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Original Article

Outcome of Microvascular Decompression Surgery in Trigeminal Neuralgia: A Single-Center 10-year Experience

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ABSTRACT

Objective: Trigeminal neuralgia is an excruciating pain in one or more of the fifth cranial nerve's branches. Our goal in this study was to report the surgical results of microvascular decompression for trigeminal neuralgia at a single center.

Methods: In our center, we retrospectively analyzed 35 patients who operated with microvascular decompression for trigeminal neuralgia between 2013-2023. The patients had a minimum of 2 years of follow-up.

Results: Twenty-four patients had right-sided, and 11 had left-sided trigeminal neuralgia. Sixteen of them were female, and 19 of them were male. The age interval was between 27-78 years old. The median age of patients was 57 years. Twenty-nine patients reported complete resolution of trigeminal neuralgia after microvascular decompression who did not have previous interventional pain treatment history. These patients did not have any persistent complications.

Conclusion: Microvascular decompression for trigeminal neuralgia is a safe and effective treatment modality. Patients with trigeminal neuralgia that are resistant to medical therapy are ideal candidates for microvascular decompression surgery.

INTRODUCTION

Trigeminal neuralgia (TN) is an incredibly painful condition that affects the fifth cranial nerve. For TN, there are three etiologic classifications: 1. classic—vascular contact on the TN 2. secondary—possible underlying pathology, such as multiple sclerosis or schwannoma; and 3. idiopathic—no discernible structural reason.[1] The overall incidence of TN is approximately 40–50 cases per one million, while the estimated prevalence is around 100–200 per million population.[2] It is recommended to employ magnetic resonance imaging (MRI) to look into the underlying cause of TN. If MRI is not appropriate, neurophysiologic procedures such as brainstem auditory evoked potentials and brain computed tomography and angiography should be used instead. Thin-slice MRIs of the brain and internal auditory meatus are what we typically seek; enhancement is typically not necessary.[3] A high-quality thin-slice MRI can detect possible nerve compression or distortion with good sensitivity (88%; 95% confidence interval 80%–93%) and specificity (94%; 95% confidence interval 91%–96%).

First-line medical therapy is carbamazepine and oxcarbazepine for TN. For the second-line theraphy, lamotrigine, baclofen, gabapentin, and pregabalin are on the list.[3] There is strong evidence for carbamazepine, but for the other options, the evidence is weak. Approximately 25–40% of TN patients choose surgery within two years of the onset of symptoms, according to the guidelines.[4] TN can be treated surgically using posterior fossa microvascular decompression (MVD), and neuroablative therapies include internal neurolysis, balloon compression, glycerol rhizolysis, stereotactic radiosurgery, and radiofrequency thermocoagulation. The best surgical outcomes for MVD are seen in individuals with classic TN, or vascular contact on the trigeminal nerve with long-lasting pain alleviation. In the current study, we aimed to present the 10-year single-center surgical outcomes of MVD for TN.

MATERIALS AND METHODS

The study was approved by the Istanbul Medipol University Clinical Research Ethics Committee (Date: 17/04/2024, No: E-10840098-202.3.02-2399). The study is in compliance with the Declaration of Helsinki.

Patient Characteristics

We retrospectively analyzed 35 patients operated between 2013-2023 with a minimum of 2-year follow-up. Preoperatively, all of the patients used the carbamazepine and did not obtain adequate pain control from medical treatment. Eight of them required additional analgesic medication, and seven of them used gabapentinoid besides carbamazepine. All of the patients had vascular contact with the trigeminal nerve, and one patient had cerebellopontine angle tumor. The pain levels of the patients were evaluated with the Barrow Neurological Institute Pain Intensity Scale. The scale is graded as follows:

