A Study on the Recurrence Rate of Trigeminal Neuralgia after MVD and the Related Factors

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Abstract

The aim of this article is to investigate the related factors affecting the recurrence of microvascular decompression (MVD) after trigeminal neuralgia. We selected 400 cases of patients who met the diagnostic criteria of primary trigeminal neuralgia. The recurrence rate of patients and their statistical data related factors such as age, gender, disease duration, pain branches, vascular compression, patients, and complications (urban and rural), were collected. Of the 400 cases, 36 had recurrence after 2 years. In female group, the recurrence rate was (9.4%) higher than the recurrence rate in male group (8%); no recurrence rate of vascular compression group (40%) was higher than that of vascular compression group recurrence rate (8.6%); the recurrence rate of each branch in pain group from high to low was V_{2-3} (13.4%), V_2 (12.5%), V_1 (9.1%), V_3 (7.5%), V_{1-2-3} (4.4%), V_{1-2} (4.3%), V_{1-3} (0%); and the difference was statistically significant ($p < 0.05$). Gender of the patient, the presence of vascular pressure, and the branch of pain could significantly affect the postoperative recurrence rate of trigeminal neuralgia in patients treated with simple MVD ($p < 0.05$).

Keywords

- ▶ trigeminal neuralgia
- ▶ microvascular decompression
- ▶ pain branch
- ▶ recurrence rate

Introduction

Trigeminal neuralgia (TN), as a common Department of Neurosurgery disease, can be divided into two types: primary and secondary. At present, there is no definite pathogenesis of TN. Although tumor, arteriovenous mixing, vascular malformation, and petrous ridge fiber compression and other halfmoon ganglion lesions are found during operation, the exact mechanism remains uncovered.^{1,2} At present, it is universally believed that TN is caused by nerve compression, demyelinating disease (multiple sclerosis and senile demyelination), and so on.³ However, no case or research can completely prove this argument. Considering the assignable recurrence rate in a portion of patients who

received microvascular decompression (MVD) treatment,^{4,5} we analyzed and collected data of patients who had a relapse of symptom of TN after MVD and tried to find out the related factors that affect the recurrence of TN after MVD.

Materials and Methods

Ethics Statement

This study was approved by the Institutional Moral and Ethical Committee of the Jining No.1 People's Hospital. All surgical procedures were conducted according to the guidelines of the Institutional Moral and Ethical Committee of the Jining No.1 People's Hospital.

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General Information

The clinical data of 400 patients of primary TN admitted and treated by MVD between January 2012 and December 2014 in Jining No.1 People's Hospital were retrospectively reviewed. There was no significant difference in the general data of the cases included in the study. And the follow-up lasted for 2 years, mainly through telephone and outpatient visit to collect the recurrence rate. Three-hundred patients (172 males and 192 females) had a relapse of symptom of TN after MVD. The patient age was 24 to 79 years old, and the mean age was 60.3 years old, with an average history of pain for 7.5 years. There were 36 cases (15 males and 21 females) of recurrence pain, their age was 32 to 72 years old, and the mean age was 57.2 years old, with an average history of 6.5 years.

Inclusion Criteria

Patients included in this study were in line with the International Association for the Study of Pain defined by the primary standard diagnosis of TN. The characteristics of primary TN in clinic: 1. pain involves and is limited to one or more of the trigeminal branches; 2. pain lasts from a few seconds to 2 minutes after onset; 3. severe pain is described as knife-, needle-, or lightning-like and induces a burning sensation that can be accurately localized and triggered. Two TN patients who underwent surgery were excluded on account of the loss of heart function with abnormal coagulation function. Other exclusion factors included the presence of tumors or a vascular malformation as revealed by imaging, secondary TN-induced multiple sclerosis, and psychiatric disorders.

Operation Process

After general anesthesia, patients in the lateral decubitus position in the contralateral, suboccipital retrosigmoid approach, bone window ~2 cm diameter, transverse to the lower edge of the sigmoid sinus posterior margin of the inverted "T" shape incision of dura mater, slow release of cerebrospinal fluid, and suspended dura mater exposed view. The release of cerebrospinal fluid to the cerebellar collapse was satisfactory, that is, the introduction of microscopes. With the aid of microscopy, a sharp cut was performed on the arachnoid, until the dissection of trigeminal nerve and brain stem area, as shown in ►Fig. 1. We then characterized the condition of the trigeminal nerve and explored the whole course of the intracranial segment of the trigeminal nerve. After the confirmation of the responsible vessels, leave the surface of the trigeminal nerve, and apply two pads with polyester cotton, as shown in ►Fig. 2. The operation area was soft and tight; before dural closure, the operation areas was soaked with 30 mg of papaverine for 2 min and repeatedly washed with normal saline.

