Endoscopic Neurovascular Decompression for Trigeminal Neuralgia

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Abstract

Introduction: Microvascular decompression (MVD) is a highly accepted and effective method for treatment of patients with primary trigeminal neuralgia (TN) result from vascular compression. However, endoscopic neurovascular decompression (ENVD) for TN provides the better surgical outcomes and minimal complication and recurrence rates and good levels of patient contentment over the long run.

AIM OF THE WORK: To evaluate the effect of endoscopic neurovascular decompression (ENVD) for management of trigeminal neuralgia.

PATIENTS AND METHODS: A retrospective, noncomparative, consecutive case series of 12 cases (8 male/ 4 female) Primary TN cases (mean age 57.5 years; range, 43-61) experienced endoscopic retrosigmoid approach for neurovascular decompression [NVD] in neurosurgical wards. Carried out between January 2018 and January 2020 at Al-Azhar University Hospitals. Trigeminal neuralgia was diagnosed after a thorough history, targeted physical assessment, and MRI were performed to rule out other cerebellopontine (CPA) cranial neuropathies, MRI was done on all patients using T1 and T2 scans without contrast and a T1 sequence with contrast

Results: Improvement of trigeminal pain was noticed in all cases subjected to endoscopic surgery in this research within 24 h after surgery after full recovery. Abortion of producer occur early in one patient due to intraoperative bleeding from laceration of bridging veins during cerebellar retraction and bleeding stopped by compression. patient had recovered safely with a good improvement of trigeminal pain but six months post operative patient complaining of facial pain and controlled by medical treatment. No cases of a cerebrospinal fluid leak or hearing impairment were recorded. No recurrence of trigeminal pain at the follow-up period ranged from 6 months to two years.

Conclusions: ENVD for trigeminal nerve is minimally invasive procedure effective in release neurovascular conflicts and improving pain of trigeminal neuralgia. and safe procedure demonstrate, a minimal rate of surgical complications and a good functional outcome.

Key Words: microvascular decompression, trigeminal neuralgia, Neurovascular decompression, Endoscopic surgery, minimally invasive surgery

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Introduction:

An intermittent, paroxysmal, lancinating pain along the trigeminal nerve spread is characteristic of the condition known as trigeminal neuralgia (TN). Patients with TN often experience chronic, debilitating pain that is difficult to treat medically and often results in the decision to explore surgery options (1).

Alterations in the trigeminal nerve's morphology are the usual outcome of neurovascular compression, the leading cause of TN. Compression of the anterior inferior cerebellar artery (AICA) or the superior cerebellar artery (SCA) are the most common sources of this condition. Multiple sclerosis and cerebellopontine angle (CPA) tumors are two additional causes of TN symptoms (2).

There are a number of suggested treatments for trigeminal neuralgia, but microvascular decompression (MVD) of the nerve core is the gold standard and can eradicate symptoms in most patients. Decompressing the offending vessel(s) and releasing any arachnoid adhesions blocking the entrance root from Meckel's cave to the trigeminal root entry zone is the goal of this delicate technique (3).

Microvascular decompression (MVD) can be done by microscopic approach, endoscopic assisted or pure endoscopic approaches with or without Teflon padding. Each one had merit and limitations. However, endoscopic neurovascular decompression (ENVD) for TN provides the better surgical outcomes and minimal complication and

recurrence rates and good levels of patient contentment over the long run.

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Surgical technique:

Under general anesthesia, the patient was placed in the park bench position, making with the incision site pointing up and the head elevated at 10 -15 degrees. Pin fixation of the skull was used in every case. In addition, lumbar drains are used and open for continuous drainage of CSF and closed at dural opening. To improve hemostasis and soft tissue dissection, 5-7 mL of 2% lidocaine with 1:100,000 epinephrine was administered into the retroauricular region along the planned cut lines.

