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Effective Management of Trigeminal Neuralgia by Neurostimulation

Alaa A. Abd-Elsayed, MD, MPH,[1] Ravi Grandhi, MBA,[2] Harsh Sachdeva, MD[2]

[1]Department of Anesthesiology, University of Wisconsin School of Medicine and Public Health, Madison, WI [2]Department of Anesthesiology, University of Cincinnati, Cincinnati, OH

Background: Treatment of trigeminal neuralgia 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 (PNS) has been used to treat many chronic pain conditions, but few reports exist about its use to treat trigeminal neuralgia.

Case Report: We present the case of a patient with trigeminal neuralgia resistant to conventional techniques of pain management. Conservative pain management was attempted but was ineffective. As a result, a PNS was placed with minimally invasive surgery. Pain scores were recorded before and after the procedure, and the patient reported complete resolution of her pain.

Conclusion: PNS implantation can be a safe and effective method to treat trigeminal neuralgia. More research is needed to define its mechanism of action.

Keywords: *Chronic pain, electric stimulation therapy, peripheral nerves, trigeminal neuralgia*

Address correspondence to Alaa A. Abd-Elsayed, MD, MPH, Department of Anesthesiology, University of Wisconsin School of Medicine and Public Health, 600 Highland Ave., B6/319 CSC, Madison, WI 53792. Tel: (608) 263-8106. Email: alaaawny@hotmail.com

INTRODUCTION

The trigeminal nerve, a mixed facial nerve, carries tactile, proprioceptive, and nociceptive afferents of the face, mouth, and portions of the meninges. Injury or disease of the trigeminal nerve can lead to trigeminal neuralgia.[1] Trigeminal neuralgia is a syndrome of cyclic, recurrent attacks of intense, sharp, stabbing pain lasting minutes to hours that occurs in one of the branches of the fifth cranial nerve, most often V2 (maxillary) or V3 (mandibular). The pain occurs because of tactile stimulation such as brushing teeth, touching the face, hearing loud sounds, or even feeling a breeze.[2] These attacks are often unilateral and may last months to years, followed by periods of pain-free intervals. Approximately 15,000 new cases are diagnosed annually.[3] The syndrome occurs more frequently in females, and its incidence decreases with increasing age.[3] One of the key risk factors is hypertension. Most often, trigeminal neuralgia occurs where the nerve root is compressed near the pons.[3] The syndrome is generally diagnosed via clinical presentation and physical examination of V1, V2, and V3. The longer a patient goes without the correct diagnosis of trigeminal neuralgia, the harder it can be to reverse the pain.

Pharmacologic therapy is the preferred treatment. Patients for whom medication is ineffective can benefit from surgery, but surgery usually provides only short-term pain control. As a result, peripheral nerve stimulators (PNSs) are used with varying efficacy.[3] Electrical stimulation for treating trigeminal neuralgia was first reported in the 1960s[4] but did not become a widely used modality until the 2000s. We present a case of trigeminal neuralgia that was resistant to all medication and procedural modalities but was successfully managed by PNS.

CASE REPORT

A 43-year-old woman with allergies to codeine, Depo-Provera (medroxyprogesterone acetate), and penicillin had a medical history of jaw fractures that led to trigeminal neuralgia. She presented to our clinic complaining of severe right-sided facial pain. She experienced pain in the posterior temporal right side and parietal right side. The patient scored her pain as 10/10 and described it as sharp, radiating over the right side of her face, relieved by nothing, and impairing her daily activities.

We managed the patient at first conservatively; we tried drugs such as gabapentin, amitriptyline, carbamazepine, hydrocodone/acetaminophen, and tramadol. We also tried physical therapy and a transcutaneous electrical nerve stimulation unit. Our conservative management did not relieve the patient's pain to a satisfactory level. We then performed a trigeminal nerve block using bupivacaine 0.25% and triamcinolone acetonide 40 mg. The injection relieved the patient's pain temporarily. The block was repeated multiple times during the management course. The patient also underwent multiple radiofrequency ablations to the trigeminal nerve that provided temporary pain

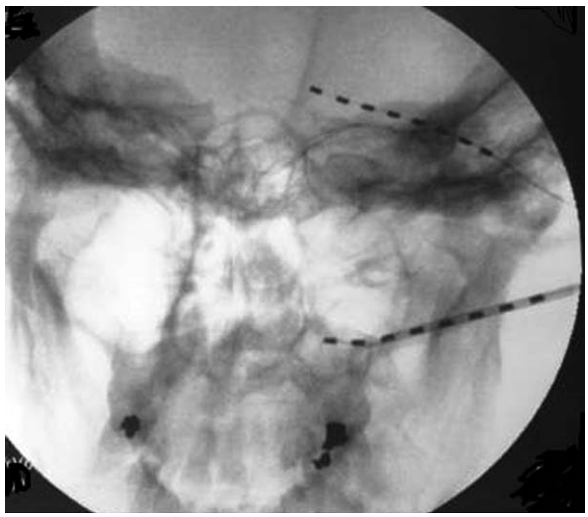

Figure. X-ray showing percutaneous lead placement in the supraorbital and infraorbital locations.

relief. However, none of these methods provided satisfactory pain relief to the patient, and the pain continued to impair her work and daily activities. After discussing the risks and benefits of placing a PNS, the patient agreed to the procedure. We performed a 1-week trial during which we placed 2 percutaneous leads in the supraorbital and infraorbital locations under fluoroscopy (Figure). The patient had complete resolution of pain, and she agreed to proceed with the permanent PNS implant.