Statistical Analysis

SPSS 19.0 software was used for statistical analysis. The differences in recurrence rate of patients were compared in terms of sex, age, history, source of patients, side effects, vascular compression, and pain. The variables were assigned to each factor. The single factor χ^2 test and logistic regression analysis were used. The significant level was $\alpha = 0.05$.

Fig. 1 Before the trigeminal nerve microvascular decompression, as we can see through the microscope, a large branch of superior petrosal vein lies in the middle of the scope and blocks off vision of the right side of the trigeminal nerve partially. The superior cerebellar artery, which is the responsible blood vessels of the trigeminal nerve, compresses the root of the nerve in the form of the bow from anterosuperior to posteroinferior and finally to anteroinferior.

Results

Based on the related factors of χ^2 test analysis, we grouped according to the related factors of the patients, and found out that the female group in the recurrence rate (9.4%) was higher than the recurrence rate in male group (8%); no recurrence rate of vascular compression group (40%) was higher than that of vascular compression group recurrence rate (8.6%); the recurrence rate of each branch group in pain from high to low was V2 to 3 (13.4%), V2 (12.5%), V1 (9.1%), V3 (7.5%), V1 to 2-3 (4.4%), V1 to 2 (4.3%), V1 to 3 (0%); the difference was statistically significant ($p < 0.05$), as shown in ►Table 1. The difference of other factors was not statistically significant. Logistic regression analysis was used to assign the relevant factors to patients. The results showed

Fig. 2 After trigeminal nerve microvascular decompression, we can find a very small piece of polyester cotton was filled between the trigeminal nerve and the superior cerebellar artery, which contributes to the displacement of the responsible blood vessels far away from the nerve.

Table 1 Comparison of clinical data of patients with primary trigeminal neuralgia treated with MVD

Factors	Groups	Cases	Recurrent cases	Nonrecurrent cases	Recurrence rate (percentage)	χ^2	p-Value
Sex	Male	187	15	172	8	15.321	0.043
	Female	213	21	192	9.9		
Age(years)	20–30	17	0	17	0		
	30–40	53	6	47	11.3		
	40–50	94	10	84	10.6		
	50–60	119	12	107	10	5.368	0.231
	60–70	85	6	79	7.1		
	70–79	32	2	30	6.3		
Time of disease (years)	1–5	248	22	226	8.9		
	5–10	90	8	82	8.9	4.935	0.312
	10–15	62	6	56	9.7		
Pain side	Left	192	17	175	8.9		
	Right	206	19	187	9.1	4.835	0.342
	Bilateral	2	0	2	0		
Vascular compression	Yes	395	34	361	8.6	12.234	0.045
	No	5	2	3	40		
Pain branch	V ₁	11	1	10	9.1		
	V ₂	72	9	63	12.5		
	V ₃	67	5	62	7.5		
	V ₁₋₂	70	3	67	4.3	13.546	0.031
	V ₂₋₃	112	15	97	13.4		
	V ₁₋₂₋₃	68	3	65	4.4		
	V ₁₋₃	0	0	0	0		

Abbreviation: MVD, microvascular decompression.

Note: To compare each index group recurrence rate: female high rate of recurrence than men, ($p < 0.05$); no vascular compression than patients with recurrent vascular compression in patients with high rate ($p < 0.05$); the recurrence rate of patients with pain branch showed the distribution of V2–3 (13.4%), V2 (12.5%), V1 (9.1%), V3 (7.5%), V1–2–3 (4.4%), V1–2 (4.3%), V1–3 (0%), ($p < 0.05$); the difference was significant.

that gender, vascular compression, and pain branches were correlated with postoperative recurrence rate ($p < 0.05$), as shown in ►Table 2.

Discussion

Microvascular decompression is the most common surgical treatment of TN⁶ this surgery has the characteristic of small trauma, quick recovery, so it has been widely accepted by people worldwide.⁷ With the promotion of MVD for a long

time, more and more specialist hospitals have mastered the advanced treatment technology of TN, and more and more cases have been treated. In the early days of the MVD application, people were shocked by the subversive therapeutic effects of this technology. Indeed, its operative effect is much better than that of many previous internal and external treatment methods. Therefore, people often think that a small amount of relapse after MVD treatment is just an occasional case, or it is an occasion which is operated by doctors who are not mature enough. With the increase in the

Table 2 The statistical analysis of logistic regression between recurrence rate after MVD and patient-related factors

Variable	B	SE	Wald	p-Value	OR	95% CI
Sex	–1.135	0.536	5.951	0.016	0.273	0.095–0.764
Vascular compression	–0.945	0.429	4.448	0.039	0.412	0.212–0.832
Pain branch	–0.945	0.575	4.752	0.026	0.376	1.026–1.953

Abbreviations: CI, confidence interval; MVD, microvascular decompression; OR, odds ratio; SE, standard error.