Skin was cut in a straight fashion, measuring between 5 and 3 centimeters in length. The incision was made about 1 centimeter behind what was thought to be the craniotomy's posterior border and about two fingers away from the helix projection's retromastoid location. The occipital artery and C2 nerve can be protected from injury if the incision is made in this location; once the skin flap has been raised, the dissection can begin with a large cutting burr; however, a diamond burr is needed when working close to the dura and the sigmoid sinus to prevent damage to those structures. The sigmoid and transverse sinuses are reached via a 1.5- to 2-cm-diameter circle craniotomy. Opening the dura in a C-shape, beginning behind the sigmoid and transverse sinuses, helps avoid the need for forceful abduction of the cerebellum. For easier dural re-suturing after surgery, the dural incision is made 1-2 millimeters from the margins of the craniotomy.

Gentle cerebellar retraction, superior and medially to identify the petrosal vein (Dandy vein) and its sacrifice was done to expose the trigeminal nerve in upper CPA followed by gentle circumferential arachnoidal release around the trigeminal nerve, as a result, we perform a comprehensive examination of the TN, beginning at the base of the cranium and ending at the mouth of Meckel's cave, in order to locate any potential areas of neurovascular compression. When the superior cerebellar artery presses on the trigeminal nerve at the root entrance zone, we first move the artery away from the nerve and then use Teflon felt pledgets to keep the artery from moving back into the nerve's path.

Statistical analysis:

Age, sex, years since TN start, TN side, vascular loop side, vascular artery implicated in NVC, therapies prior to surgery, comorbidities, surgical results, complications, and duration until pain disappearance were all recorded. The information was shown as a frequency distribution and a percentage breakdown. In order to conduct statistical research, SPSS for Windows was used (SPSS version 16, Chicago, Illinois). A value of $p < 0.05$ was considered statistically significant.

RESULTS:

The median age at surgery was years range from 41 to 72 years.8 female and 4male. nine patients (75 %) had left-sided symptoms, and no patients had bilateral symptoms or subjected to previous procedure. The majority of patients Had both V2 and V3 distribution of pain, only 3pateint had V1,V2andV3 distribution of pain. Six months to four years is the average time period of signs preceding surgical intervention. Eleven individuals (91.6% of the total) were found to have vascular compression during operation. The SCA (superior cerebellar artery) was the most frequently located arterial during surgery. The length of hospital stay range from 2–7 days. There were no perioperative deaths. Improvement of trigeminal pain was noticed in all cases subjected to endoscopic surgery in this research within 24 h after surgery after full recovery. one patient recovered with slight facial palsy, which resolve after the corticosteroid course. Abortion of producer occur early in one patient due to intraoperative bleeding from laceration of bridging veins during cerebellar retraction and bleeding stopped by packing compression had recovered safely with a good improvement of trigeminal pain but six-month postoperative patient complaining of facial pain and controlled by medical treatment. Hearing loss or leakage of cerebral fluid were not reported. No recurrence of trigeminal pain at the follow-up period ranged from 6 months to two years. [Table 1].

N.	Age	sex (M or F)	Side of pain (Rt or Lt)	TN symptom Duration in monthes	TN branch (V1,V2,V3)	Previous Procedure	Associated Abnormal facial movement	Operating Time in minutes	Compressing Vessel	Complication	Outcome
1	49	F	Rt	24	V2,V3	NO	NO	150	SCA		Improved
2	53	F	Lt	36	V2,V3	NO	NO	120	SCA		Improved
3	60	M	Lt	20	V1,V2,V3	NO	NO	130	SCA	Pneumocephalous	Improved
4	44	F	Lt	12	V2,V3	NO	NO	120	Vein		Improved
5	39	F	Lt	6	V2,V3	NO	NO	90	SCA		Improved
6	59	F	Lt	18	V2,V3	NO	NO	90	SCA		Improved
7	50	F	Lt	12	V2,V3	NO	NO	120	SCA		Improved
8	62	M	Rt	10	V1,V2,V3	NO	NO	120	SCA	Post op facial numbness	Improved
9	41	F	Rt	24	V2,V3	NO	NO	180	-	Intra op bleeding, Post op facial numbness, Wound tenderness	Improved
10	54	F	Lt	40	V2,V3	NO	NO	130	SCA		Improved
11	61	M	Lt	24	V2,V3	NO	NO	90	SCA		Improved
12	55	M	Lt	8	V1,V2,V3	NO	NO	90	SCA		Improved

