Trigeminal Neuralgia Neuro Anatomical and Neurosurgical Approach

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Abstract
Trigeminal Neuralgia is not an infrequent condition and patients present with severe agonizing pain. Although drugs are used initially for treatment but most of the cases they prove non beneficial. Some new treatment modalities are used in the form of neurosurgical techniques for pain relief. This article summarizes the new concepts of pain relief in Trigeminal Neuralgia.

Keywords trigeminal, Phenytoin, Ganglion, Neuralgia, Ablation, Electrode, Pain Syndrome

1. Introduction
Trigeminal Neuralgia constitutes an important part of Pain Syndromes.
Trigeminal neuralgia is also known as tic douloureux and is usually characterized by sudden, repetitive, unilateral, sharp, and lancinating pains in the distribution of, typically, the second, but sometimes third, branch of cranial nerve V, the trigeminal nerve. The patient may describe a trigger point on the face that elicits the pain when touched or stimulated. A current leading etiologic hypothesis for trigeminal neuralgia is irritation and pulsatile compression of the root entry zone of the nerve by an artery in the posterior fossa, usually a loop of the superior cerebellar artery. The pain is excruciating and can be debilitating. The current topic describes the Neuroanatomy of Trigeminal nerve, the clinical presentation, the most common drugs used as well as the other modalities used in treatment of this Atypical Pain Syndrome. As a result of effective treatment options available a patient can be left with his choice of treatment deemed the most appropriate by the attending physician.

2. Methodology
The methodology used is the data collected from Critical care Medicine, Neurologists and General Physicians. The unpredictable response to the different treatment options available particularly the abnormal response to the drugs as far as the improvement in pain is concerned has prompted for other options which can remove the patients complaints about the severe nature of the pain.

The Trigeminal Nerve
It is “sensory” to the face and head and “motor” to the muscles of mastication. The trigeminal nerve is more important as a sensory nerve. It carries (1) pain and temperature (2) touch and (3) proprioception. Each type of these sensation ends in a special nucleus.
Course of the Trigeminal Nerve (5th Cranial Nerve). The Pain evaluation done by doctors in several hospitals was of the general and similar nature described by patients as usually sudden, repetitive, unilateral, sharp, and lancinating.

3. Results
The pain of trigeminal neuralgia responds to atypical drugs like phenytion, carbamezapine, pregabaline, tricyclic antidepressants in some cases and the response to conventional NSAIDS is poor. In severe cases the pain does not respond to drugs at all and in such cases a look out for a grave underlying cause as well as a neurosurgical approach to pain is needed. The article describes the various modalities that can be used.

4. Discussion
The trigeminal nerve leaves the anterior aspect of the pons as a small motor root and a large sensory root. The nerve passes forwards out of the posterior cranial fossa. It then rests on the upper surface of the apex of the petrous part of the temporal bone in the middle cranial fossa. The large sensory root now expands to form crescent-shaped trigeminal
ganglion. The trigeminal ganglion lies within a pouch of dura mater called the trigeminal or Meckels cave. The ophthalmic, maxillary and mandibular nerves arises from the anterior border of the ganglion. Fibers and leaves the skull through the superior orbital fissure to enter the orbital cavity. The maxillary nerve also contains only sensory nerve fibers and leaves the skull through the foramen rotundum. The mandibular division contain both sensory and motor fibers and leave the skull through the foramen ovale. Nuclei of the trigeminal nerve main sensory nucleus in the middle part of the pons (for TOUCH), Descending or spinal nucleus in the medulla and lower part of pons (for pain and temperature) Mesencephalic nucleus in the midbrain and upper part of pons (for proprioception). The motor nucleus of the trigeminal nerve sends motor fibers to the muscles of mastication. All these relations are important while managing the patient of Trigeminal Neuralgia as far as surgical interventions in case of intractable pain is concerned.  

