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CASE SERIES

Different Modalities of Treatment of Trigeminal Neuralgia

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Abstract

Background: **Trigeminal neuralgia (TGN): it is a syndrome characterized by recurrent sudden and usually unilateral severe brief stabbing. One and more branches of the fifth cranial nerve are causing pain. It is a painful, brief experience. Pain can occur spontaneously and be triggered by innocuous stimuli like yawning, chewing, light touch, and other transmitted stimuli and divided by different lengths of pain-free intervals.**

Aim and objectives: **To assess the effectiveness of different modalities in studied cases with TGN.**

Patients and methods: **This research was carried out on a group of 20 patients having TGN managed by different modalities, percutaneous radiofrequency (RF), microvascular decompression (MVD), peripheral neurectomy, and nerve block. This study was conducted on patients with variant ages at the time of diagnosis, presenting with TGN, admitted and managed at the Neurosurgery Functional Unit, -Faculty of Medicine Al-Azhar University from 2017 to 2021.**

Result: **The description of radiological findings by MRI FIESTA: the major finding was no loop compassing (50%) in patients followed by arterial loop compassing the trigeminal nerve (35%). Most of the patients had V1, V2, V3 affected in 70% of the patients, and 20% of the patients had V2, V3 affected. The major surgery done was RF (40%) followed by MVD (30%).**

Conclusion: **Females were more frequently impacted by TGN than males. All of the studied procedures particularly MVD and RF were safe and influence in cure of TGN.**

Keywords: Cure, Modalities, Neuralgia, Trigeminal

1. Introduction

Trigeminal neuralgia (TGN): it is a syndrome characterized by sudden and usually unilateral severe brief stabbing recurrent pain in one and more branches of the fifth cranial nerve. It is a painful, brief experience. Pain may be unexpected and triggered by gentle, innocuous stimuli like yawning, chewing, light touch, and other transmitted stimuli, with pain-free intervals of differing duration.[1]

The occurrence of TGN is nearly 4050 cases per million, with overall incidence of 100 200 per million population.[2]

TGN differs with age, less than five per million in younger than 18 years, and 800 per million in old age.[3]

Pain descriptions related to TGN are available since prehistoric times. The disorder was first described by Roman and Greek physicians Galen and Aretaeus. Johannes, the German physician who suffered from TGN, made one of the earliest notes on the disease in 1671.[4]

Few years later, physician and philosopher John Locke gave thorough explanation of the disease, such as cure. Pain is so severe that it is referred to as 'suicide disease.' Some texts refer to it as prosopalgia, which is derived from Greek words prosopon (face) and algos (pain). Severe TGN causes repetitive facial muscle spasms that mimic facial tics, prompting Nicolas André to coin the term tic Douloureux in 1756.[4]

According to earliest studies, TGN has a very poor response to therapy. To cure disease, some people recommend sleeping in a dark room, taking hot baths, and drinking wine.[5]

Until 19th century, the only mode of cure was medication. Quinine, mercury, camphor, opium, arsenic, and ether were among drugs used in cure.

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Reaction to these drugs was negative. Schloesser performed the first percutaneous alcohol injections in the peripheral trigeminal nerve in 1904.[6]

Substances injected into the Gasserian ganglion, as phenol and other types of alcohol. Pollock and Potter proposed using radiographs to verify the position of the injecting needle in order to reduce difficulties.[4]

Stereotactic electrocoagulation of the gasserian ganglion through the foramen ovale was performed in 1931 using a head frame. Seven Sweet and Wepsic conducted the first radiofrequency (RF) thermal lesioning of the trigeminal nerve in 1974.[7]

Early surgery dates back to 1750s, in 1858: the earliest surgery was performed by Carcochan. Selective sectioning of dorsal trigeminal root fibers known as the Spiller-Frazier technique presented in 1920s and widely experienced.[8]

More than a decade ago, fully endoscopic microvascular decompression (MVD) of trigeminal nerve was characterized.[9]

The need of an endoscope as an alternative to a microscope in transsphenoidal pituitary surgery to enable resection of unaccessible microscopic-assessed transsphenoidal surgery has revolutionized anterior skull base surgery.[10]

The purpose of this research was to assess the efficacy of various modalities in studied cases suffering from TGN.