I No pain, no medical treatment

II Occasional pain, no need for medical treatment

III Partial pain, adequate pain control with medical treatment

IV Partial pain, no adequate pain control with medical treatment

V Severe pain, no pain control

Surgical Approach

An illustrated case example: A 71-year-old female patient with pharmacoresistant TN in all dermatomes of the right trigeminal nerve. Under intratracheal general anesthesia, the patient was entered through a right suboccipital retroauricular skin incision following the necessary skin antisepsis and surgical draping on the left side decubitus under the skull clamp. Skin, subcutaneous, and pericranium were passed. The right suboccipital muscles were dissected subperiosteally. Additionally, a right retrosigmoid craniectomy was performed with the aid of a cranial perforator. Dura was opened and hanged. The microscope was pulled into the field. Cerebellar retraction proceeded, and the cerebrospinal fluid was drained. The petrosal vein was recognized and coagulated. Proceeding with microsurgical dissections, the right 5th cranial nerve and portio minor were revealed. Then, the superior cerebellar artery, which was compressing the anterior aspect of the nerve, was dissected and removed from the nerve (Fig. 1 & Fig. 2). Teflon was put between the vein-nerve borders. One tissue adhesive was applied to it. Following hemostasis, the dura was primarily closed. The bone flap was fixed with a mini plate-screw system (1 mesh, eight screws). After hemostasis, primary treatment was applied to the layers in an anatomical plan. Perioperative early complications were not observed. The patient was extubated, conscious, co-

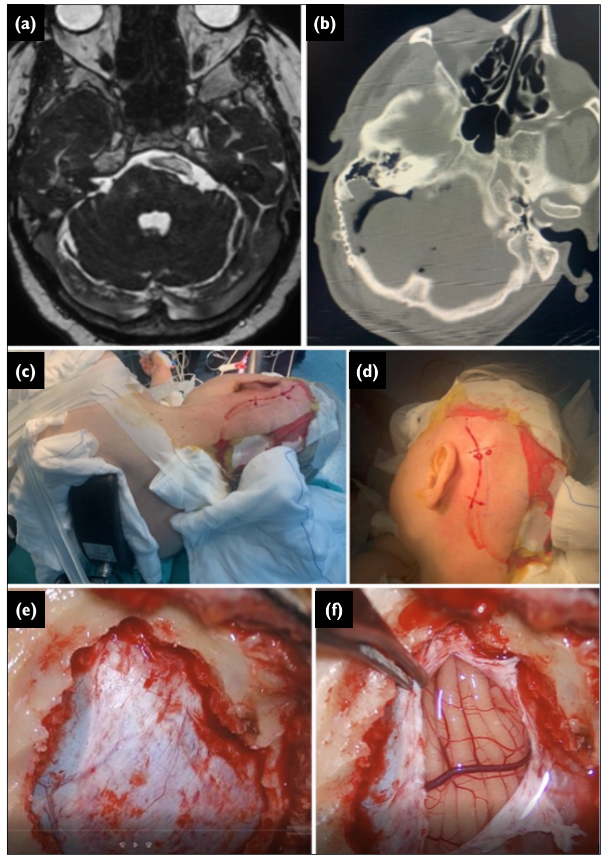

Figure 1. (a) Preoperative magnetic resonance imaging, and **(b)** postoperative computed tomography of the patient. **(c)** Surgical positioning in lateral decubitus, **(d)** Right retroauricular skin incision. **(e)** After retrosigmoid craniectomy, **(f)** After limited dural opening.

operative, without any network deficits, and was taken out of the operating room and handed over to the anesthesia team. In long-term follow-up, she was completely pain-free.

Statistical Analysis

The calculations presented in the study were made via https://www.calculator.net/mean-median-mode-range-calculator.html and https://www.medcalc.org/calc/ .

RESULTS

Eleven patients had left-sided trigeminal neuralgia, and 24 had right-sided TN. Sixteen of them were female, and 19 of them were male. The age interval was between 27-78 years old. The median age of patients was 57 years. The superior cerebellar artery was the number one offending vessel for the pain (63.3%) (Table 1). When pain dermatome was analyzed, V1-V2-V3 was the most prevalent one, with 31.4%. Twenty-nine patients reported complete resolution of TN after MVD. Six patients were previously treated with radiofrequency ablation, and one had Gamma Knife radiosurgery treatment. Four of the patients in this

