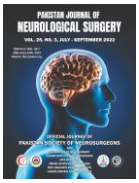

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Original Article

Microvascular Decompression in Trigeminal Neuralgia: Analysis of the Effectiveness of the Surgical Technique and Intraoperative Neuroanatomy-7 Years of Institutional Experience

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ABSTRACT

Objective: The study analyzed the effectiveness of microvascular decompression based on BNI score improvement and interpret the anatomy of offending vessels.

Materials and Methods: A total of 57 patients were included in the study. Data was collected and analyzed for age and gender distribution, the severity of pain, affected division of trigeminal nerve, duration of symptoms, type of petrosal vein, offending vessel, pre-op BNI score, one month & one-year post-op BNI score and major & minor complications of the procedure.

Results: The most common indication for patients to undergo microvascular decompression was side effects of pharmacological treatment, i.e., 36.8%.The most common combination of affected divisions involved was V1 & V2, i.e., 26.3%. BNI score was evaluated 24 hours after surgery and it was observed that 56 (98.2%) patients had a BNI Score of 1. After one year, 46 (80.7%) patients had a BNI Score of 1. So, an effective outcome of microvascular decompression was observed in 80.7% of patients. The most common offending vessel was arterial compression, i.e., 47 (82.4%). Among them, a superior cerebellar artery was found in 40 (85.1%) patients and an anterior inferior cerebellar artery in 7 (14.8%) patients.

Conclusions: Microvascular decompression is a safe and effective procedure for classical trigeminal neuralgia and arterial compression is found in the majority of patients. The BNI score is an effective tool for assessing and categorizing the patient's pre and postoperatively.

Keywords: Trigeminal neuralgia (TGN), Microvascular decompression (MVD), Barrow Neurological Institute (BNI) pain score, Cerebellopontine (CP) angle.

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INTRODUCTION

Trigeminal neuralgia is electric current-like pain affecting one or more divisions of the trigeminal nerve. Pain is categorized by various pain scales and Barrow Neurological Institute (BNI) pain intensity score is considered a common and efficacious scoring system for trigeminal neuralgia. The first-line treatment for patients with idiopathic trigeminal neuralgia is pharmacologic therapy. Multiple surgical options are available including microvascular decompression. Long-term results of microvascular decompression are promising and usually the established modality in cases of pharmacological failure. Trigeminal neuralgia is an electric current-like pain affecting one or more divisions of the trigeminal nerve leading to the miserable status of the patient. It usually affects one side of the face.[1] Its estimated incidence is 12.6 in 100,000 people per year.[2] V2 and V3 divisions of the trigeminal nerve are usually involved in comparison to V1.[3]

Trigeminal neuralgia is a unique nociceptive disorder caused by compression of the trigeminal nerve in the root entry zone by a vascular loop leading to a morphological change in the myelin sheath of the trigeminal nerve. The superior cerebellar artery is the most common off-ending vessel followed by the anterior inferior cerebellar artery and in rare cases a venous loop. Plaques due to multiple sclerosis can also result in trigeminal neuralgia whereas space-occupying lesions in the region of Meckle's cave or cerebellopontine angle can also cause trigeminal neuralgia.[4,5,6]

Magnetic resonance imaging with contrast is the gold standard investigation which can help in diagnosing the offending loop or any lesion causing compression of the trigeminal nerve.

The first-line treatment for patients with classic and idiopathic trigeminal neuralgia is pharmacologic therapy. The most commonly used medication is the anticonvulsant drug carbamazepine. There are multiple surgical options available ranging from radiofrequency ablation to standard Microvascular decompression (MVD).[7]

Pain is categorized by various pain scales while Barrow Neurological Institute (BNI) pain intensity score is considered one of the common and efficacious scoring systems for trigeminal neuralgia.

The categorization of the BNI score is as follows[8]:

(I) No pain, no medication.
(II) Occasional pain, not requiring medication.
(III) Some pain is adequately controlled with medication.
(IV) Some pain is not adequately controlled with medication.
(V) Severe pain/ no pain relief.

The American Academy of Neurology divides trigeminal neuralgia (TGN) into two categories, i.e., classical and idiopathic. Classical TGN is defined as neuralgia secondary to morphological distortion in the trigeminal nerve due to any offending vessel whereas idiopathic TGN is defined as neuralgia in which there is no physical compression of the nerve by the offending vessel.[9] Although MRI-based grading was suggested by Leah et al. has better efficacy in identifying the offending vessel.[10] The indentations found on the trigeminal nerve suggest morphological change causing symptomatology.[11]

The intraoperative anatomy of cerebellopontine angle in cases of trigeminal neuralgia is always fascinating and needs appropriate dissection which is possible with adequate knowledge of the CP angle anatomy. The offending vessel compresses the trigeminal nerve in the root entry zone. The petrosal vein is the first obstacle to reaching the trigeminal nerve. Anatomy and relations of the petrosal vein are variable. The dissection of CP angle cisterns is of utmost importance to prevent major or minor complications.

