Trigeminal Neuralgia

BACKGROUND

Introduction
Trigeminal neuralgia, also referred to as tic douloureux, is a distinct, painful disorder of the face that is easily evoked by trivial stimuli. The International Association for the Study of Pain defines classical idiopathic trigeminal neuralgia (TN) as “a sudden, usually unilateral, severe, brief, stabbing, recurrent pain in the distribution of one or more branches of the fifth cranial nerve.” However, there are variations in presentation that are more difficult to diagnose. Patients who experience this disorder are continually fearful while in remission that the attacks may reoccur. Treatment for trigeminal neuralgia consists of both medical and surgical options. The epidemiology, diagnostic criteria, pathophysiology and treatment options will be discussed.

Epidemiology

The estimated incidence of trigeminal neuralgia ranges from 2.1 - 5.9/100,000 new cases per year. There is a slight female to male predominance of 1.5 to 1. The peak incidence of trigeminal neuralgia occurs in the fifth to seventh decades with 90% of cases beginning after age 40. A familial link in patients with trigeminal neuralgia is rare, but several cases have been reported. The cause of trigeminal neuralgia is not identified in approximately 85% of cases. Secondary causes of TN include benign or malignant tumors of the brain or multiple sclerosis, and these may present later in the disease process. These secondary causes result in approximately 15% of the diagnosed cases.

RELEVANT ANATOMY

Clinical Characteristics and Diagnosis (Signs and Symptoms of disease)
The pain of trigeminal neuralgia is usually a sharp, electric-like sensation. It is generally extremely severe with painful episodes typically lasting seconds, although some patients with classic trigeminal neuralgia report attacks of up to two minutes. Multiple attacks often occur for days, weeks or months at a time. Most individuals have short, pain-free intervals, but often have difficulty detecting these respites and report that their pain is constant. Some patients have what is believed to be an atypical presentation with dull, burning pain in between episodes of sharp, shooting pain. These cases are believed to have less favorable treatment outcomes.

Trigeminal Neuralgia occurs in the distribution of the trigeminal nerve. The trigeminal nerve is the main sensory nerve for the face and has three branches V₁ (eye), V₂ (maxillary/upper lip), and V₃ (jaw). The pain is infrequently localized to the area around the eye. Table 1 contains the frequency of involvement of the three distributions. In a large literature review, it was noted that 61% of patients complained of right-sided attacks while 36% had left-sided attacks. It is rarely bilateral and most of these cases are a result of a secondary cause such as multiple sclerosis.
Table 1: Distribution of pain in trigeminal neuralgia

| V_1 alone | 4% |
| V_2 alone | 17% |
| V_3 alone | 15% |
| V_2 + V_3 | 32% |
| V_1 + V_2 | 14% |
| V_1 + V_2 + V_3 | 17% |

Attacks of trigeminal neuralgia can be triggered by the slightest of stimuli. While the most frequent triggers are talking and eating, slight touch, brushing teeth, cold air and emotional distress can also cause the intense pain. A patient affected by an acute attack of trigeminal neuralgia generally ceases all facial movement and brings his/her hands to the area of pain while being careful not to disturb the area.

The International Headache Society has established diagnostic criteria for idiopathic trigeminal neuralgia (Table 2). Most physicians investigate for secondary trigeminal neuralgia, especially if a sensory loss is noted on examination.

Table 2: International Headache Society criteria for trigeminal neuralgia

1. Paroxysmal attacks of facial or frontal pain that last a few seconds to less than 2 minutes.
2. Pain has at least four of the following characteristics:
   A. distribution along one or more divisions of the trigeminal nerve,
   B. sudden, intense, sharp, superficial, stabbing, or burning in quality:
   C. severe intensity,
   D. precipitation from trigger areas or by certain daily activities such as eating, talking washing the face, or cleaning the teeth,
   E. the patient is entirely asymptomatic between paroxysms
3. No neurologic deficit.
4. Attacks are stereotyped in the individual patient.
5. Exclusion of other causes of facial pain by history, physical examination findings, and special investigation when necessary.

Pathophysiology (Cause of disease)

The true cause of TN is unknown. A common hypothesis is that chronic irritation of the nerve by an artery leads to a greater than normal excitability of the nerve. This hyperexcitability then causes the brain to interpret normal sensory stimuli as exceedingly painful. Other experts hold that the painful stimuli are a result of an abnormality within the central nervous system. The various treatment regimes currently in use seek to block the pain during the trigger and/or amplification process.
TREATMENT OPTIONS

• Medical
• Surgical

Medical Treatment

Both medical and surgical treatments are used in TN. Generally medical treatment is attempted prior to surgical evaluation. It was discovered approximately 65 years ago that the pain from trigeminal neuralgia responded to anti-seizure medications (such as notably diphenylhydantoin and carbamazepine) led researchers to believe the pain was a result of epileptic seizures. Today, several effective medications are attempted prior to surgical therapy.

• Carbamazepine: Recognized as the best available drug for the treatment of TN and is the first-line agent used by most physicians. Its mechanism is to decrease the response of trigeminal neurons to peripheral stimulation. Carbamazepine delivers relief in up to 80% of individuals in the short term, but relief rates fall to 60-70% in the long term.

• Phenytoin: Was the first drug noted to be effective for TN, now relegated as a second or third-line agent. Its proposed mechanism is lowering the central response of the maxillary nerve stimulation.

• Baclofen: Can be used alone, or in combination with Carbamazepine and Phenytoin. Its mechanism of action is similar to that of Phenytoin.