2. Patients and methods

The research was conducted on a group of 20 patients having TGN managed by different modalities, percutaneous RF, MVD, peripheral neurectomy, and nerve block. This study was conducted on patients with variant ages at the time of diagnosis, presenting with TGN, admitted and managed at the Neurosurgery Functional Unit, Faculty of medicine Al-Azhar University from 2017 to 2021.

2.1. Inclusion criteria

Patients with TGN, patient's loss of response to medical treatment and different ages and comorbidities, but type of treatment differs.

2.2. Exclusion criteria

Other types of facial pain.

Techniques: all research participants were exposed to the following.

2.3. Taking thorough history

Complete medical history, complaint: the chief complaint uses the patient's own words evaluation in other words, history of present illness: severe pain in sharing of trigeminal nerve or one of its branches.

Proper analysis of pain regarding site, character, severity (according to visual analog scale 'VAS'), interval in between attacks, duration, and response to any medication given before.

N.B. Each symptom was analyzed regarding the onset, course, duration, associations, exacerbating factors, relieving factors, and associated symptoms: complete general examination, neuralgical examination, VAS, past history of previous interventions, and medical and past history.

2.4. Neurological examination

2.4.1. Mental status

Cranial nerves examination with special attention to: trigeminal nerve (cranial nerve V) – this nerve is evaluated by having the studied cases clench their jaw and testing for sensation of ophthalmic, maxillary, and mandibular branches. In comatose studied cases, corneal reflex is usually conducted to measure brainstem function. Lack in awake studied case could indicate localized lesion impacting the trigeminal nerve, facial nerve, or both.

VAS: we assess pain for the patients group as a baseline by the VAS, which is a valid and reliable extent of chronic pain intensity, as well as acute pain measurement using a ruler. The studied cases provide pain intensity score ranging from 0 to 10 cm, with a score of 0–4 cm indicating mild pain, –5–7 cm of moderate pain, and 8–10 cm of severe pain.

Radiological assessment through the following:

FIESTA – 'fast imaging employing steady-state acquisition' MRI: 3D FIESTA method was used to image the pons in the TN region.

Investigations: complete blood picture: hemoglobin concentration, red blood cells, white blood cells, and platelet count are all measurements; renal function examination: serum creatinine, blood urea, and urine analysis; liver test profile: serum aspartate and alanine aminotransferases, serum albumin, serum bilirubin, prothrombin time, and international normalized ratio; coagulation profile (INR, APTT, platelets, and fibrinogen) and ECG and ECHO when needed.

Consent for surgery: all participants who agree to share in this study signed an informed consent form after being fully informed about the technique and its circumstances before the operation of full EVD.

2.5. Operative procedures

2.5.1. Skin incision and soft tissue dissection

A small (5 × 5 cm) area behind the ear is shaved. Before making skin incision, anatomical surface

landmarks must be identified. The TS is recognized and characterized along the line that connects inion with the zygomatic arch at the level of supramastoid crest and passes through the asterion. Tip and body of the mastoid are then depicted by a second line.

Small vertical elliptical craniectomy (3 × 2 cm) is conducted just caudally to the asterion using a high-speed 5 7 mm cutting drill. Opening is elliptical in shape, with the posterior margin of SS and the inferior margin of the TS forming the anterior and superior borders, and sinuses junction forming the upper anterior extremity of ellipse.

2.5.2. Exposure of CPA and nerve decompression

Microscope is presented at this point in the process. Dura mater is opened curvilinearly, with its base toward the SS, revealing both the tentorium and the posterior surface of the petrous ridge and generating direct supralateral cerebellar corridor beneath the superior petrosal sinus.

The trigeminal nerve is investigated along its entire length from its origin at the brainstem to its exit through the porus trigeminus once it has been recognized as running just behind and medially deep to the SPV complex.

2.6. Postoperative assessment

(1) Postoperative clinical assessment through neurological examination including conscious level and cranial nerve examination and symptoms of increased intracranial pressure.
(2) Postoperative radiological assessment through computed tomography (CT) scan of the brain.

