EVALUATION OF MICROVASCULAR DECOMPRESSION SURGERY FOR TREATMENT OF PRIMARY TRIGEMINAL NEURALGIA.

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ABSTRACT:

Background: *Trigeminal neuralgia may be "classical" or "symptomatic". The term classical refers to trigeminal neuralgia (TN) of unknown cause. While the secondary or symptomatic trigeminal neuralgia is due to other causes such as tumors or demyelinating lesions. The pathogenesis of TN and the effect of the different surgical procedures are not completely understood until now. However, the neurovascular conflict theory is a cause widely accepted and can also explain other cranial rhizopathies. Treatment options for the trigeminal neuralgia include medical treatment, ablative procedures (Gasserian ganglion percutaneous techniques, gamma knife surgery) and non-ablative procedure (microvascular decompression). Microvascular decompression is associated with the most favorable outcome.*

Aim of the study: *the study aims to evaluate the effectiveness of microvascular decompression in patients with primary trigeminal neuralgia regarding pain control, recurrence rate, and procedure-related complications.*

Patients and Methods: *We conducted a prospective observational study on 20 patients with primary trigeminal neuralgia, operated upon for microvascular decompression with follow up period at immediate post-operative, 6, 12 months period regarding pain control and recurrence.*

Results: *excellent outcome with complete pain resolution has been observed in 75%, and only 5 % no pain control at immediate post-operative month follow up, there is a 5% incidence of transient facial palsy and CSF leakage.*

Conclusion: *Although MVD surgery is an effective remedy for cranial nerve rhizopathies. Emphasis on operative skills, safety focus, and pre-plans for managing postoperative complications is critical to improving patient outcomes. As these cranial nerve hyperactivity disorders per se are not life-threatening, a safe surgery should be the priority of MVD*

Keywords*: trigeminal neuralgia, vascular compression, endoscopic, internal neurolysis.*

INTRODUCTION:

Trigeminal neuralgia is also coined with 'tic douloureux': a syndrome characterized by paroxysmal attacks of pain. Via myelinated A-fibers, it is caused by non-nociceptive stimuli such as yawning, chewing, light touch, and other transmitted stimuli. Trigeminal neuralgia may be "classical" or "symptomatic". The term classical refers to trigeminal neuralgia (TN) of unknown cause. While The secondary or symptomatic trigeminal neuralgia is due to other causes such as tumors or demyelinating lesions[1]. The pathogenesis of TN and the effect of the different surgical procedures are not completely understood until now[2]. However, The neurovascular conflict theory is a cause widely accepted and can also explain other cranial nerve rhizopathies[3]. Facial pain is a complex issue that may originate not only from the nerves but also from other facial structures. The most important issue is the sound clinical diagnosis of the trigeminal neuralgia, as the importance of investigations is limited to reveal secondary causes or compressing vascular loop. Treatment options for the trigeminal neuralgia include medical treatment[4,5], ablative procedures (Gasserian ganglion percutaneous techniques, gamma knife surgery)[6],[7]and non-ablative procedure (microvascular decompression)[8],[9].

AIM OF THE WORK:

The aims of the work to evaluate the effectiveness of microvascular decompression in patients with primary trigeminal neuralgia regarding pain control, recurrence rate, and procedure-related complications.

PATIENTS AND METHODS:

A prospective observational cohort of 20 patients with primary trigeminal neuralgia operated upon in the Ain shams university hospital and Wisconsin university hospital in the period between 2016-2019. All patients met the inclusion criteria: primary trigeminal neuralgia with no previous percutaneous procedures. Preoperative clinical assessment involves the assessment of the pain regarding quality, side, distribution, duration of symptoms before the surgical intervention, type of pain based on Burchiel classification, associated other cranial nerve rhizopathy, any previous surgical or percutaneous procedures. Also, radiological assessment involving thin cuts posterior fossa MRI combined with MRA.

Intraoperative assessment involves a determination of the offending vessels, preservation of the superior petrosal vein, the role of the endoscope. Postoperative assessment of the complications: CSF leakage, hematoma, cranial nerve dysfunction, mortality. All patients had been followed up in an outpatient clinic or contacted by a phone call to assess pain control at immediate post-operative, 6, 12 months follow up post-operative pain assessment using Barrow neurological institute pain intervention (BNI). Failure considered if pain persists beyond one year.