The objective of this study is to analyze the effectiveness of microvascular decompression

based on BNI score improvement and interpret the anatomy of offending vessels and variations of the petrosal vein in cerebellopontine angle concerning microvascular decompression of trigeminal nerve along with documentation of major and minor complications of the surgical procedure.

MATERIALS AND METHODS

Study Setting

This study was conducted at the Department of Neurosurgery, Jinnah hospital Lahore, from 1st January 2015 to 31st December 2021.

Inclusion Criteria

A total of 57 patients were included in the study. Patients of all ages of both genders who were diagnosed with trigeminal neuralgia were included in the study.

Exclusion Criteria

Patients with trigeminal neuralgia secondary to the tumor and multiple sclerosis were excluded from the study. Patients who had previous surgery and radiofrequency ablation were also excluded from the study.

Data Collection and Analysis

Data were collected and analyzed for age and gender distribution, the severity of pain, affected division of trigeminal nerve, duration of symptoms, type of petrosal vein, offending vessel, pre-op BNI score, one month & one-year post-op BNI score and major & minor complications of the procedure.

RESULTS

Gender Distribution

Out of 57 patients, 31 (54.4%) were male and 26 (45.6%) were female.

Clinical Information

39 (68.4%) patients had right-sided TGN whereas 18 (31.6%) had left-sided TGN. The most common indication for the patients to undergo MVD was side effects of pharmacological treatment i.e. 36.8% (Table 1).

Table 1: Reason for MVD (Microvascular decompression).

Reason for MVD	Frequency (n)	Percent
(1) Side effects of medication	21	36.8
(2) Uncontrollable pain	16	28.1
(3) Combination of 1 & 2	20	35.1
(4) Total	57	100

In our study, the most common combination of affected divisions involved was V1 & V2 (26.3%) (Table 2). The majority of patients (50.9%) had a duration of symptoms ranging from 5-10 years followed by 2 – 5 years (26.3) (Table 3).

Table 2: Division of trigeminal nerve involved.

Division of Nerve	Frequency (n)	Percent
V2	11	19.3
V3	12	21.1
V1 and V2	15	26.3
V2 and V3	10	17.5
V1,V2,V3	9	15.8
Total	57	100.0

Table 3: Duration of symptoms.

Years	Frequency(n)	Percentage
1 year	5	8.8
1-2 years	6	10.5
2-5 years	15	26.3
5-10 years	29	50.9
>10 years	2	3.5
Total	57	100.0

Complications

Regarding minor complications, only 4 (7%) patients had facial numbness. 2 (3.5%) patients

had facial palsy among the major complications of the procedure.

The most common type of superior petrosal vein was type A (49.1%) in our patients who underwent MVD (Table 4).

Table 4: Type of superior petrosal vein.

Type of Superior Petrosal Vein	Frequency (n)	Percent
Type A	28	49.1
Type B	22	38.6
Type C	7	12.3
Total	57	100.0

Barrow Neurological Institute (BNI) Scores

The pre-op BNI score was documented according to the BNI score table and it was found that no patient had scores of 1, 2 & 3, whereas 50.9% had a score of 4 (Table 5).

Table 5: Pre-op BNI score.

Pre-op BNI Score	Frequency (n)	Percent
4	29	50.9
5	28	49.1
Total	57	100.0

24 hours post op BNI score was evaluated and it was observed that 56 (98.2%) patients had BNI Score 1 and 1 (1.8%) patient had BNI Score 3. The score remained the same one-month post-op while after one year, 46(80.7%) patients had BNI Score 1. So, an effective outcome of MVD was observed in 80.7% of patients (Table 6).

Table 6: One-year post-op BNI score.

One-Year Post-op BNI Score	Frequency (n)	Percent
1	46	80.7
2	10	17.5
3	1	1.8
Total	57	100.0

Offending Vessel Leading to Trigeminal Neuralgia

The most common offending vessel was arterial compression i.e., 47 (82.4%). Among them, the superior cerebellar artery was found in 40 (85.1%) patients, and the anterior inferior cerebellar artery in 7(14.8%) patients (Table 7).

Table 7: Offending vessel leading to trigeminal neuralgia.

Offending Vessel	Frequency(n)	Percent
Artery	47	82.4
Vein	10	17.5
Total	57	100.0

DISCUSSION

The first-line treatment for patients with classic and idiopathic trigeminal neuralgia is pharmacologic therapy. The most commonly used medication is the anticonvulsant drug carbamazepine. Other drugs include oxcarbazepine, baclofen, lamotrigine, phenytoin, gabapentin, clonazepam, and valproic acid. There are multiple surgical options available ranging from radiofrequency ablation to standard microvascular decompression (MVD).[8] The long-term results of MVD are promising and usually the established modality in cases of pharmacological failure.