2.6.1. Percutaneous radiofrequency trigeminal (retrogasserian) rhizotomy

These procedures were performed under fluoroscopic guidance with IV sedation. RF ablation is the most commonly performed procedure. A 22-G, 10 cm RF cannula was introduced at a point 2–3 cm lateral to and 1 cm inferior to the commissura labialis. It was pointed at the pupil 3 cm anterior to the external auditory meatus.

2.6.2. Neurectomy: supraorbital neurectomy

It is contacted extraorally into the incision in te upper brow; nerve is recognized and avulsed by reeling on a hemostat. Nerve fragments were cauterized. Double-layered closure was suggested.

2.6.3. Infraorbital neurectomy

Maxillary vestibular approach was used to reach the infraorbital nerve. Infraorbital foramen was recognized as well as the infraorbital nerve and its peripheral branches. The nerve was then avulsed from soft tissues and the infraorbital canal using a hemostat and reeling. Deep in the foramen, nerve remnants were cauterized.

2.7. Inferior alveolar neurectomy

An incision was made lingually or buccally along the anterior border of the elevated ramus, followed by blunt dissection to deepen its medial aspect.

2.7.1. Outcome

We assessed the clinical outcome of the patient by the VAS for pain for the measurement of pain intensity before and after the operation.

2.7.2. Ethical consideration

All participants provided informed consent after being notified about the research's goals and process, any applicable objectives. Research procedures had no bad impacts on participants and service provided.

2.8. Data management and statistical analysis

SPSS, version 20 was used for data entry, handling, and statistical analysis. Following examination of significance were used: Kruskal–Wallis, Wilcoxon, χ^2, logistic regression analysis, and Spearman's correlation. Data were expressed, and appropriate analysis was performed based on the type of data obtained for each variable. *P* values of less than 0.05 were deemed clinically meaningful.

3. Results

This work was carried out on 20 patients who were admitted and operated for TGN from 2017 to 2022 at Al-Azhar University Hospitals (Table 1).

The description of demographic data in all studied patients as regards age, the mean age was 48.65 ± 11.84 years with a mean BMI of 24.82 ± 5.77 kg/m^2. As regards sex 60% of the patients were males. The mean follow-up duration was 16.2 ± 9.24 months (Fig. 1).

The patient who complain of TGN shows that the left side was affected in 40% of the patients and the right was in 60% (Fig. 2).

Most of the patients were type 1 (85%), secondary to herpes zoster was 10%, and only one patient was type 2 (Table 2).

The description of radiological findings by MRI FIESTA: The major finding was no loop compassing 50% in patients followed by the arterial loop compassing the trigeminal nerve (35%) (Table 3).

Table 1. Demographic data of two tested categories.

Variables	Studied cases ($N = 20$)
Age (years)	
Mean ± SD	48.65 ± 11.84
Range	23–70
Sex [n (%)]	
Male	12 (60)
Female	8 (40)
BMI (kg/m^2)	
Mean ± SD	24.82 ± 5.77
Follow up (months)	
Mean ± SD	16.2 ± 9.24

Most of the patients had V1, V2, V3 affected (70% of the patients), and 20% of the patients had V2, V3 affected (Table 4).

In 20 patients who were admitted to our hospital the major surgery done was RF (40%) followed by MVD (30%) (Table 5).

The major complication was dizziness and ataxia (15%), two of them improved and one patient with facial palsy partially improved on treatment (Table 6).

There is significant decrease in VAS from preoperative to postoperative in all treatment modalities.

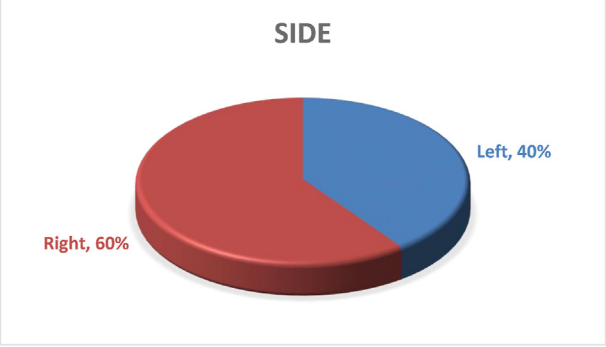

Fig. 1. Description of side distribution among the studied patients.