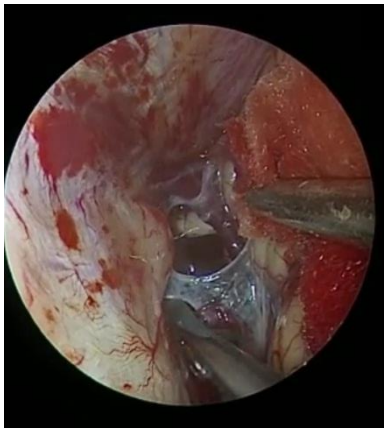

Figure (1): Endoscopic view of upper CPA demonstrating trigeminal nerve and dandy vein

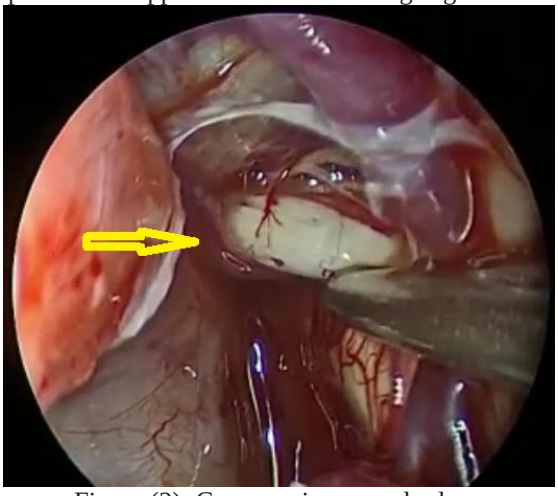

Figure (2): Compressing vascular loop

Discussion:

Micro vascular decompression (MVD) of the nerve core is the gold standard and can eradicate symptoms in most patients. Decompressing the offending vessel(s) and releasing any arachnoid adhesions blocking the entrance root from Meckel's cave to the trigeminal root entry zone is the goal of this delicate technique (4).

Although there are multiple methods for management of trigeminal neuralgia, Ninety percent of patients report improvement in pain after MVD, and this improvement is sustained in 68-88% of cases after 5 years and in 61-88% of cases after 10 years (5, 6).

In this research series of 12 cases (8 male/ 4 female) patients, mean age years (range 43-61), affected by primary trigeminal neuralgia underwent to endoscope minimally invasive retrosigmoid approach for neurovascular decompression [NVD]. although a limited number in our research but This is consistent with research of **Leif-EB, et al(2014**). which have Forty-seven patients (17 men) were identified and enrolled.

Classic TN's pathogenesis has not been fully elucidated. Some fundamental principles state that demyelination and later remyelination occur as a result of neurovascular compression at the trigeminal nerve root entrance zone close to the medulla (7).

About 1–3 millimeters down the nerve from the medulla is the nerve root entry zone, also called the Obersteiner–Redlich zone. Epiphaptic cross-talk occurs when sense A-beta fibers abnormally activate nociceptive A-delta fibers as a result of demyelination and remyelination. The bioresonance theory proposes that harm to the sensory nerves and abnormal impulse transmission results from vibration around the trigeminal nerve rather than just direct compression (8).

Another idea, called the spark hypothesis, proposes that compression causes axotomized somata, which become hyperexcitable and cause paroxysmal nociceptive transmission (9).

Trigeminal neuralgia can be divided into two types: primary and secondary. Primary TN is triggered by vascular compression, whereas secondary TN comprises all other causes of facial nerve damage. In our research, all the affected cases were primary (triggered by vascular compression).

Regarding the age of onset of TN in the research: the age of onset, mostly in the
fifth or sixth decade of life, seems to be similar to other studies (10).