Near the apex of the petrous temporal bone, the lower layer of the tentorium is evaginated anterolaterally under the superior petrosal sinus to form a recess between the endosteal and meningeal layers in the middle cranial fossa. This recess is the trigeminal cave and contains the roots and ganglion of the trigeminal nerve.

![Figure 1. The exit of Trigeminal nerve from Brain Stem](image1)

![Figure 2. The Sensory supply of face by branches of Trigeminal nerve](image2)
Presentation of Trigeminal Neuralgia

Trigeminal neuralgia is mostly characterized by sudden, lightning-like paroxysms of pain in the distribution of one or more divisions of the trigeminal nerve. Mostly the neuralgia is caused by compression of the trigeminal nerve by normal but aging arteries or veins of the posterior fossa. In some patients the cause is idiopathic. But in some cases an underlying disease can be a determining cause. In some cases the pain of trigeminal neuralgia may be a symptom of a gasserian ganglion tumor, multiple sclerosis, or a brain-stem infarct involving the descending root of the trigeminal nerve. In most of the cases patients presenting to doctors have a history of pain which in itself is diagnostic. The character of the pain is that it occurs as sudden, brief, lightning-like stabs, frequently precipitated by touching a trigger zone around the face especially near lips or the buccal cavity. At times routine activities like usual talking, eating a meal, or brushing the teeth serves as a trigger to start the pain. The pains occur in spasms and intervals. The pains rarely last longer than seconds, and each burst is followed by a refractory period of several seconds to a minute in which no further pain can be precipitated. The pain is usually not full spread over the whole course of trigeminal nerve but mostly limited to one or more divisions of the trigeminal nerve, usually the second, or third, or both. In Between paroxysms of pain, the patient is mostly asymptomatic. The diagnosis can be misleading in case history is not taken properly as In idiopathic trigeminal neuralgia, the neurologic examination is entirely normal. In symptomatic trigeminal neuralgia, there may be sensory changes in the distribution of the trigeminal nerve, and such a finding should prompt a careful search for structural disease of the nervous system.

Pharmacotherapy

Clinicians while treating this pain found that this pain syndrome was resistant to conventional NSAIDS and pain killers. Ibuprofen, Paracetamol, Indomethacin, Naproxen, Meloxicam, Tenoxicam were not highly beneficial. Clear evidence suggests the analgesic efficacy of carbamazepine, baclofen, and pimozide in trigeminal neuralgia and of the tricyclic antidepressants in neuropathic pain. For lancinating neuropathic pains, not only carbamazepine and phenytoin but valproate, Baclofen and clonazepam have been reported to be effective. But in severe cases still patients did not respond to these drugs and other procedures were needed to relieve the pain especially in cases where secondary causes for trigeminal neuralgia are present.

Microvascular decompression (MVD)

It is a surgical procedure that relieves abnormal compression of a cranial nerve. It is performed to treat trigeminal neuralgia in cases where compression is often caused by an artery or vein compressing the nerve root as it leaves the brainstem. When compressed, normal nerve impulses can recruit nearby nerve fibers and send faulty messages. MVD involves surgically opening the skull (craniotomy) and exposing the nerve at the base of the brainstem to insert a tiny sponge between the compressing vessel and the nerve. This sponge isolates the nerve from the pulsating effect and pressure of the blood vessel. To treat trigeminal neuralgia, a sponge is placed between the trigeminal nerve and the superior cerebellar artery or a branch of the petrosal vein. By removing the compression, the painful symptoms are relieved.

Neurectomy

Theoretically appealing, there is little role for the transection of nerves to relieve pain. A number of procedures have therefore been described to prevent this recurrence, such as separating the two nerve ends, burying the nerve in muscle, burying the nerve in bone, or covering the nerve with Silastic. Most peripheral nerves are mixed, reducing the value of transection unless motor loss is acceptable. Avulsion or alcohol ablation of the infraorbital, supraorbital, or mental nerve has a valuable role in the treatment of trigeminal neuralgia, although the benefit is often temporary.