Table 2. Radiology findings distribution among the studied patients.

	Patients ($N = 20$) [n (%)]
Arterial loop compassing the trigeminal nerve	7 (35)
No loop compassing	10 (50)
Teflon graft (previous surgery)	1 (5)
Venous loop compassing the trigeminal nerve	1 (5)
Venous loop touching the trigeminal nerve	1 (5)

Table 3. Roots affected distribution among the studied patients.

	Patients ($N = 20$) [n (%)]
V1	1 (5)
V2	1 (5)
V1, V2, V3	14 (70)
V2, V3	4 (20)

Table 4. Surgery distribution among the studied patients.

	Patients ($N = 20$) [n (%)]
MVD	6 (30)
MVD (internal neurolythesis)	2 (10)
Nerve block for V1, V2, V3	1 (5)
Nerve block for V2	1 (5)
Neurectomy of V1	1 (5)
Neurectomy of V2, V3	1 (5)
Radiofrequency	8 (40)

Table 5. Complications distribution among the studied patients.

	Patients ($N = 20$) [n (%)]
No	12 (60)
Delayed healing and infected wound	1 (5)
Dizziness and ataxia	3 (15)
Dysesthesia on V1, 2, 3	1 (5)
Fascial palsy	1 (5)
Parotid edema	1 (5)
TMG osteoarthritis	1 (5)

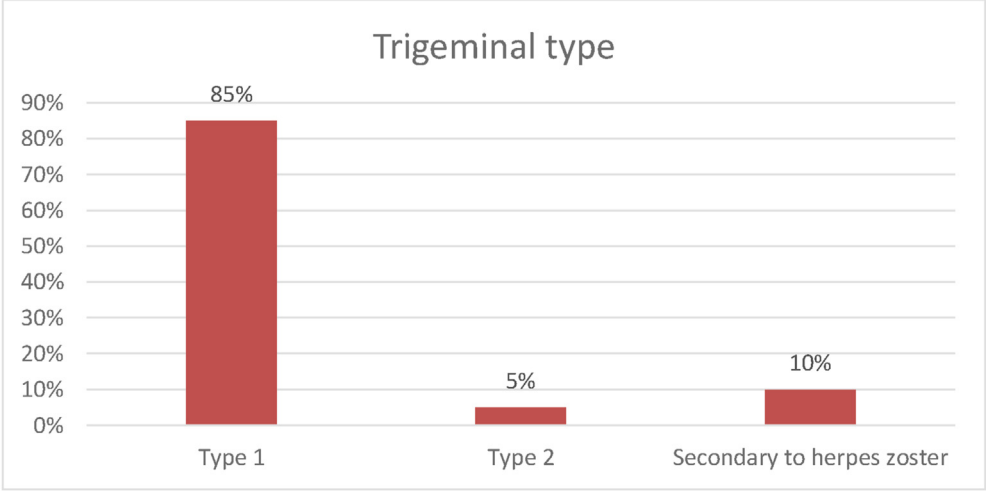

Fig. 2. Description of trigeminal type distribution among the studied patients.

Table 6. Preoperative and postoperative visual analog scale according to surgery distribution between the studied cases.

	VAS (mean ± SD)		^{p}t	*P*
	Preoperative	Postoperative		
MVD	9.5 ± 0.548	1.00 ± 0.00	38.1	<0.001
MVD (internal neurolythesis)	8.5 ± 0.707	1.00 ± 0.00	15	0.042
Nerve block for V1, V2, V3	9	1	–	–
Nerve block for V2	9	1	–	–
Neurectomy of V1	9	1	–	–
Neurectomy of V2, V3	9	1	–	–
Radiofrequency	9.38 ± 0.744	1.25 ± 0.463	27.5	<0.001

VAS, visual analog scale.

3.1. Case 1

3.1.1. Clinical data

A female patient 58 years not suffering from diabetes mellitus or hypertension presented with typical TGN. She received medical treatment and improved initially and then pain returned despite increase in the dose of medication.