Note: In the observation group VS control group, the recurrence rate of the observation group (12.5%) was lower than that of the control group (85.7%), $p < 0.05$; the difference was significant.

number of treatment cases, technical experience is also accumulating. About 10% of the postoperative recurrence rate is recurring. This arouses our attention. Looking back on the cases of MVD, it seems that the difference in the pain branch of the patients with TN has some unconfirmed connection with the recurrence of MVD after the operation. The related factors of the patients with TN and pain are related to the recurrence rate after the MVD operation, which has attracted more and more attention.

Correlation between Sex and Recurrence after MVD

In the research on the epidemiology, the incidence, and prevalence of TN, women are more than men, and increased with age.⁸ In this study, statistics shows that gender is associated with recurrence after TN, and women are a risk factor for one of the recurrences of TN.

In a retrospective study, relapse of MVD in different gender primary patients was found in this study. After follow-up, the recurrence rate of different genders was statistically significant. Women showed a risk of relapse in the long-term prognosis. Therefore, women may be one of the risk factors for long-term recurrence after TN, but this is only a statistical conclusion in local area, and the degree of risk is still needed to be confirmed by a larger long-term multicenter sample study. We have a question, why the cases of women with primary TN are more than that of men? The underlying mechanism behind this problem is the real reason for the prognosis risk factors of MVD after primary TN surgery. For female patients, the recurrence rate after MVD alone is higher than that in men. It is mainly considered that gender is an important factor associated with recurrence. Physiological and pathological factors are unknown. However, from the perspective of treatment, combined treatment should be used to reduce the risk of recurrence. At present, the combined treatment in our hospital is "MVD combined with trigeminal nerve root carding" and "MVD combined with trigeminal sensory root partial rhizotomy."

Relapse Correlation of Age and MVD

Most researchers tend to be 60 to 70 years old as a protective factor for the prognosis after long-term MVD surgery. According to statistics, the safety of MVD in elderly TN patients is.⁹ Therefore, elderly patients should not be a protective factor for their prognosis instead of an obstacle for MVD treatment. The functional status of the various organs of the patient is the main criterion to determine the risk of MVD operation. The reason why the advanced age is a protective factor for prognosis analysis of patients considered may be as a result that brain atrophy gradually increased with aging, thus lead to easier exposed of the trigeminal nerve during MVD operation, thereby reducing the long-term recurrence rate.

The age of the patient determines the choice of the timing of the operation and the judgment of the long-term effect in the clinical work. At present, there is no clear standard about its research. The grouping criteria of each researcher vary. However, different grouping methods may produce negative or even opposite results, so it requires a lot of clinical studies to confirm.

The Recurrence Association of TN after MVD

The relationship between the course of disease and the recurrence of TN has always been controversial in academic circles. The biggest difficulty is that it is very difficult to determine the specific influence of TN duration on the recurrence of MVD after operation. It is more difficult to quantify. In the course of study included in this study, the recurrence of the long course was higher. At present, scholars are concerned about how long the course of disease is easy to lead to the prognosis of MVD. The correlations among disease history, long-term prognosis, and recurrence rate are further complicated by the involvement of many other factors. Indeed, some experts have posited that patients with TN disease and vascular compression of nerve growth. Moreover, increasing trigeminal nerve damage gradually exacerbates consequent changes to myelin sheaths and nerve stems; typical trigeminal nerve pain gradual worsens to atypical trigeminal neuralgia and finally evolves into irreversible neuronal damage, resulting in the increased recurrence rate following MVD. If the effect of the course of the disease on the prognosis is considered, the TN patients with long course of disease are recommended to reduce the recurrence of TN with the combination of medication. Or MVD sensory root resection or carding is also recommended. The long-term recurrence is avoided by cutting the sensory root of the trigeminal nerve. Although the patients with sensory root dissection suffered from facial numbness on the affected side, the improved operation is still worth choosing compared with the pain of the two operation after MVD recurrence.