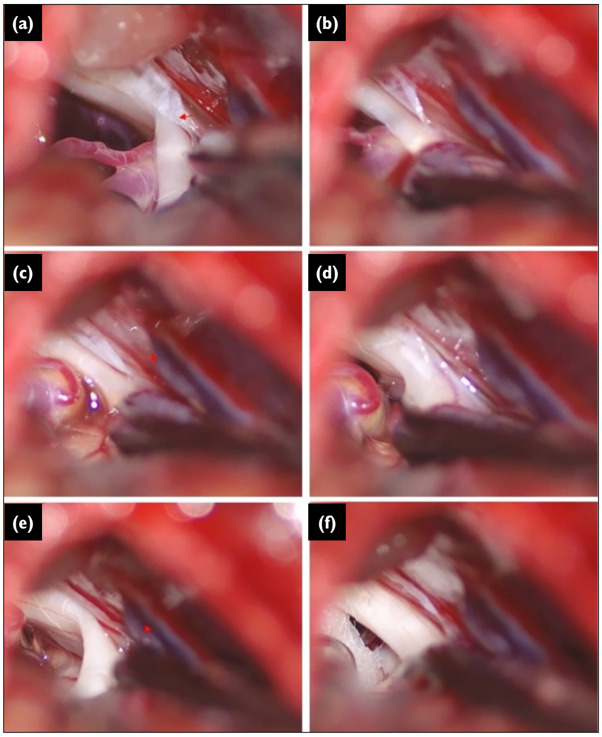

Figure 2. (a-f) The superior cerebellar artery, which was compressing the anterior aspect of the nerve, was dissected and removed from the nerve.

group had recurrent TN with increased pain scores from grade III to grade IV. This was significantly higher when compared to only the pharmacologically treated group (p<0.02). Only in two patients, we observed cerebrospinal fluid fistula in the postoperative period, one was resolved with lumbar drainage, and the other one was resolved with a bandage. Demographic characteristics of TN patients treated with MVD are given in Table 2.

DISCUSSION

Trigeminal neuralgia, also referred to as tic douloureux, is "recurrent unilateral brief electric shock-like pains, abrupt in onset and termination, limited to the distribution of one or more divisions of the trigeminal nerve and triggered by innocuous stimuli." According to the International Classification of Headache Disorders.[1] Differential diagnoses of TN include painful trigeminal neuropathy, trigeminal autonomic cephalalgias, and temporomandibular disorders that cause nociceptive pain.[5] Correct and timely diagnosis is crucial in TN, which may cause depression, anxiety, and sleep disorders.[6] Additional clinical support with a multidisciplinary team will lead to better management of patients with TN.

The high-resolution 3D MRI techniques (CISS, FIESTA, TOF) would give information about the trigeminal nerve and its surrounding blood vessels.[7] When there is obvious vascular compression, MVD surgery will benefit the most. MVD is the most durable with the lowest risk of sensory

Table 1. Table for offending vessel

Responsible vessel	N (%)
Superior cerebellar artery	19 (63.3%)
Superior cerebellar artery + superior petrodal vein	5 (16.6%)
Superior petrosal vein	3 (10%)
Superior cerebellar artery + Anterior inferior cerebellar artery	2 (6.6%)
Anterior inferior cerebellar artery	2 (6.6%)
Vertebral artery	1 (3.3%)
Basilar artery	1 (3.3%)
Anterior inferior cerebellar artery + superior petrosal vein	1 (3.3%)
Superior cerebellar artery + Anterior inferior cerebellar artery + superior petrosal vein	1 (3.3%)

deficits when compared with other ablative procedures (stereotactic radiosurgical rhizolysis, percutaneous balloon rhizotomy, percutaneous glycerol rhizotomy, and percutaneous radiofrequency rhizotomy) The improvement of pain seems to diminish to 50% over time, despite the great initial response to the medical therapy for TN in its early stage.[8] It is noteworthy that 20% of patients in a multifunctional specialist center trial did not see an improvement in their condition, a finding that should spur additional research to close this management gap.[9]

In our case series, the number of right-sided TN was two times more than left-sided TN patients. In a recent review of Lambru et al.,[10] it was reported as 60% right sided TN in case series. The male-to-female ratio was 1.2. In the literature, it was reported that TN is more prevelant in women than in men.[10] In our study, the median age was 57 years old, which is parallel with the literature.[10] Only one patient had tumor-related TN. The superior cerebellar artery was the number one offending vessel. Singh et al.[11] also reported in their clinical TN case series that the superior cerebellar artery was the primary offending vessel. Three dermatomal TN was the most prevalent one. All the patients without any previous interventional pain management history had complete resolution of pain after MVD without any long-term complications. Patients with previously failed interventional pain management history had poor pain outcomes after MVD.