Clinical examination: no surgery or trauma to the head and neck, no history of visual and sensory changes, and no history of transient neurological deficits or difficulty walking.

Radiological investigation: MRI FIESTA normal.

Operative data: the patient underwent percutaneous RF rhizotomy. These procedures are performed under fluoroscopic guidance. A 22-G, 10 cm RF cannula is introduced at a point 2–3 cm lateral to and 1 cm inferior to the commissura labialis. It is aimed at the pupil from 3 cm anterior to the external auditory meatus. A submentovertex, or oblique submental fluoroscopic view, can be used to envision the foramen ovale. Once within the foramen, straight lateral view is used to confirm location within Meckel's cave. The cannula is advanced such that the tip of the electrode is located at the junction of the petrous ridge and clivus. Needle repositioning may be necessary. When location is confirmed, thermoablation at 50° for 60 s is performed with the patient sedated. Adequate lessoning is confirmed by loss of pinprick discrimination in the target distribution, and the needle is withdrawn (Fig. 3).

Follow-up: smooth recovery, no postoperative complications, and the studied case was free of pain and we followed up the patient up to 6 months.

Fig. 3. Photograph of the patient after insertion of the canula (permission taken).

3.2. Case 2

3.2.1. Clinical data

A 59-year-old male patient not diabetes mellitus or hypertension presented with typical TGN of supraorbital distribution only from 4 years not responding to medical treatment. The pain was sharp and stabbing in nature and scored 9 on VAS.

3.2.2. Clinical examination

No surgery or trauma to the head and neck, no history of visual and sensory changes, and no history of transient neurological deficits or difficulty walking.

3.2.3. Radiological investigation

MRI and arterial MR FIESTA were normal.

3.2.4. Operative data

The patient underwent supraorbital neurectomy after discussing with the patient of different modalities by neurectomy or RF; depending on the advantages and complications we choose to do supraorbital neurectomy under sedation (Fig. 4).

3.2.5. Follow-up

Smooth recovery, no postoperative complications, and postoperative follow-up showed not any recurrence of pain.

4. Discussion

Even though drug treatment is the first-line cure for TN, surgical intervention is an effective substitute cure option for the studied cases, who have refractory TN and are experiencing intolerable side

Fig. 4. Supraorbital neurectomy.

effects. Surgical intervention for cure of TN is classified into two types: ablation and nonablation.[11]

This potential observational research was carried out in the Department of Neurosurgery Functional Unit, Faculty of Medicine Al-Azhar University from 2017 to 2021. This research was conducted on 20 studied cases, who were admitted and operated for TGN by different modalities according to patient age and comorbidity.

Our team at the functional unit describe the different modalities to the patient and describe the operation and its side effect of any intervention and choose the operation according to the patient age and presentation of symptoms and comorbidity and any compressing vascular loop or not and if there are two modalities of treatment, the patient can choose one of the types of operation.

Regarding the demographic data in the studied patients, we found them to be of 48.65 ± 11.84 years; as regards sex 60% of the patients were males. Mean follow-up duration was 16.2 ± 9.24 months.

The present study is supported by Hitchon et al.[15] who conducted a retrospective evaluation of their experience on 195 TN cases with previously untreated TN who were enrolled in research. Seventy-nine studied cases had MVD, 36 had RF, and the surviving 80 had stereotactic radiosurgery (SRS) ($P = 0.045$). There were 73 males and 122 females. Studied cases undergoing more invasive MVD were younger (57 ± 14 years) than those currently conducting less invasive RF and SRS (75 ± 15 & 73 ± 13 years, $P < 0.0001$). In 195, there was 32 ± 46 month follow-up obtainable. In the current study, the TN morbidity is greater in women than in men, and it rises with age. In line with meta-analysis by Foley et al. who discovered that females outnumber men by 60.5%, with average years old of onset of TN being 45.4 years. Also, the present study was supported by a systematic review by Zakrzewska et al.[13] who aimed to assess the clinical effectiveness of treatments in studied cases with TGN and multiple sclerosis. The study included 26 studies with a total of 803 patients. And found that age at onset was 49 years and the majority were females (60.5%).

