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Trigeminal surgery: A review

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Abstract
Introduction: The study of trigeminal surgery is linked to trigeminal neuralgia and being a serious disorder can impair the patient's quality of life.
Objective: To analyze the literature on relevant aspects of trigeminal surgery, such as decompression, sensitivity, anesthesia and schwannomas.
Methodology: PubMed, SCOPUS and Google Scholar databases were reviewed to find recent articles published on trigeminal surgery with the following keywords: “trigeminal nerve”, “trigeminal surgery”, “decompression”, “schwannomas”, “anesthesia”.
Results: Microvascular decompression is the most effective procedure for the management of trigeminal neuralgia; highly favourable results have been achieved with this technique. Sensitivity is of great importance in the treatment of this condition, since it is the reason why patients will come for consultation with the aim of eliminating any discomfort related to a nerve condition. Anesthesia requires correct management for a good result in trigeminal surgery and to provide the best care and recovery to patients. Schwannomas are usually benign and rare intracranial tumours. There are several treatments that can help to treat them, the most used and that has achieved excellent results is gamma knife radiosurgery.
Conclusions: Trigeminal neuralgia is a condition that usually appears in one or more branches of the trigeminal nerve, trigeminal surgery is usually a method to treat this condition by means of different techniques such as microvascular decompression and thus achieve disappearance of this disorder.

Keywords: Trigeminal surgery, decompression, trigeminal nerve, schwannoma, sensibility, treatment

1. Introduction
The study of trigeminal surgery is of great importance as it is linked to trigeminal neuralgia, this condition is a serious disorder and impairs the quality of life of patients [1].
Trigeminal neuralgia (TN) is characterized by sudden, severe, brief, stabbing, recurrent episodes of facial pain in one or more branches of the trigeminal nerve. Attacks of pain may occur spontaneously or may be triggered by non-noxious stimuli, such as talking, eating, washing the face, or brushing the teeth [2-3].
Initially, patients may experience short, mild attacks. But this pain disorder can progress and cause longer and more frequent episodes of pain and discomfort. TN affects women more often than men and is more likely to occur in people over 50 years of age [4].
One of the treatments for trigeminal neuralgia is surgery, however, there are several points of importance that require proper review. In this paper, we discuss several relevant points in trigeminal surgery, such as microvascular decompression, sensitivity, anesthesia, and schwannomas.

2. Materials and Methods
Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using guidelines, i.e., identification, review, choice and inclusion.

The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews. The search was performed using Boolean logical operators AND, OR and NOT, with the keywords: “trigeminal nerve”, “trigeminal surgery”, “decompression”, “shwannomas”, and “anesthesia”. The keywords were used individually, as well as each of them related to each other.

3. Results and Discussion

3.1 Decompression

Microvascular decompression (MVD) is a procedure consisting of the release or decompression of the trigeminal nerve and is the most effective procedure for the long-term management of TN. The long-term outcome is associated with the type of vascular structure involved, with pure venous conflict being associated with a higher risk of surgical failure. These findings should be taken into account when planning surgery for patients with TN [5]. In addition, complications in this procedure are uncommon and are usually transient [6]. The likelihood of an excellent outcome is higher in men and in patients with primary trigeminal neuralgia [7]. The selection of this technique depends on the accurate finding of neurovascular compression by preoperative imaging. In addition, magnetic resonance imaging plays a diverse role in MVD, not only in identifying the responsible vessels but also in determining prognosis and as a tool for scientific research [8].

Accurate diagnosis is crucial because neuroimaging interpretation and clinical management differ among the various forms of facial pain. MR images using specific sequences should be part of the diagnostic analysis to detect possible neurovascular contact and exclude secondary causes [9].

Trigeminal microvascular decompression is the surgery of choice in patients with trigeminal neurovascular conflict, while neuro ablative surgical treatments may be offered if MR images show no neurovascular contact or when patients are considered too fragile for microvascular decompression or do not wish to take the risk [10].

Primary trigeminal neuralgia (TNP) recurs after MVD surgery. However, the rates and factors contributing to the recurrence of TN remain controversial. Even for patients with TNP who have a successful operation, 10% of them will still relapse. There are several factors that may affect this recurrence rate, although, compared to other operations, MVD has a relatively lower recurrence rate. Improved surgical techniques and the combination of partial sensory rhizotomy and MVD will produce better results [11].

Other treatments used for trigeminal neuralgia are percutaneous procedures (glycerol rhizotomy; thermo coagulation; and balloon compression). In comparison, MVD provides better initial pain relief and longer-lasting relief than percutaneous surgery [12].

Based on the information obtained we can conclude that MVD is a widely recommended procedure in TN, and favorable results have been achieved with this technique. There are more treatments, but MVD has proven to be the most effective and widely used.

3.2 Sensitivity

There is a high density of free nerve endings of trigeminal neurons. These neuronal fibres are highly specialized to detect noxious stimuli such as thermal, mechanical, chemical and biological signals [13].

Trigeminal nerve injury and trigeminal neuralgia produce intractable pain in the orofacial skin and oral mucosa, through mechanisms distinct from those seen in the spinal area, which is particularly difficult to predict or treat [14]. Many recent studies suggest that inflammation is involved in neuropathic pain [15].

The main clinical manifestation of trigeminal nerve damage is loss of sensory innervation of the cornea and disruption of neurotransmitter supply to its cells, which manifests as corneal hypo- or anesthesia [16]. Neurosensory disorders caused by trigeminal nerve lesions can affect many aspects of daily life [17-18].

