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Original Article

Contributing factors to pain-free outcome in trigeminal neuralgia following microvascular decompression

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ABSTRACT

Background: Trigeminal neuralgia (TN) is a disease that impairs patients' daily activities. Microvascular decompression (MVD) is known as the best procedure to relieve pain, yet a small portion of patients still experience pain after surgery. This study will analyze the prognostic factor of MVD for TN patients.

Methods: This is a retrospective cohort study of patients with TN who underwent MVD in an Indonesian tertiary hospital from January 2012 to December 2023. It combines medical records and patient interviews followed by statistical analysis to identify prognostic factors influencing the outcome of MVD for TN.

Results: Good response to carbamazepine is a favorable factor for short-term pain-free following MVD ($P = 0.01$). The type of pain emerged as the sole significant prognostic indicator for short-term ($P < 0.001$) and long-term ($P = 0.04$) pain relief following MVD. The duration of pain, the type of blood vessels compressing, and the location of compression demonstrated no statistically significant prognostic value on post-MVD pain-free outcomes.

Conclusion: MVD outcomes are influenced by several factors, including trigeminal pain type (for short and long-term outcomes) and response to carbamazepine (short-term outcomes). Conversely, other factors thought to influence MVD outcomes, such as the duration of pain, the type of blood vessel compressing the nerve, or the site of nerve compression, have not been proven to influence the procedure's outcome.

Keywords: Microvascular decompression, Pain-free, Trigeminal neuralgia

INTRODUCTION

Trigeminal neuralgia (TN) is a debilitating disease marked by intense, stabbing pain in the face, most commonly caused by neurovascular compression on the trigeminal nerve in the prepontine cistern.[3,5] There are two types of pain in TN; one is the typical pain, usually triggered by daily activity such as speaking or eating. Typical TN is characterized by extremely sharp and severe pain that persists briefly, ranging from a few seconds to a few minutes. Another is atypical TN, which mainly presents with a persistent burning sensation accompanied by sharp pain.[2,3,11]

Microvascular decompression (MVD), especially in the root entry zone (REZ) area, is considered the best surgical intervention for intractable TN, a condition in which medication such as carbamazepine and another antiepileptic drug is no longer effective due to a limited dosage range to relieve pain or prevalent side effects.[3,11]

MVD's successful rate of alleviating pain was reported between 55% and 93% of cases.[3,5] Therefore, it is essential to analyze possible prognostic factors determining pain relief in patients with intractable TN undergoing MVD. Various aspects, including clinical profile and operative findings, will be analyzed to explore the success rates and prognostic factors in MVD for TN. To our knowledge, this is the first MVD in TN data published in Southeast Asia.

MATERIALS AND METHODS

This is a retrospective cohort study in Indonesia's tertiary hospital from January 2012 to December 2023; patients suffering from intractable neuralgia trigeminal were assessed by inclusion and exclusion criteria to participate in the study. The patient must be older than 18 years old and have undergone MVD by two subspecialized functional neurosurgeons (HS and AF). The sample was excluded from participation if they had an intracranial tumor, multiple sclerosis, intracranial infection, or had undergone an MVD previously.

Patient clinical profiles, operative findings, and pain follow-up, including preoperative pain duration (< or > 5 years), response to carbamazepine (good or poor), type of pain (typical or atypical), compressing structure to the nerve (arterial, vein or mixed), and location of compressed nerve data (REZ, non-REZ or mixed) were collected. These data were then analyzed with postoperative data, which is the pain-free outcome, to find the prognostic factor influencing the outcome.

This study describes two outcomes: short-term pain-free, which is the pain status at the early postoperative time before the patient is discharged from the hospital, and long-term pain-free status, which was evaluated at least 12 months after the procedure. Pain-free is decided by the Barrow Neurological Institute (BNI) pain scale I, which is defined as no pain without medication.

All of the MVD procedures used in this study were retrosigmoid approaches continued with interposition of the neurovascular contact with Teflon™ (polytetrafluoroethylene), which has been a standard procedure.[3,6]

Data of preoperative pain duration, response to carbamazepine, type of pain, compressing structure to the nerve, and location of compressed nerve were statistically analyzed using Statistical Package for the Social Sciences (SPSS) software (version 19.0, SPSS, Chicago, IL, USA) to find a significant prognostic factor for either short or long-term pain relief in TN after MVD using Fisher test for two categorical variable, Spearman, or Pearson test in SPSS. The confidence level for statistical significance was a $P < 0.05$.

Table 1: Demographics of patients.