The intraoperative anatomy of cerebellopontine angle in cases of trigeminal neuralgia is always fascinating and needs appropriate dissection which is possible with adequate knowledge of the CP angle anatomy. The offending vessel compresses the trigeminal nerve in the root entry zone. The petrosal vein is the first structure encountered to reach the trigeminal nerve. Anatomy and relations of the petrosal vein are variable and require meticulous dissection before approaching the trigeminal nerve.[12] The dissection of CP angle cisterns is of utmost importance to prevent major or minor

complications.

The long-term outcome of MVD is more favorable for patients with the offending vessel in classical TGN as compared to idiopathic TGN.[13] Multiple sclerosis is one of the common entities to cause TGN other than vascular compression. The scoring of the severity of the pain of trigeminal neuralgia according to the International Headache Society is globally accepted and we categorized our patients according to the same criteria.[14]

In our study, patients with paroxysmal and continuous concomitant pain had the same effectiveness in terms of BNI score which is contradictory to previous studies where pure paroxysmal pain had more significant relief than continuous concomitant pain.[15]

Microvascular decompression is the most widely accepted and effective surgical method to treat TGN. In our study, TGN is more common in males (54.4%) but it was more in females in a study conducted by Herta et al (53.3%).[16] The right side is more frequently involved in our study (68.4%), the same as in a study by Herta et al (61.8%). In our study, the most common indication for surgery was side effects of medication (36.8%) followed by a combination of uncontrollable pain and medicine side effects (35.1%). In a study by Herta et al, the most common indication was uncontrollable pain (71.9%). The pain category was pure paroxysmal in the majority of cases (54.4%) which is the same and comparable with Herta et al (55%).[16] In our study, the combination of V1 and V2 divisions (combined) was involved in the majority of patients (26.3%) but V3 was found commonly involved in another contemporary study.[16] Type A petrosal vein was found preoperatively in the majority of cases (49.1%).

The pre-op BNI score in about half of the patients (50.9%) is 4 and in others (49.1%), it is 5. In another study, score 5 was the most common (83%). The most common offending vessel is the artery (82.4%), also reported in Herta et al, study (82%). The superior cerebellar artery is the most frequently involved (85.1%) in our study whereas it was found in 68.9% of cases in the study of Herta et al[16].

In other studies, 84% to 98% of patients showed immediate post-op pain relief[17,18,19] while it is 98.2% in our study where patients had post-op BNI score 1. In another study, 2 years of follow-ups showed 75.8% of patients with a BNI score of 1 while we observed 80.7% of patients at a score of 1 after one year of follow-up.[15]

Arterial compression is the most common finding in TGN patients and it was observed to be the strongest predictor for good outcome[19] but their results were not statistically significant. In our study, 82.4% of patients had arterial compression and among them, the superior cerebellar artery is the most common i.e. 85.1%. The criteria for successful surgery is contradictory in many studies due to which the meta-analysis cannot infer statistically proven results for outcome after MVD. On the other hand, central pathophysiological changes in the spinal trigeminal nucleus are associated with poor outcomes after MVD.[20,21]

MVD is considered a gold standard, safe and effective procedure for TGN. In our study, facial numbness was seen in 7% and facial palsy in 3.5% of patients. We performed all cases in a lateral position although it is suggested in some studies that the sitting position is safe and effective in morbidly obese patients to avoid cerebellar swelling and have good exposure.[22,23] In our experience, if appropriate positioning is achieved then the surgeon can proceed with retractor-less surgery which is associated with fewer complications although retraction of the cerebellum is believed an essential maneuver in previous studies.[17,24,25] The use of an endoscope for MVD is in practice for two decades but we didn't use an endoscope in our cases.

LIMITATIONS OF STUDY

- Single center study.
- The sample size is small.
- Relatively short follow-up.

RECOMMENDATIONS

We recommend long-term follow-up of patients after MVD as well as the intraoperative anatomical finding relations with the success and complications of operative technique.

CONCLUSION

Microvascular decompression is a safe and effective procedure for classical trigeminal neuralgia. Arterial compression is found in the majority of patients and the BNI score is an effective tool to categorize the patient's pre and postoperative pain grading.

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Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that no other relationships or activities could appear to have influenced the submitted work.

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Usman Ahmad Kamboh & Adeel Rauf	1. Study design and methodology.
2.	Mehreen Mehboob, &Usman Ahmad Kamboh	2. Paper writing.
3.	Faizan Aslam, & Aiqa Gulshan	3. Data collection and calculations.
4.	Sana Jamal	4. Analysis of data and interpretation of results.
5.	Mehwish Manzoor	5. Literature review and referencing.
6.	Manzoor Ahmad	6. Editing and quality insurer.