Radiofrequency therapies for TN are widely used in clinical practice. However, there is no strong evidence for its long-term efficacy and safety.[12] Sensory loss is one of the handicaps for ablative procedures.[3,10] Iatrogenic damage can result in anesthesia dolorosa, which is a pain sensation in a region that is totally touch-numb. There is a high rate of complications, particularly with repeated surgeries. There is no proof that one procedure is better than another for ablative procedures.[10] For stereotactic radiosurgery, literature support the evidence that MVD is better for long-term pain relief.[13] Thus, early discussion of surgical inter-

Table 2. Demographic characteristics of trigeminal neuralgia patients treated with microvascular decompression

Age, Gender	Side	Dermatom	Preop Medication	Preoperative intervention	Vascular contact	Postoperative Complication	Postoperative Barrow pain scale	Re-operation
46, F	Left	V1, V2, V3	Carbamazepine	RFA	Sup. cerebellar artery, Superior petrosal vein	(-)	III…to....IV	(+), after 2 years
27, M	Right	V2, V3	Carbamazepine, tramadol	(-)	Sup. cerebellar artery	CSF Fistula at 1st month	I	(-)
35, M	Left	V1, V2, V3	Carbamazepine	RFA	Sup. cerebellar artery, Anterior inferior cerebellar artery	(-)	III	(-)
67, F	Left	V1, V2, V3	Carbamazepine	(-)	Sup. cerebellar artery, Superior petrosal vein	(-)	I	(-)
64, M	Right	V1, V2	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
66, F	Right	V2, V3	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
58, F	Left	V1, V2	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
31, F	Right	V1, V2, V3	Carbamazepine	(-)	Sup. cerebellar artery, Superior petrosal vein	(-)	I	(-)
45, F	Right	V3	Carbamazepine	(-)	Sup. cerebellar artery, Anterior inferior cerebellar artery, Superior petrosal vein	(-)	I	(-)
52, F	Right	V1, V2, V3	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
62, F	Left	V3	Carbamazepine	Gamma Knife, RFA	Sup. cerebellar artery	(-)	III…to...IV	(+), after 6 years
78, F	Right	V1, V2, V3	Carbamazepine, Gabapentin	(-)	Sup. cerebellar artery, Superior petrosal vein	(-)	I	(-)
71, F	Left	V2, V3	Carbamazepine, tramadol, Pregabalin	(-)	Anterior inferior cerebellar artery	(-)	I	(-)
36, M	Right	V1, V2, V3	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-) suggested after 3 years
74, F	Right	V2	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
40, F	Left	V2, V3	Carbamazepine, Gabapentin	RFA	Sup. cerebellar artery, Superior petrosal vein	(-)	III…to…IV	(-) suggested after 2 years
53, M	Right	V1, V2, V3	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
48, M	Right	V3	Carbamazepine	RFA	Sup. cerebellar artery	(-)	III…to…IV	(-) suggested after 1 year
49, M	Left	V1, V2, V3	Carbamazepine	(-)	Basilar artery	(-)	I	(-)
54, M	Right	V3	Carbamazepine	(-)	Sup. Petrozal vein	(-)	I	(-)
64, F	Right	V1, V2	Carbamazepine	Supraorbital and infraorbital nerve blokage	Sup. cerebellar artery	(-)	I	(-)
47, M	Right	V1, V2	Carbamazepine, Gabapentin	(-)	Sup. cerebellar artery	(-)	I	(-)
41, M	Right	V3	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
64, M	Left	V1, V2, V3	Carbamazepine	(-)	Sup. Petrosal vein	(-)	I	(-)
62, M	Right	V2	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
57, M	Right	V1, V2	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)
54, M	Right	V1, V2	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I…to…IV	Supraorbital-infraorbital nerve blokage
52, F	Right	V1, V2	Carbamazepine, Gabapentin	(-)	Sup. cerebellar artery, Anterior inferior cerebellar artery	(-)	I	(-)
65, F	Right	V2, V3	Carbamazepine	(-)	Vertebral artery	(-)	I	(-)
59, M	Left	V1, V2,V3	Carbamazepine	(-)	Sup. Petrosal vein, Anterior inferior cerebellar artery	CSF Fistula	I	(-)
67, M	Right	V1, V2	Carbamazepine	(-)	Sup. cerebellar artery	Surgical site infection	I	(-)
63, M	Right	V2, V3	Carbamazepine, Gabapentin	(-)	Anterior inferior cerebellar artery	Transient Facial paralysis Grade II (due to CPA tumor-acoustic neurinoma)	I	(-)
54, F	Right	V2, V3	Carbamazepine	(-)	Sup. Petrosal vein	(-)	I…to…II	(-)
64, M	Right	V3	Carbamazepine, Gabapentin	RFA	Sup. cerebellar artery	(-)	I	(-)
60, M	Left	V2, V3	Carbamazepine	(-)	Sup. cerebellar artery	(-)	I	(-)