RESULTS:

There were 12 females and 8 males in this series. The ages if the patients ranged from 21-84 years with a mean age of 58.3 +/- 17.03 years, (Table 1). No patient history of multiple sclerosis, all patients had been refractory to medical therapy. The majority of patients had pain in the second and third division of the trigeminal nerve (Table 2). most of the patient had type 1 trigeminal pain (Table 3). Endoscopic-assisted surgery is done in 15 % of cases. Superior cerebellar artery represents the most common offending vessels (65%), while the basilar artery represents (10%) (Table 4). The mean duration of symptoms before the operation was 13 months. Pain assessment reveals at different follow-up periods including immediate post-operative, after 6 months, one year follow up as shown (Table 5). There is a trend but not statistically significant suggesting better outcomes with type one trigeminal neuralgia. (Table 6).

Complications: There were no operative deaths or major strokes in this series of patients. Csf leakage noticed in 5%, and one patient (5%) experienced transient facial palsy and hearing loss till one year of follow-up

Patient demographics:

The age ranged from 21 till 84 years with a mean age of 58.3 +/- 17.03

Table (1): age distribution in the population group.

Age range (years)	Number of patients	Percentage (%)
< 50	4	20
50 - 70	11	55
>70	5	25

Clinical characteristics:

Table (2): Distribution of pain in different trigeminal nerve branches.

Trigeminal branch affected	n	%
V_2	5	25
V_3	4	20
$V_{2,3}$	8	40
$V_{1,2}$	2	10
$V_{1,2,3}$	1	5

Table 3: vessels involved in the conflict.

Vessels	n	%
SCA	13	65
SCA and vein	2	10
Basilar	2	10
Negative exploration	2	10
vein	1	5

Table 4: characteristics of pain.

Type of pain	N	%
Type 1	17	85
Type 2 a	2	10
Type 2 b	1	5

Table (5): follow up assessment immediate, after 6 months and at one year follow up.

Post-operative period	Excellent (BNI I)	Good (BNI II)	Fair (BNI III)	Poor (BNI IV, V)
Immediate	15 (75%)	3 (15%)	1 (5%)	1 (5%)
6 months	16 (80%)	2 (10%)	1 (5%)	1(5%)
1year	16 (80%)	3 (15)	0	1(5%)

Table (6): Relationship between the type of pain and pain relieve after 6-months follow up.

Type of pain	Number of patients.	Excellent	Good	Fair	Poor
Type 1	17	16 (94%)	1(6%)	0	0
Type 2 a	2	0	1(50%)	1(50%)	0
Type 2 b	1	0	0	0	1(100%)

DISCUSSION:

Trigeminal neuralgia is primarily an adult disease with an average age of onset ranging from 57 to 61 years[10], with only 1.5% of trigeminal neuralgia patients younger than 50 years[11]. In our series, the average age of patients at the onset of pain was 60 years. The proposed theory underlying the later age of onset is likely due to atherosclerosis and arterial elongation leading to the repositioning of the arterial vessel. Remodeling and repositioning of the vessel ultimately place it in contact with the trigeminal nerve[12].

The incidence of trigeminal neuralgia in the general population is about 27/10000, while the incidence increases with age to around 1/1000 patients older than 75 years[13]. Herein the patients older than 70 years represent 25% of the study population.

Safety of MVD in elderly patients has been a concern and has prompted some neurosurgeons to apply an “age cutoff” when recommending the procedure and advocate for ablative procedure as an alternative. More recently published series in older age groups indicate that fitness, rather than age, should be considered in the decision to recommend MVD[12, 14]. In this study, the preoperative anesthesia assessment of the involved older adults showed a good score based on ASAPS (American Society of Anesthesiologist Physical Status Classification). Patient age showed no significant impact on pain relief, recurrence, hospital stay, or complication rates. These findings are in agreement with the previously published series[12, 14].

Previously published series reveals the incidence of trigeminal neuralgia is more common in females than males[18, 87]. Our results are consistent with this finding (F: M ratio 1.5:1). One proposed explanation for this sex difference is that women have smaller nerve volumes than men.

Trigeminal neuralgia pain is characterized by unilateral pain with the involvement of one or more of the trigeminal nerve branches; the mandibular and maxillary branches are most commonly affected[15-17]. In our series, the most common distribution of symptoms was V2 and V3 divisions, followed by V2. The preoperative pain assessment corresponds to score IV, V based on the Barrow Neurological Institute (BNI) Pain Intensity scale. This distribution can be explained by the large peri-oral somatotopic fiber distribution[18] along with its high concentration of larger fibers (*A*β and *A*δ fibers) when compared with the lateral zones of the face. The same *A*β and *A*δ fibers are located in a more superior position in the REZ and consequently are more vulnerable to compression, mostly by the superior cerebellar artery (SCA), which represents the most common offending vessel[19].