Retrogasserian Rhizotomy for Trigeminal Neuralgia

Pain in the face that involves the distribution of the lower cranial nerves should be considered a distinct entity, and it responds to denervation more favorably. Trigeminal neuralgia consists of intermittent bouts of lancinating pain that is often triggered and is limited to the trigeminal distribution in a patient who is neurologically intact. Most patients are over 55 years of age. Retrogasserian ganglion compression, glycerol ablation, and radiofrequency lesioning are variations of rhizotomy; however, results following these procedures are excellent. All three are performed percutaneously, with fluoroscopic control, while the patient is under sedation and they can incorporate specific localization by stimulation. In an elderly patient with idiopathic trigeminal neuralgia, these procedures represent the treatment of choice when medical management with carbamazepine, phenytoin, or baclofen has failed. In a younger patient, or one who considers sensory loss unacceptable, microvascular decompression of the trigeminal root entry zone is preferred, but this has the added risk of open craniectomy. At times, vascular decompression is combined with open partial caudal root section.

Caudalis DREZ Coagulation

Nucleus caudalis DREZ coagulation was introduced as an extension of DREZ lesioning in 1982. The trigeminal nucleus caudalis contains second-order neurons subserving pain, temperature, and crude touch from the fifth, seventh, ninth, and tenth cranial nerves. Sjoquist performed
trigeminal tractotomy, and Hitchcock reported stereotactic nucleotomy. The latter causes destruction of only a portion of the nucleus caudalis. The El-Naggar-Nashold electrode has been used since January 1990. It is modified and consists of two electrodes to accommodate the varying size of the nucleus caudalis and a right-angle bend to facilitate accurate lesion placement. Proximal insulation of the electrode tip protects the spinocerebellar tract, which overlies the nucleus. A very small craniectomy is performed from just past the midline to the lateral edge of the big foramen magnum, and the ipsilateral half of the atlas is removed. A single linear row of lesions is made at 75°C for 20 seconds, in a gentle curve extending cephalad from C2, in line with the DREZ and remaining medial and dorsal to the rootlets of the eleventh cranial nerve. Approximately 10 lesions are made with the shorter electrode (1.8-mm. tip with 0.6-mm. proximal insulation), ending at the level of the motor rootlets of C1. The remaining 6 to 10 lesions are made with the longer electrode (2.6-mm. tip with 0.6-mm. proximal insulation) and extend up to the level of the obex, where the impedance decreases and the tissue is softer to penetration. It has been found to be highly effective as a treatment modality for trigeminal neuralgia.

Stereotactic surgery

Stereotactic radiosurgery is a fairly new treatment that uses a concentrated beam of radiation to try and reduce pain signals travelling along the trigeminal nerve. The goal of stereotactic procedures is to provide accurate navigation to a point or region in space. Stereotactic methods provide guidance techniques to access deep structures within the brain without the necessity of direct visualization. Further developments included frame-based, image-guided neurosurgical procedures for the biopsy and treatment of lesions using primarily computed tomography (CT) or magnetic resonance imaging (MRI) as well as the advent of frameless stereotaxis, which provides accurate localization based on various forms of three-dimensional digitization of the skull and brain. Radiosurgery is usually performed by delivering a high dose of ionizing radiation in a single treatment session using multiple beams precisely focused at the target inside the brain. Several reports have documented the efficacy of Gamma Knife, stereotactic radiosurgery for trigeminal neuralgia. Because radiosurgery is the least invasive procedure for trigeminal neuralgia, it is a good treatment option for patients with co-morbidities, high-risk medical illness, or pain refractory to prior surgical procedures.

5. Conclusion

Severe bouts of pain of Trigeminal Neuralgia can be a cause of great anxiety to a patient. Usually in the first instance the Atypical pain responds to the drugs but once it leads to deepening anxiety and associated co morbidity a change to a neurosurgical technique is indicated by a specialist and dealt by a specialist. Neurectomy, Rhizotomy, Caudalis DREZ Coagulation can be helpful in severe cases.

REFERENCES