The Correlation between the Incidence of the Onset and the Recurrence of MVD

Numbers of studies also showed that the pain sites of TN patients were more common on the right side, and the ratio between the right and left sides was ~1.6:1.¹⁰ However, the research in the past did not show the affected side is correlated with the prognosis. In this research, the region case research into behavior in revealing the pathogenesis of TN side and MVD postoperative recurrence and no obvious association. There are few cases of bilateral pain, so there is no clear evidence of the risk of bilateral pain and the risk of recurrence after MVD. However, some scholars have identified bilateral pain as a risk factor for the prognosis of patients with MVD. For the reason that this type of TN is easily recrudesced after the treatment of MVD, there is no clear unified opinion in the academic circles at present. That vein compression of the trigeminal nerve may be one of the important factors that causes bilateral pain, and vein oppression is often overlooked as the artery is the artery is more than the cause of the recurrence rate high.

Therefore, the incidence of primary TN is unilateral, and the affected side has no significant effect on the long-term recurrence rate after MVD. Adequate decompression may be the only practical way to reduce the long-term recurrence rate in patients with very few bilateral TN.

In patients who were right-sided affected and patients who came from rural areas, the proportion of MVD recurrence is relatively high, but the statistical analysis does not reach the

required level. Even so, for the treatment of the elderly patients who could tolerate facial numbness, we can combine trigeminal nerve sensory radical rhizotomy or carding to reduce the possibility to recurrence.

The Correlation of TN Pain Branch and Recurrence after MVD

After statistical cases, the incidence of recurrent pain in V2 to 3, V2, and V3 patients was significantly higher than that of other pain branches. In the study of all the related factors, the pain branch of TN is also a more important factor associated with prognosis. In the present study, statistical results show that pain zoning is a risk factor for prognosis. Among V2 to 3, V2, and V3 patients, the recurrence rate of MVD after primary TN is higher than that of other pain branches. The specific pathogenesis has not yet been reported. We speculate that the differences consequent of disparate pain zoning may implicate anatomical factors or vulnerable anatomical features in the recurrence of TN: proneness to vascular compression, difficult microsurgical decompression, or pulling of the nerve induced by recompression.¹¹ If the patient's anatomic factors lead to recurrence, it is easy to explain why the surgeon's skill is not enough to completely prevent the recurrence of TN after MVD treatment.¹²

The presence of a primary TN patient with the characteristics of the pain branch indicates a higher recurrence rate after MVD. In the specific clinical use, although the pain branch of TN patients V2 to 3, V2, V3 by MVD treatment of postoperative recurrence rates compared with other branches of the combination of high probability of recurrence, hence the MVD + PSR (large sensory root rhizotomy) or surgical strategy to improve the carding operation is more meaningful.

At present, a great number of studies have confirmed that primary TN is the absolute indication for MVD treatment. For TN pain branch is V2 to 3, V2 patients should choose MVD treatment only if they choose to use it, which should have a higher risk of recurrence.

This study also found that other related cases of patients were associated with recurrence. Patients with vascular compression (40%) were more likely to relapse than those with significant vascular compression (8.6%). Women (9.9%) had a higher rate of recurrence than men (8%).

In the 30s of last century, foreign scholars have suggested that vascular compression is the main cause of TN.¹³ The effect of MVD in the treatment of TN is also confirmed. It is not easy to relapse after the operation of vascular compression nerve root. The cause of this kind of patient is clearer, and the problem of low recurrence rate after the operation is better explained by.¹⁴ Without vascular compression of the patients belong to the onset of factors is unknown, there may be other causes besides the vascular compression of the previous head trauma, such as intracranial infection and occult immune injury; these unknown factors constitute the pure¹⁵ associated factors of recurrence of MVD after treatment of TN. Therefore, the patients who have no vascular compression are also a patient with high risk of recurrence after simple MVD treatment and it may be necessary to

augment the intraoperative nerve treatment for such patients.¹⁶ As aforementioned, such solutions include combinatory surgical strategies or partial sensory rhizotomy that can prevent the burden of undergoing two operations.¹³ These combined measures can reduce two patients suffering, will not blindly expand the use of sensory root rhizotomy or combing were brought to the patient discomfort, earnestly improve the quality of life of patients.