Characteristics	*n* (%)
Sex	
Male	28 (50.9)
Female	27 (49.1)
Age	
<60 yo	39 (70.9)
>60 yo	16 (29.1)
Race	
Javanese	39 (70.9)
NonJavanese	16 (29.1)
Comorbidity	
Hypertension	20 (36.4)
Diabetes	16 (5.4)
Pain duration	
<5 years	35 (63.6)
>5 years	20 (36.4)
Pain type	
Classic	50 (90.9)
Atypical	5 (9.1)
Drug response	
Good	46 (83.6)
Poor	9 (16.4)
Compressing structure	
Arterial	45 (81.8)
Vena	6 (10.9)
Mixed	4 (7.3)
Compression site	
REZ	41 (74.5)
Non-*REZ*	3 (5.5)
Mixed	11 (20)
Short-term outcome	
Pain-free	46 (89.1)
No pain-free	9 (10.9)
Long-term outcome	
Pain-free	36 (65.4)
No pain-free	9 (16.4)
Loss to follow-up	10 (18.2)

REZ: Root entry zone, yo : years old

RESULTS

This study included 55 subjects, 28 males and 27 females. The mean age of the sample was 51.3 years, with the youngest patient being 22 years old and the oldest being 78 years old. The median duration of preoperative pain was 36 months, with the shortest pain duration being 4 months and the longest being 20 years. 83.4% of the patients have a good responded to carbamazepine.

Based on operative findings, 74.5% of patients experienced neurovascular contact at the REZ, 5.5% found neurovascular contact at the distal REZ, and the rest of the samples had multiple neurovascular contacts. As much as 81.8% of compression was caused by arterial structures dominated by SCA, while the remainder was caused by compression of venous (10.9%) and a mix of arterial and venous structures (7.3%).

Forty-six patients (89.09%) experienced pain-free with BNI Class 1 at the short-term follow-up, and after long-term follow-up, the pain-free rate with BNI Class 1 was 80% [Table 1]. There were 10 losses to follow-up patients at the long-term follow-up. Long-term follow-up was done for at least 12 months, with the mean follow-up being 54 months and the most extended follow-up being 12 years.

Good response to carbamazepine was found to be a favorable factor for short-term pain-free after MVD ($P = 0.01$). The type of pain emerged as the only significant prognostic indicator for both short-term ($P < 0.001$) and long-term pain ($P = 0.004$) relief following MVD, with typical pain type being a favorable prognostic factor [Table 2]. The duration of pain, the type of blood vessels compressing, and the location of compression demonstrated no statistically significant prognostic value on post-MVD pain-free outcomes.

DISCUSSION

Statistical analysis revealed a significant correlation ($P < 0.05$) between pain type and both short-term and long-term (i.e., >1 year) post-MVD pain outcomes, with typical pain as a favorable contributing factor. This corroborates prior studies indicating that atypical pain types portend a poor MVD prognosis in TN. Atypical pain likely originates from nonneurovascular compression pathology, potentially involving central nervous system lesions or irreversible trigeminal nerve damage unresponsive to vascular decompression.[5,7]

A good response to carbamazepine was shown to be a favorable prognostic factor for short-term pain-free status. A patient with a positive response to the medication could

Table 2: Outcome analysis of each prognostic factor.

Characteristics	Pain-free (Short term)	No pain-free (Short term)	*P*-value	Pain-free (Long term)	No pain-free (Long term)	*P*-value
Pain duration			0.625			0.414
<5 years	39	6		28	8	
>5 years	9	1		8	1	
Pain type			**<0.001**			**0.004**
Classic	48	2	RR 25 CI 95 (6.43–97.2)	35	5	RR 6.4 CI 95 (2.52–16.22)
Atypical	0	5		1	4	
Drug response			**0.01**			*P*=0.186
Good	43	3	RR 6.815 CI95 (1.82–25.39)	31	6	
Poor	5	4		5	3	
Compressing structure			0.724			0.104
Arterial	39	6		27	8	
Vena	5	1		5	1	
Mixed	4	0		4	0	
Compression site			0.344			0.267
REZ	34	7		25	8	
Non-*REZ*	3	0		2	0	
Mixed	11	0		9	1	

REZ: Root entry zone, RR: Relative risk, CI: Confidence interval. Bold: Statistically significant ($p < 0,05$ = Statistically significant)

indicate that the etiology of the disease is neuropathic pain caused by nerve compression. MVD will eventually remove the pathological process, stopping the pain in TN.[3,10]