Other agents include but are not limited to valproic acid, lamotrigine, gabapentin, oxcarbazepine, and topiramate. Polypharmacy, or treatment with more than one drug, is sometimes required as patients become less responsive to medication with time.

TECHNIQUE AND RISKS OF SURGICAL TREATMENT

Surgical therapy is generally reserved for cases refractory to medical management, or when the side-effect profile of medical management exceeds the risk of surgery. There are several surgical approaches to the treatment of TN. The current mainstays of therapy include peripheral nerve ablation, percutaneous trigeminal rhizotomy, microvascular decompression and stereotactic radiosurgery. The chosen procedure varies depending on the patient’s age, concurrent medical problems, and their risk for general anesthesia.

1. Peripheral nerve ablation is a procedure that locally blocks the division of the trigeminal nerve involved with pain. The means of ablation typically include local (peripheral) blocks with phenol or alcohol or a neurectomy of the involved trigeminal branch under local anesthesia. This procedure is a consideration for especially elderly patients that are not candidates for general anesthesia with pain more in the forehead than the lower divisions of the trigeminal nerve. Disadvantages to this procedure include sensory loss in the distribution of the ablated nerve as well as a high rate of recurrence of pain due to nerve regeneration.

2. Percutaneous trigeminal rhizotomy (PTR) is a viable option for the treatment of trigeminal neuralgia in people who are at an increased risk of general anesthesia, patients wishing to avoid a craniotomy, multiple sclerosis patients, and individuals with a life expectancy of less than 5 years. The objective of this procedure is to destroy selective fibers of the trigeminal nerve deep in the skull. The methods of ablation typically include radiofrequency coagulation, glycerol injection, mechanotrauma by balloon ablation, and injection of sterile boiling water. Recurrence rates are generally thought to be comparable with the different lesioning techniques. The primary difference between PTR and peripheral nerve ablation is the depth of the target and the type of technique used to block the nerve’s pathways. Recurrence of pain is often treated by another PTR as are those that fail peripheral nerve ablation. The main
disadvantage of this procedure is a higher recurrence rate than other more invasive procedures.

3. **Microvascular Decompression (MVD)** is indicated in patients who are unable to achieve adequate relief through medical management and have an anticipated survival ≥ 5 years and are considered candidates for a craniotomy under general anesthesia. The objective of this procedure is to explore the base of the brain surgically through a craniotomy. Usually a non-absorbable insulator is placed at the base of the trigeminal nerve. Relief is often long lived with preservation of pain relief at ten years averaging 60-70%. This procedure carries the risk of major neurological compromise at a rate of between 1 - 10%.

4. **Sterotactic Radiosurgery (SRS)** is becoming more widely practiced and is the least invasive of these procedures. SRS is generally recommended for patients with many co-morbidities, high-risk medical illness and pain refractory to other surgical procedures. Significant pain reduction rates are considered to be high, but many are not pain free. Pain relief begins approximately 3-6 months after the procedure. SRS can be repeated as early 4 - 6 months after the original procedure. Disadvantages of this technique includes a roughly 20 - 30% risk of decreased sensation in the nerve after the treatment. Additionally, radiosurgery involves the application of ionizing radiation to a portion of the brain. The long-term effects of targeted radiation to the brain have not been fully elucidated.

### EXPECTED OUTCOME AFTER SURGERY

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Percutaneous Techniques (PTR)</th>
<th>MVD</th>
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<tbody>
<tr>
<td></td>
<td>RFR</td>
<td>Glycerol</td>
</tr>
<tr>
<td>Initial Success Rate</td>
<td>91-99%</td>
<td>91%</td>
</tr>
<tr>
<td>Medium-term recurrence rate</td>
<td>19% @ 6y</td>
<td>54% @ 4y</td>
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<tr>
<td>Long-term recurrence rate</td>
<td>80% @12y</td>
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<tr>
<td>Facial numbness</td>
<td>98%</td>
<td>60%</td>
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**AUTHOR**

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**RELEVANT TERMS**

**Trigeminal nerve:** Cranial Nerve 5 that supplies sensation to the face in three distributions.

1. **Peripheral nerve ablation:** Procedure that locally blocks the painful portion of the trigeminal nerve, just under the skin or mouth lining. The nerve may be injured by injection of alcohol, cutting (sectioning) or avulsion of the nerve branch.
2. **Percutaneous Balloon Compression Rhizotomy:** Procedure where a balloon is inflated to compress and mechanically injure the trigeminal nerve root as well as the Gasserion ganglion.
3. **Percutaneous Glycerol Rhizotomy:** A chemical injection of glycerol is placed into the space surrounding the Gasserion ganglion. This glycerol produces a relatively mild injury to the nerve.
4. **Percutaneous Radiofrequency Rhizotomy:** Lesioning the gasserion ganglion with thermocoagulation.
5. **Microvascular Decompression (MVD):** Used to alleviate neurovascular compression upon the trigeminal nerve root. Micro-instruments are used to mobilize offending vessels away from the trigeminal nerve root. This decompression is permanently maintained by inert implants, between the offending vessels and nerve.
6. **Stereotactic Radiosurgery (Gamma Knife):** This technique provides focused radiation to be delivered to the trigeminal nerve root and produces injury and results similar to the other percutaneous rhizotomy procedures.
**ADDITIONAL FIGURES**

Percutaneous Trigeminal Rhizotomy (PTR)

- Balloon Compression of Ganglion

- Radiofrequency Rhizotomy (RFR)

- Glycerol Injection

Microvascular Decompression (MVD)
Stereotactic Radiosurgery (Gamma Knife) for Trigeminal Neuralgia (SRS)