Recurrence Correlation of Preoperative MR and MVD

The initial magnetic resonance imaging (MRI) examination of the head of MVD was primarily used to exclude secondary TN, such as tumor of the occupying lesion. With the development of imaging technology, magnetic resonance angiography (MRA) has been gradually applied to discover whether there is blood vessel compression to the trigeminal nerve in cerebellopontine angle, which makes MVD operation more clear. However, there are some differences between MRA and MR in tomographic imaging. There are some differences between layer thickness and interval distance, so that some of the compressed vessels do not fall on the scanning level; hence, there will be some cases of vascular compression, which cannot be reflected in the fault images. Although MRI findings were not included in this study, some scholars believe that MR shows a vascular neural conflict, which is a good long-term protective factor for TN after.¹⁶ However, the methods used by different scholars are different. Different MRIs of different authors use different parameters. It is difficult to integrate the preoperative MR in evaluating the effect of MVD on postoperative recurrence of TN.

It is now considered that MR is the only specific imaging examination of TN before operation. However, low MR resolution, inadequate operation technology and other limitations diminish the utility of the examination results: even negative results cannot exclude small arteriovenous compression or arachnoid adhesion caused by TN. It is therefore necessary to combine the clinical manifestation of patients with TN with other relevant factors to determine the appropriate surgical approach. However, it is believed that with the continuous progress of MR instrument resolution and physician operation technology, MR will play a more and more important role in the diagnosis and treatment of TN.

Correlation between Intraoperative Factors and Recurrence after MVD

The study of intraoperative factors that affect the long-term efficacy of MVD in the treatment of primary TN is mainly to explore the relationship between vessels and nerves in cerebellopontine angle and its prognosis. The doctor performed the improvement in the understanding of MVD, constantly improving the level of operation and the prognosis of patients. Thorough decompression in the operation is an independent factor in reducing postoperative recurrence

Type of Responsible Vessel and Prognosis

The types of responsible vessels are usually divided into arteries, veins, arteries, and veins, and no responsible blood

vessels, in which SCA; AICA; SCA + AICA and so on. Many studies have shown that arterial compression is a good protective factor for long-term prognosis. The reason is still unclear. It is presumed that it is related to the operation of doctors. Compared with arterial wall, the artery is more elastic and easier to separate, and the effect after decompression is better. If the responsible vessels are veins, it is more difficult to distinguish, and the vein wall is weaker than the arterial wall. Because of the fear of easy rupture and bleeding, the operation decompression is not enough. Due to the bleeding in the operative area, the arachnoid adhesion around the operation may lead to the source of new compression around the nerve. Therefore, even if the decompression is enough, the long-term prognosis after MVD is also poor, and there is a problem of postoperative recurrence. No vascular compression is a risk factor for the prognosis, and the data analysis in this study also confirms this point.

The Trigeminal Nerve Itself Has a Brown Spot

Although the prevailing view is that the blood vessel in Root Entry/Exit Zone (REZ) area is the most common cause of the trigeminal nerve stem compression, but there is no evidence of compression at the trigeminal nerve around TN patients. There are only brown spots. There were brown spots on the nerve root, and the experts explored the whole course of the nerve root and did not omit the possible responsible vessels. In another study, we made a research and analysis. It is considered that TN with brown spots on the nerve roots is an independent risk factor for recurrence after MVD treatment. The operation principle of MVD emphasizes "decompression," any vessels including small arteries and veins, in any part of the trigeminal nerve decompression are in contact with the operation, but for no obvious nerve brown spots type TN to do these "decompression," will appear in patients with postoperative recurrence after operation or invalid the situation.

Due to the limited conditions, the parameters of the patient's phase are not very comprehensive, but the factors that are taken are all easily obtained in clinic, which bring us many conveniences for understanding and evaluating prognosis. Through this research we found that female, V2 to 3, V2, as a branch of pain V3 TN patients without vascular compression in operation, the simple MVD operation long-term recurrence risk. Aiming at these risk factors of TN patients, we put forward the following preventive measures: (1) for TN patients with long history and older patients, it is still recommended to perform surgical treatment actively and take MVD+ surgical strategy of radical sensory rhizotomy. (2) for young patients with unbearable numbness in the opposite side, the operation strategy of MVD+ carding can be better.

To sum up, there are many factors that influence the long-term recurrence of primary TN after microvascular decompression. Various factors play a common role and affect the risk difference of recurrence after MVD in TN patients. There are also interactions among various factors. From the perspective of patient's own factors, pain area, gender, and vascular compression are important factors associated

with TN. Other factors such as age, onset side, course of disease, and recurrence have only partial reference significance, and the correlation did not reach the significant level of statistics. As for "pain branch V2-3, V2, V3; female, without vascular compression," patients with simple MVD treatment with higher recurrence rate will need studies of larger sample size, multicenter data analysis, and in-depth study of pathology and electrophysiology.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (name of institute/committee) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

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Conflict of Interest

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or nonfinancial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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