vention, MVD, before interventional pain management will be appropriate to prevent persistent sensory loss. Endoscopic MVD also has promising results in pain control with lower complication rates than open MVD.[14]

Conclusion

Trigeminal neuralgia is a debilitating condition that presents with relapses and remission.

Pharmacotherapy has limited efficacy, and pain control diminishes with time. Ablative procedures could have persistent complications such as anesthesia dolorosa which may even worsen the condition. Thus, MVD surgery is a physiological approach with promising results in long-term pain control in patients with TN with minimal and transient postoperative complication risk in pharmaco-resistant classical and idiopathic TN cases. When there is vascular contact in preoperative images in patients with TN, MVD should be the first-line surgical approach.

Ethics Committee Approval

The study was approved by the Istanbul Medipol University Clinical Research Hospital Ethics Committee (Date: 17.04.2024, Decision No: E-10840098-202.3.02-2399).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: P.K.B., A.B., E.C.; Design: P.K.B., A.B..; Supervision: E.C.; Materials: E.C.; Data: N P.K.B., A.B., E.C.; Analysis: P.K.B., A.B., E.C.; Literature search: P.K.B., A.B.; Writing: P.K.B., A.B.; Critical revision: E.C.

Conflict of Interest

None declared.

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Trigeminal Nevraljide Mikrovasküler Dekompresyonun Sonuçları: Tek Merkezli 10 Yıllık Deneyim

Amaç: Trigeminal nevralji, beşinci kraniyal sinirin bir veya daha fazla dalında ortaya çıkan dayanılmaz bir ağrıdır. Bu çalışmadaki amacımız, tek bir merkezde trigeminal nevralji için mikrovasküler dekompresyon cerrahisi yapılan hastaların sonuçlarını bildirmektir.

Gereç ve Yöntem: Merkezimizde 2013-2023 yılları arasında trigeminal nevralji nedeniyle mikrovasküler dekompresyon ile ameliyat edilen 35 hastayı retrospektif olarak analiz ettik. Hastalar en az 2 yıllık takip süresine sahipti.

Bulgular: Yirmi dört hastada sağ taraflı ve 11 hastada sol taraflı trigeminal nevralji vardı. Hastaların 16'sı kadın, 19'u erkekti. Yaş aralığı 27-78 arasındaydı. Hastaların ortanca yaşı 57 idi. Daha önce girişimsel ağrı tedavisi öyküsü olmayan yirmi dokuz hastada mikrovasküler dekompresyon sonrası trigeminal nevraljinin tamamen düzeldiği bildirildi. Bu hastalarda kalıcı komplikasyon görülmedi.

Sonuç: Trigeminal nevralji için mikrovasküler dekompresyon güvenli ve etkili bir tedavi yöntemidir. Medikal tedaviye dirençli trigeminal nevraljisi olan hastalar mikrovasküler dekompresyon cerrahisi için ideal adaylardır.

Anahtar Sözcükler: Mikrovasküler dekompresyon; radyofrekans termokoagülasyon; trigeminal nevralji.