In the current study, we found the most studied cases, TN impacts only one side of face, and the right side is more commonly involved than the left.[14]

In the current study, as regards side distribution among the studied patients, the present study showed that the left side was affected in 40% of the patients and the right was in 60%.This was in disagreement with Hitchon et al.[15] who noted that the right side was most impacted, with 115 studied cases impacted on the right side and in 80 studied cases on the left.

In current study, regarding trigeminal type distribution among the studied patients, the present study reported that most of the patients were of type 1 (85%), secondary to herpes zoster was 10%, and only one patient was type 2. However, Wang et al.[16] reported that all patients were trigeminal type 1.

In this study, regarding MRI FIESTA radiology findings distribution among the studied patients, we found that the major findings were no loop compassing (50%) in patients followed by arterial loop compassing the trigeminal nerve (35%). So, the main cause of TGN in the current study was arterial loop compassing the trigeminal nerve.

Regarding the history of previous intervention among the studied patients, the present study showed that one patient had previous MVD, and one patient had RF on V2, three and another patient showed no previous intervention of TGN.

Also, regarding the roots affected distribution among the studied patients, we found that most of the patients had V1, V2, V3 affected in 70% of the patients, and 20% of the patients had V2, V3 affected.

However, Wang et al.[16] reported that the most common affected roots were V2+V3 in 48 (28%) patients followed by V3 in 35 (21%) patients and then V2 in 27 (16%) patients.

V1, V2, and V3 involvement was 10.5, 52.3, and 37.2%,[17] while only one division, two divisions, and three divisions of the trigeminal nerve were implicated in 58.2, 32.6, and 9.2%.[18]

Regarding surgery distribution among the studied patients, we found that in the 20 patients who were admitted to our hospital the major surgery done was RF (40%) followed by MVD (30%). However, Hitchon et al.[15] reported that TN was managed with MVD in 79/195 patients, RF rhizotomy in 36/195 patients, and by SRS in 80/195 patients.

Also, Wang et al.[16] reported that 340 studied cases underwent first-time cure for idiopathic TN; out of them 164 patients were treated with MVD, 168 SRS, and 8 RF.

The present study showed that the major complication was dizziness and ataxia (15%); two of them were improved and one patient with facial palsy and partially improved on treatment. Another study by Artz et al. was conducted on 20 TN patients who underwent MVD and reported lower incidence of complications and a better outcome were also described in other researches.

In a research by Wang et al.[16] adverse reactions were more common in the MVD group than in the SRS cohort. There were six CSF leaks, five pseudomeningoceles, six wound infections, one postoperative hematoma that required evacuation, and one studied case who felt better manage facial nerve palsy. Nine studied cases needed additional surgery for wound revision and washout. There were no cases of long-term hearing loss and neuropathic facial pain. Overall, the problem rate for MVD in this series was around 11%. Sandell and Eide[19] reported that the most common complications among 19 cases treated with MVD were bacterial meningitis in one case, facial numbness in two cases, dizziness in one case, and impaired hearing in two cases.

The meta-analysis by Li et al.[20] reported that when likened to RF, MVD was linked to higher rates of pain relief and lower occurrences of facial numbness, but higher postoperative problems and total costs. We found that there is a significant decrease in VAS from preoperative to postoperative among the studied group of patients. And according to the surgery type we also found that all procedures resulted in a significant improvement in pain score.

In accordance with our results Sandell and Eide[19] described that the VAS score was significantly decreased in patients treated with MVD.

Also, Salama et al.[21] reported that 95.2% ($N = 20$) of MVD studied cases experienced instant pain relief, &and 90.5% ($N = 19$) experienced long-term relief during the 2-year follow-up period.

4.1. Conclusion

In conclusion, TN impacted females more frequently than males. All of the processes investigated, especially MVD and RF, were found to be safe and have an important role in the cure of TN. More comparative researches with a larger sample size and longer follow-up period are required to verify our findings and identify the risk factors for adverse outcomes.

Conflict of interest

There are no conflicts of interest.

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