Although trigeminal neuralgia outcome is variable, many reports have shown that shorter duration of symptoms corresponds with favorable short and long-term outcomes following MVD[16, 20]. However, there was no consensus regarding this issue[21]. We did not find evidence of this relationship in our series.

Pain character is another known prognostic factor for the outcome of MVD. Patients with typical pain (unilateral, lancinating, electric episodic) corresponding to Burchiel type 1 group are known to have better outcomes[16, 17] compared to patients with atypical pain (constant dull aching) corresponding to Burchiel type 2b group. Atypical pain is mostly associated with a secondary cause such as multiple sclerosis or tumors. In this study we noticed a trend for better outcome associated with type 1 (typical trigeminal pain) group of patients.

The superior cerebellar artery is the most common offending vessel in our series, representing 60–80% of cases. This finding agrees with most of the published series[16, 17]. It is believed that the superior cerebellar artery compresses the ventromedial aspect of the cisternal segment of the trigeminal, causing mostly typical trigeminal pain in the distribution of the maxillary and mandibular division of the trigeminal nerve. Venous compression as the cause of TN is a relatively rare pathology and occurs in 7–13% of the cases[3, 22-24]. We found that venous compression was detected in 5% of the cases and was associated with atypical type of trigeminal pain (Burchiel type 2) (persistent, burning pressing pain).

The vertebrobasilar dolichoectasia represents an infrequent cause of trigeminal neuralgia, accounting for approximately 2–5.7% of all known cases. Involvement of the vertebrobasilar dolichoectasia is characterized most commonly by significant dilation, elongation, and tortuosity of the vertebra-basilar arteries[25, 26]. We had two cases (10%) of basilar artery dolichoectasia with trigeminal neuralgia in which patients presented with a typical trigeminal pain in the distribution of V2,3 branches of the trigeminal nerve.

The surgical management of vertebrobasilar artery related trigeminal neuralgia varies from retro-sigmoid approach with either separation technique or isolation technique with a sling or anterior petrosectomy (Kawase approach)[27]. We used the retrosigmoid approach in both of our patients, with application of silicon sling for separation of the vessel from the nerve. The role of nerve monitoring is essential in such case as there may be some degree of traction over the facial nerve. However, it is not essential in every case of microvascular decompression; we found it of added value in case of a sling separation of dolichoectatic basilar artery related trigeminal neuralgia. The second case underwent pure endoscopic retro-sigmoid approach and surgical exposure with separation of the basilar artery using a piece of cigar-like Teflon.

In the evaluation of the cause of trigeminal neuralgia, gradient echo imaging, such as CISS (constructive interference in the steady state) or FIESTA (Fast Imaging Employing Steady-state Acquisition), in addition to MR angiography, is usually useful to assess the existence of offending arteries with a very high level of certainty (96% sensitivity, 90% specificity)[28]. Since the incidence of trigeminal neuralgia is 1/10000, it is estimated that 99.9% of individuals with neurovascular compression do not have trigeminal neuralgia, while 28.8% of patients with Type 1 TN exhibit no neurovascular compression[28]. Thus, some cases of trigeminal neuralgia have no vascular compression.

Herein we encountered the situation of negative exploration with no offending vascular loop. Although the patient presented with typical trigeminal neuralgia pain. There was a thickened arachnoidal band surrounding the nerve distorting its course, there was no history suggesting the origin of this arachnoid band (e.g., previous history of meningitis or head trauma). The microsurgical release was performed with internal neurolysis.

Arachnoid thickening or granulomatous adhesion between the root and surrounding structures can cause an abnormal course of the trigeminal nerve root, which causes root angulation and/or torsion, as well as the pulsatile movement of the trigeminal nerve root. This tethering effect can promote abnormal root stretching force, especially at the REZ, which might promote the hyperexcitability of the nerve. This theoretical mechanism suggests that it is important to make the root free along the entire length, especially at its distal portion in cases with no offending vessels[29].

Although we attempted to avoid missing the vascular loop using the 30-degree endoscope to see the blind spot, we could not identify any offending vessels. Instead, we identified an arachnoid adhesion and performed microsurgical release, which ultimately led to an improved outcome. In the other case, internal neurolysis was performed and the patient showed improved symptoms throughout the follow up period. The marked improvement during the post-operative period in these two cases is consistent with the published series of the internal neurolysis in case of negative exploration as a salvage pathway, in addition, releasing the arachnoid band around the nerve with internal neurolysis[30].