Pain from traditional TN typically affects just one side of the face and can be located anywhere along the trigeminal nerve, which is divided into three segments. It most often manifests as a shift in the V2 and V3 ranges. Less than 5% of people experience only V1-related pain (11).

In our research, all the studied cases were unilateral, which was the left side is more commonly affected representing 75% of cases in our research, and The V2 and V3 distributions are most commonly affected. While 25 %of cases in our research with V1, V2 and V3 distributions of trigeminal nerve and no cases with one branch affection.

In our research the duration of symptoms prior to surgery was range from 6 to 40 months but a median duration of symptoms prior to surgery was 5 years (range 1 month–27 years as observed in research of Leif-EB, et al(2014).

The surgical treatment is the curative treatment, which can be done via microscopic or endoscopic approaches with or without Teflon padding. Each one has its merit and limitations. However, endoscopic microvascular decompression (EMVD) provides the highest rate of long-term patient' satisfaction with the lowest rate of recurrence or complications. In this research, we do a circumferential arachnoid release with release a neurovasclar conflict and keep a compressing vessel away from trigeminal nerve by small Teflon pad in between aiming to achieve good neurovascular separation.

The endoscope, or microscope, has many uses in MVD procedures for TN, including as an effective lighting instrument for MVD because the lens can be inserted into the cerebellopontine angle. All of the roots can be seen, and the surgeon can see the cranial nerves and problematic arteries from any angle because there are no blind spots. Fully endoscopic MVD can enhance surgical results by reducing the risk of nerve damage due to vessel omission (since the endoscope will show the nerve from whole its perimeter more than the microscope) (12). The surgeon can decompress the brain sufficiently during a completely endoscopic operation without the need for the lengthy dissection of the arachnoid membrane and retraction of the cerebellum that is typically necessary for microscopic exposure.

Several single-center studies have reported on E-MVD since its initial description by Eby et al.(13) in 2001. All have found it to be extremely secure, with fantastic short- and medium-term functional outcomes. Among these, the largest was conducted by Kabil et al., who reported findings for 255 cases, all of whom had a positive 3-year success rate and a reduced rate of complications than those seen in previously published studies of microscopic MVD (14).

In this research all cases subjected to pure endoscopic retrosegmoid approach with improving operative time with subsequent cases. and we found the most compressing vessel was SCA in 80% of our cases and one case with compressing vein mostly the superior petrosal vein. The operation was aborted in one patient due to perfuse

hemorrhage and no vessel observed. this result consistent with other research which report that SCA the anterior inferior cerebellar artery (AICA) was accountable for 10% of the trigeminal nerve compression and the facial nerve for 75% of the compression. However, it was always determined that a compressed artery was to blame in every case (15).

Vascular stenosis was found during surgery in 42 of the patients (89%). It was discovered that compressed arteries and veins come in a wide variety of shapes, with the SCA being the most commonly recognized single artery (16).

Regarding the complications: Ipsilateral facial numbness was recorded in one case (8.3%), which appears early postoperative and improved within 2 weeks by

Neurotonic therapy.

Another one patient with postoperative headache and dizziness due to pneumocephalus which improved in many days.

Also, a case of massive intraoperative bleeding mandating cessation of surgery with an unexpected surgical outcome as the patient had completely recovered with totally improved TN without intracerebral hematoma; and postoperatively patient develop headache, ipsilateral facial numbness, and dizziness. This finding had stimulated our thinking regarding the mechanism of improvement after surgery as it may be just posterior fossa decompression.

The results of this research demonstrate an improved rate of trigeminal neuralgia relief, a lower incidence of complications and a better outcome with ENVD. However, several drawbacks exist in our study, the most significant of which is the small sample size and early experience in endoscopic approach for CPA.

Conclusions:

ENVD for trigeminal nerve is minimally invasive procedure effective in release neurovascular conflicts and improving pain of trigeminal neuralgia. and safe procedure demonstrate, a minimal rate of surgical complications and a good functional outcome.

Conflict of Interest:

The authors declare that they have no conflict of interest.

Financial disclosure

None to disclose

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