The patient was placed under general endotracheal anesthesia, and local anesthesia was infiltrated within the incisions. Dissection was performed to place the battery in the right subclavicular region. We tunneled to place a bifurcated extension on the right side and connected a single 1 × 8 Octad electrode (Medtronic, Inc.) directly to the right neck area. Three needles were placed through a temporal incision: one at the supraorbital location, one at the infraorbital location, and one at the frontoparietal junction. Two Quad Plus electrodes (Medtronic, Inc.) were placed in the infraorbital and frontoparietal regions, and a 1 × 8 Octad electrode was placed in the supraorbital region. Electrodes were secured to the fascia via 2-0 silk sutures. Once we tunneled to the parietal incision, 2 Quad Plus electrodes were connected to the bifurcated extension, and the 1 × 8 Octad electrode was tunneled directly to the battery via the superior port. After double-checking that all the connections were made correctly and completing the intraoperative electronic testing, we placed a strain relief coil in the temporal incision and parietal incision and closed the wounds. The patient was discharged the same day after we determined no obvious complications were present.

The patient returned to our clinic 3 weeks after surgery for a follow-up visit and indicated her pain was well controlled. She reported being able to perform her daily activities without any discomfort, to sleep on the right side of her face, to walk and exercise, to attend social and family events, and to work more efficiently. This improvement in pain scores and function was the same as she had reported during the 1-week trial.

DISCUSSION

Diagnosis of trigeminal neuralgia can be difficult, but a variety of treatments helps prevent disease flare-ups.

The most prevalent treatment modality is carbamazepine, an anticonvulsant often used for epilepsy and seizure control that stabilizes the inactivated sodium channels. Anticonvulsants used less frequently include clonazepam and gabapentin. Another treatment modality is antispasmodic medications such as baclofen, which is a gamma-aminobutyric acid derivative. Anticonvulsants and antispasmodics are often used in combination to achieve maximum pain control. However, medical management can sometimes be ineffective or cause patients to experience too many adverse effects, leading to noncompliance or a desire to seek alternative therapies. Side effects associated with anticonvulsants and antispasmodics include dizziness, confusion, and drowsiness. These effects can be additive, causing significant impairment in functional ability.[5] Sometimes pain medications such as hydrocodone/acetaminophen and acetaminophen/oxycodone can be used, but the addictive potential and occasional lack of efficacy can leave patients desiring higher doses.

If medications are not effective, surgery can provide a short-term solution to the problem. The most effective surgery is microvascular decompression, a procedure in which the physician surgically separates the blood vessel near the trigeminal nerve from the trigeminal nerve.[3] Patients who undergo this operation have significant pain relief in the short term; however, in the long term, the pain control decreases, causing individuals to seek different treatments or repeat surgeries that may lead to increased complications.[4] Another procedure often used is a nerve rhizotomy that selectively destroys nerve roots with a glycerol injection, balloon compression, or a thermal lesion to help relieve neuromuscular conditions. All of these procedures damage the trigeminal nerve to achieve pain relief. However, one of the side effects of damaging the trigeminal nerve is facial numbness, so patients often do not prefer such procedures.[5] Another procedure used to treat trigeminal neuralgia is gamma knife radiosurgery, a procedure in which the surgeon directs a beam of electricity at the trigeminal nerve and destroys it. Pain relief occurs weeks after the procedure. Gamma knife radiosurgery is often the preferred surgical procedure because it can be repeated without additional harm to the patient.[5]

Because surgery lacks long-term efficacy, alternative medical therapies have emerged, including the off-label use of PNSs. PNSs have been used effectively to treat chronic pain localized to a peripheral nerve distribution. In the procedure, an electric current is applied to a nerve to cause neuromodulation of pain. Electrodes attached to the nerve provide weak electrical stimulation that causes a tingling sensation. This process has two steps. First, a trial electrode is placed for which the patient can control the amount of current needed to effectively relieve pain. Once the level of current needed to relieve the pain is determined, a permanent electrode with an internal battery pack is placed via a minimally invasive surgical procedure to provide long-term relief. After the nerve stimulator is placed, the patient can resume normal activities.

During the 1900s, our understanding of the phenomenon of pain transformed from one based on physical/sensory manifestations (peripheral pain pattern theory) to one more related to the emotions and mood of the individual (gate control theory). The mechanism of gate control theory involves the dorsal horns in the spinal cord that inhibit or facilitate transmission from the body to the brain because of the diameter of active peripheral nerves and the dynamic processes of the brain.[6] In times of stress or anxiety, the brain sends signals that open or close the nerve gates in the peripheral nervous system. When the gates are open, the perception of pain is amplified significantly. Closing these gates reduces pain. PNSs work by providing an electrical signal that blocks the opening of these gates.[7]

Pain is a reflexive stimulation to protect the body from danger while it heals. Chronic pain results when the body continues to open the gates in the nervous system, thereby amplifying pain signals without the presence of an adequate stimulation. Some people have sensitivity to pain and reduced life expectancy as a result. Individuals have a different threshold for pain depending on sex, ethnicity, and genetics.

PNSs are effective even in patients who are not considered good candidates for surgery.[8] Often, patients who undergo PNS implantation still maintain limited sensation in the affected areas, providing greater pain control to most patients. In contrast to more invasive surgical techniques, the overall complication rate of facial PNS placement is quite low. The incision sites are smaller, so the procedure results in lower infection rates, bleeding risk, and visible scarring. Complications are usually related to wound breakage, infections, device damage, or pain from the device.

CONCLUSION

Trigeminal neuralgia can be managed in many ways, but when all other treatments fail, the off-label use of neuromodulation via PNS is indicated. While PNS implantation has been shown to be safe and effective for a wide array of diseases, more research is needed to define its mechanism of action.

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