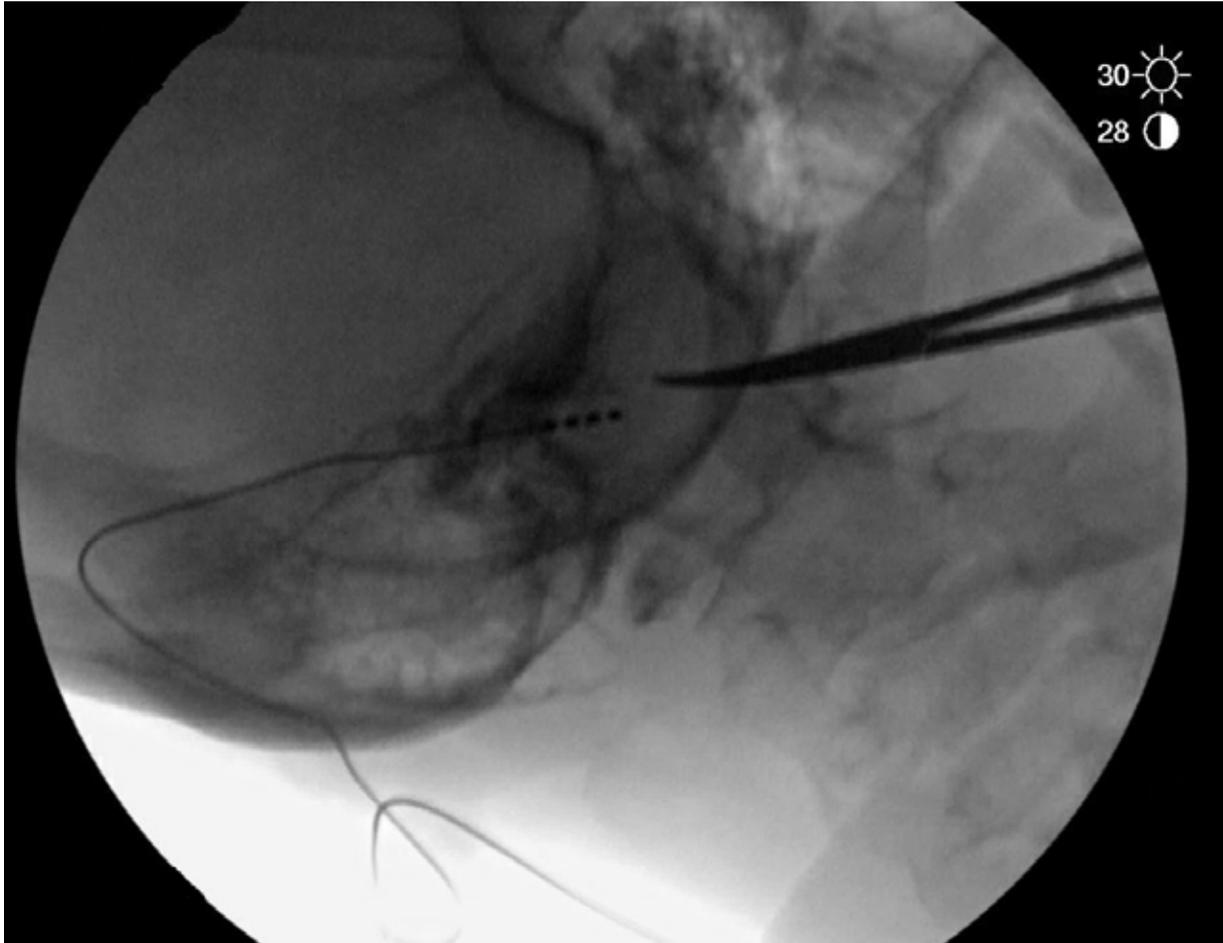


Fig. 2. X-ray of the placement of the lead.

netic navigation system for electrode positioning at the level of the GG, with positive outcome. Our approach uses a quad deep brain stimulator electrode directed to the GG with fluoroscopy guidance and patient feedback.

Although published experience using GG as a target for treatment of facial pain is small, the results have shown efficacy with a better safety profile than with spinal cord stimulation (20). The outcomes from these studies suggest that this less invasive alternative compares favorably to more invasive surgical interventions (16,21).

This procedure is not without risks and possible complications. Like any other interventional technique, introducing the needle could be a source of infection or bare the risk of bleeding, especially in the craniofacial area with tight critical structures. Sterile techniques and

using fluoroscopy guidance are of utmost importance. Another unique possible complication for this technique is lead migration and fracture given the dynamic nature of the neck and jaw area (19). Larger, longer term, prospective studies of this percutaneous approach that follow electrode stability and effectiveness are warranted.

CONCLUSIONS

Percutaneous stimulation of the GG is a promising technique for the treatment of refractory TNP. More studies and experiences with this technique are needed to better demonstrate the efficacy and the safety profile, which potentially could allow this procedure to be considered ahead of the more invasive neurodestructive surgical treatments.

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