The role of the trigeminal system in facial and Dural sensitivity has long been recognized. More recently, the trigeminal system has also been considered of great importance in the nociceptive innervation of the brain. It is the anatomical substrate of several common conditions, such as primary or secondary headaches, trigeminal neuralgia, and other orofacial pain [19].

Trigeminal neuralgia is often misdiagnosed at initial presentation, due to a close connotation with dental pain, and is often over diagnosed, leading to numerous unnecessary surgical procedures. Evaluation of the sensorineural system can reveal the correct anatomic location of the aetiology [20-21].

Corneal and flicker reflexes are integral measures of trigeminal and facial neurosensory evaluation, and their abnormal function can facilitate the identification of intrinsic brainstem disease. These reflexes can be used to uncover pathologic lesions including intracranial trigeminal space-occupying, lateral medullary lesions, cerebral hemispheric lesions, and central nervous system degenerative diseases.

Dental surgeons and oral and maxillofacial surgeons should consider the corneal reflex in the neurological evaluation of the patient presenting with trigeminal neuralgia-like symptoms, a failure to assess corneal sensitivity may result in delayed or inaccurate diagnosis and inappropriate treatment interventions [20].

From the information obtained, we can conclude that sensitivity plays a very important role in trigeminal neuralgia. Trigeminal neuralgia is usually characterized as severe pain and it is important to be able to manage it, as most patients will seek medical attention until it is evident in order to eliminate it.

3.3 Anesthesia

Effective pain management is critical to the patient's well-being and is an important part of the perioperative care pathway [22].

Anesthesia is a safe and effective way to control pain. Anesthetic agents work by reversibly binding to sodium channels, preventing sodium from entering cells and thus inhibiting the propagation of nerve impulses. Consequently, nociceptive impulses associated with painful stimuli do not reach the brain and the patient does not perceive pain [23].

There are different types of anesthesia, one of the most commonly used for different types of procedures is local anesthesia. This article will mainly discuss general anesthesia, which is mostly used for major procedures or surgeries [24].

General anesthesia is used in medical procedures that require "putting the patient to sleep". It involves the use of a medication (either through inhalation of gases through a mask or intravenously), which results in loss of consciousness and inability to feel pain. General anesthesia often uses a combination of inhaled gases and intravenous medications [25-26].

In recent decades, several new and modern techniques have been developed for continuous monitoring of vital signs in patients undergoing surgery under general anesthesia. These complex methods are intended to be an adjunct to the classical monitoring protocols used in general anesthesia to increase patient safety [27].

The main objectives of monitoring are to avoid overdosing or underdosing of anesthetic drugs, to adapt the concentration of substances in use, to reduce post-anaesthetic complications, and to increase patient comfort.

Delirium is a common and serious postoperative complication that manifests as an acute and fluctuating failure of the brain to support normal arousal, attention, and organized thought. Postoperative delirium has been associated with delayed recovery from surgery and persistent neurocognitive disturbances, as well as other adverse outcomes [28].

It is also important to emphasize about patients' fears toward general anesthesia. The overall prevalence of preoperative anxiety among 14 000 surgical patients was reported to be 48%. The most common fears among surgical patients include: Fear of surgical complications, concern about the duration and degree of disability after the procedure, concerns about general anesthesia and associated loss of control, as well as fear of waking up and experiencing discomfort and pain during or after surgery [29].

Anesthesia is a fundamental part of any type of surgery and this is no exception, it is important to have clear and precise knowledge about the use of general anesthesia in trigeminal surgeries, this in order to achieve a better procedure when treating a neuralgia or condition in this nerve.

3.4 Schwannomas

Schwannomas of the trigeminal nerve (TS) are rare intracranial tumours, often presenting with debilitating trigeminal and/or oculomotor nerve dysfunction [30]. These tumours are benign lesions with intracranial and extracranial extension. TS are rare compared to vestibular schwannomas [31].

Trigeminal schwannomas can originate from any section of the fifth cranial nerve, from the root to the distal extracranial branches, but most develop from the gasserian ganglion, which usually grows in the middle skull [32].

There are different symptoms that patients with this tumour usually present. Among the most common are facial numbness, hypoesthesia, changes in facial sensation, weakness of the masticatory muscles and facial pain. Other symptoms that may also occur but are less common are typical trigeminal neuralgia and trigeminal motor insufficiency [31], 33].

Treatments of schwannoma have improved dramatically in the previous decades, but preservation of the original nerve functions, such as facial sensation, remains a challenge [34-35].

This tumour can be managed with a variety of treatments, including surgery, stereotactic radiosurgery, such as gamma knife radiosurgery (GKS), and combination of these [36-37].

GKS has been considered as the gold standard stereotactic radiosurgery mode for the treatment of intracranial tumours, cerebrovascular diseases and functional brain diseases. Subsequently, the efficacy, safety and complications of this type of surgery for trigeminal schwannomas have been systematically evaluated [38]. Finally, it was concluded that GKS is an effective primary and adjuvant method for treating trigeminal schwannomas, with reliable tumor control rates [39-40].

About trigeminal schwannoma, we can conclude that it is a usually benign tumour and although there are different types, this is the rarest one. Its symptoms are very characteristic and are of vital importance in order to diagnose it correctly and provide the best treatment. One of the best treatments for this tumour is GKS.

4. Conclusions

Microvascular decompression is the most effective procedure for the management of trigeminal neuralgia and sensitivity plays a very important role, since this condition is characterized by very intense pain. Anesthesia in this type of procedure is of vital importance to achieving success in surgery and thus a good quality of life for patients.

5. Conflict of Interest

Not available

6. Financial Support

Not available

7. References

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