We found the use of endoscope useful added value in this series, we used it in 3 cases, and conjunction with a microscope in 2 cases. The endoscopically assisted procedure gave us the advantages of better exploration of the cisternal trigeminal nerve underneath a prominent suprameatal tubercle. One advantage, the endoscope provides is that it eliminates the need to drill the suprameatal tubercle if it is prominent and obscuring the cisternal segment of the trigeminal nerve. This approach is, therefore, an effective way to shorten operating times and improve safety[31].

The initial exploration of the trigeminal nerve may be negative, especially in a tight posterior fossa. Every effort should be done to ensure a hidden vascular loop is not present. Several publications have shown that endoscopically assisted MVD revealed arterial compression in cases where initial exploration was either poorly seen (25%) or not at all (8%)[32]. Herein we experienced this situation of initial negative exploration; bringing the endoscope to the surgical field revealed an anteromedially situated vascular loop of the superior cerebellar artery. This experience can explain why poor outcomes after MVD results in specific cases, as missing the offending vessel due to poor visualization is detrimental[3].

Preoperative assessment of the anatomy of the petrous bone and suprameatal tubercle is essential. We encounter such situation in a single case (5%) of this series with prominent suprameatal tubercle, obscuring the cisternal part of the trigeminal nerve but with the use of endoscopic assisted surgery hidden cisternal segment had been explored with successful separation of the vascular loop. The average size of the suprameatal tubercle is 1.4–1.7 mm in height, and 5.2% of them were higher than 3 mm. The preoperative assessment allows better planning either through drilling or the use of endoscopically assisted technique for better visualization of the cisternal trigeminal nerve root[33, 34].

Superior petrosal vein (SPV) sacrifice remains a controversial issue in neurosurgery, as the neurosurgeon needs to consider whether the vein is the offending cause of trigeminal neuralgia or maybe accidentally injured during a procedure. Because the SPV intervenes between the trigeminal nerve and the surgeon, SPV sacrifice may be necessary to expose the cisternal trigeminal nerve, particularly in the brainstem. Although SPV sacrifice rarely leads to significant consequences[35], cerebellar venous infarction may result and cause serious complication[36, 37]. Herein we sacrificed the superior petrosal sinus in 3 cases with no sequelae.

Reported sporadic cases of familial trigeminal neuralgia have been known to occur[38]; however, the mode of inheritance remains unknown. In our study, we had a single case with familial occurrence in three generations affecting the grandfather, father, and this patient. In this case, the patient presented with typical trigeminal pain at the age of 29 years; workup revealed no associated cause except for a loop of superior cerebellar artery indenting the nerve. This patient underwent MVD and showed improved symptoms during follow up.

Trigeminal neuralgia may be also associated with other cranial nerve compression syndromes, including hemifacial spasm and glossopharyngeal neuralgia[39]. Herein we had 2 cases of associated nerve neuralgia: one case was associated with hemifacial spasm whereas the other was associated with glossopharyngeal neuralgia. In the former case, the patient presented with both trigeminal neuralgia and hemifacial spasm with no associated posterior fossa pathology as is typical in cases of the dolichoectatic basilar artery, posterior fossa AVM, small posterior fossa, and Chiari malformation type [40] Few reported cases of primary combined trigeminal neuralgia and hemifacial spasm to exist in the literature[39].

The incidence and severity of MVD associated complications seem largely dependent on the surgical experience, knowledge of local surgical anatomy, as well as the size and shape of the implants. The incidence of CSF leakage following MVD has been reported to be in the range of 0.9–12% of patients undergoing this procedure[41]. This relatively high incidence of CSF leak can be explained by dura mater contraction, possibly because of reduced hydration or bipolar coagulation resulting in less redundancy compared to other surgical procedures (e.g., tumor removal)[42]. Therefore, even when a watertight dural closure appears to be successful despite the contracted dura mater, there is a possibility that the needle piercing through the dura mater makes pinholes that result in CSF leakage. To overcome this problem, dural repair with muscle pieces can be of value. In our series, we experienced a CSF leak that occurred in only 1 case (5%) and was treated conservatively by lumbar puncture and a compressive bandage.

Trigeminal neuralgia is a functional disorder with many alternative treatment options, including medication or other ablative procedures. Major complications should not be accepted, and safe surgery is the primary concern.

Although neurological deficit and cranial nerve dysfunctions are rare and often transient, we had a case of transient facial nerve deficit grade 2 house Brackman classification with improvement after one week.

Conclusion:

Trigeminal neuralgia diagnosis is a diagnosis of exclusion and relies on the clinical assessment to exclude secondary causes. 3-D T2-weighted steady-state free precession sequences represent the workhorse of evaluating the cisternal CN segments and their relationship to the adjacent vessels. Age alone should not be a contraindication to MVD surgery; instead, health fitness assessment is the rate-limiting step. Typical trigeminal pain is associated with the best outcome and endoscopically assisted MVD is the method of choice for improving visualization and surgical outcome. The most important factor associated with good outcomes is the typical type of pain. Although MVD surgery is an effective remedy for cranial nerve rhizopathies, it remains technically challenging and may result in significant sequelae. Emphasis on operative skills, safety focus, and pre-plans for managing postoperative complications is critical to improving patient outcomes. As these cranial nerve hyperactivity disorders per se are not life-threatening, a safe surgery should be the priority of MVD

Disclosure:

The authors confirm that this paper has not been published in its current form or substantially similar form elsewhere including on a website and also it has not been accepted for publication elsewhere.

The authors disclose no conflict of interest.

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تقييم العلاج الجراحي لآلام العصب المخي الخامس بتخفيف الضغط الوعائي المجهري

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الهدف و المقدمه:

العصب المخي الخامس هو أحد أعصاب المخ الرئيسية المسؤول أساسا عن التغذية الحسية للوجه والتغذية الحركية لبعض عضلات المضغ والكلام وقد أثبتت الدراسات أنها تحدث للنساء أكثر من الرجال وعادة ما تكون فيما بين العقد الرابع والخامس من العمر ويمثل معدل حدوث المرض ٠,١ % ويعتمد تشخيص المرض على التشخيص الإكلينيكي والخبرة الطبيةيتم علاج ألم العصب الدماغي الخامس بالأدوية أو الاجراءات الباضعة ، وفي كثير من الحالات يؤتي العلاج الدوائي نتائج جيدة ولو لفترة محدودة من الزمن وأكثر العلاجات الدوائية استخداما هو عقار الكاربامازيبين. وفي حالة عدم الاستجابة للعلاج الدوائي يتم اللجوء إلى الإجراءات الباضعة مثل تخفيف الضغط الوعائي المجهري.

هدف الدراسه: نهدف في هذه الرسالة إلى تقييم فعالية العلاج الجراحي لرفع الضغط الوعائي المجهري في علاج آلام العصب المخي الخامس.

المرضي و طرق البحث:

◙ هذا البحث دراسة مستقبلية تمت بمستشفيات جامعة عين شمس ومستشفي هليوبوليس ومستشفي التأمين الصحي بمدينة نصر ومستشفي جامعة ويسكنسون بالولايات المتحدة الأمريكية.

◙ تم إدراج ٢٠ مريضا بالدراسة مع تسجيل الشكوى الطبية وصور الأشعة.

◙ تم استخدام الميكرسكوب الجراحي في معظم الحالات مع الاستعانة بالمنظار الجراحي في بعض الحالات.

المتابعة : تم تقييم درجة تحسن الألم ومعدل المضاعفات ومعدل ارتجاع الألم خلال فترة متابعة المريض إكلينيكيا.

النتائج:

- ١٠٠% من المرضي كانوا يعانون ألم بالعصب الخامس و ٦٠% من النساء و ٤٠% من الرجال مع تراوح المرحلة العمرية بين ٢١ سنة إلى ٨٤ سنة.
- وقد وجد أن الشريان المخيخي العلوي هو المسؤول عن هذا الضغط في ٦٥%من الحالات.
- معدل تحسن الألم مرتبط أكثر بنوعية الألم سواء أولي أو ثانوي وقد وجد أنه أفضل في النوع الأول من آلام العصب الخامس.
- معدل تحسن الألم مباشرة بعد الجراحة : ٧٥% ممتاز – ١٥% جيد – ٥% مقبول – ٥%لا يوجد تحسن.
- معدل تحسن الألم بعد ٦ أشهر : ٨٠% ممتاز – ١٠% جيد – ٥% مقبول – ٥%لا يوجد تحسن.
- معدل تحسن الألم بعد سنة من الإجراء الجراحي : ٨٠% ممتاز – ١٥% جيد – ٥%لا يوجد تحسن.

الاستنتاج:

◙ في هذه الدراسة تم التأكيد علي إجراء التدخل الجراحي لعلاج آلام العصب الخامس بتخفيف الضغط الوعائي المجهري يعتبر وسيلة آمنة وفعالة مع التأكيد على أهمية استخدام المنظار المخي أثناء الجراحة.

◙ التشخيص الإكلينيكي لآلام العصب الخامس يعتبر من أهم أسباب نجاح التدخل الجراحي.

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