Preoperative pain duration did not significantly impact short-term or long-term pain-free outcomes. A 5-year pain duration was selected, aligning with previous research.[1,5] While our findings diverge from Holste's *et al*. study in 2020,[5] they corroborate Sindou's *et al*. 2006 study.[7] This discrepancy may be attributed to insufficient neurovascular compression to induce permanent trigeminal nerve damage; consequently, patients experiencing prolonged pain demonstrated comparably favorable prognoses to those with shorter pain durations.[5,7]

Variations in blood vessel structure, including arterial, venous, or mixed vascular types, did not yield statistically significant differences in short-term or long-term pain relief. Although other studies suggested a better prognosis with arterial compression[5], our study aligns with other previous findings, which demonstrate that venous compression can induce a pathophysiology similar to arterial compression, resulting in ephaptic transmission and TN.[4,8]

Neurovascular contact sites – whether in the REZ, distal REZ, or both – showed no correlation with outcomes. This is consistent with prior research indicating that TN pathogenesis can occur not only within the REZ but also in the distal REZ.[7,9] This result suggests that neurosurgeons should comprehensively evaluate the trigeminal nerve pathway in the prepontine cistern, from the REZ to the juxta-petrous region, and perform decompression at all sites of neurovascular contact.[6,7]

Limitation of the study

There was an 18% loss of follow-up on the long-term pain-free evaluation, which reduces the sample size of the long-term pain-free outcome. Second, even though this is the first TN data published from the Southeast Asia region and conducted in the neurosurgery referral center of Indonesia, this study is a single-center study that needs to be strengthened with a multicenter study from another center.

CONCLUSION

MVD is highly effective in providing short and long-term pain relief for individuals suffering from intractable TN. In this study, short-term pain-free outcomes were found in about 89% of patients, and 80% of the patients had pain-free in long-term outcome follow-up. Factors contributing to a better outcome include typical pain and a good response to carbamazepine. Other factors, such as duration of pain, compressing structure, and compression site, have not been proven to correlate with the outcome. These insights are valuable for discussing the potential benefits of MVD with patients suffering from this intense facial pain syndrome before undergoing the procedure. A larger, multicenter prospective study should be conducted to gain a higher level of evidence.

Ethical approval: The research/study was approved by the Institutional Review Board at the Ethical Committee of Dr. Soetomo General Academic Hospital, Surabaya, number 1112/KEPK/X/2024, dated October 04, 2024.

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REFERENCES

1. Bederson JB, Wilson CB. Evaluation of microvascular decompression and partial sensory rhizotomy in 252 cases of trigeminal neuralgia. J Neurosurg 1989;71:359-67.
2. Burchiel KJ. A new classification for facial pain. Neurosurgery 2003;53:1164-7.
3. Cruccu G, Di Stefano G, Truini A. Trigeminal neuralgia. N Engl J Med 2020;383:754-62.
4. Dumot C, Brinzeu A, Berthiller J, Sindou M. Trigeminal neuralgia due to venous neurovascular conflicts: Outcome after microvascular decompression in a series of 55 consecutive patients. Acta Neurochir (Wien) 2017;159:237-49.
5. Holste K, Chan AY, Rolston JD, Englot DJ. Pain outcomes following microvascular decompression for drug-resistant trigeminal neuralgia: A systematic review and meta-analysis. Neurosurgery 2020;86:182-90.
6. McLaughlin MR, Jannetta PJ, Clyde BL, Subach BR, Comey CH, Resnick DK. Microvascular decompression of cranial nerves: Lessons learned after 4400 operations. J Neurosurg 1999;90:1-8.
7. Sindou M, Leston J, Howeidy T, Decullier E, Chapuis F. Microvascular decompression for primary trigeminal neuralgia (typical or atypical). Long-term effectiveness on pain; prospective study with survival analysis in a consecutive series of 362 patients. Acta Neurochir (Wien) 2006;148:1235-45.
8. Soni P, Potter T, Soni PP, Estemalik E, Recinos PF, Kshettry VR. Outcomes of microvascular decompression for trigeminal neuralgia with purely venous compression: A systematic review and meta-analysis. Clin Neurol Neurosurg 2020;198:106230.
9. Wang DD, Ouyang D, Englot DJ, Rolston JD, Molinaro AM, Ward M, *et al*. Trends in surgical treatment for trigeminal neuralgia in the United States of America from 1988 to 2008. J Clin Neurosci 2013;20:1538-45.
10. Yuan M, Zhou HY, Xiao ZL, Wang W, Li XL, Chen SJ, *et al*. Efficacy and safety of gabapentin vs. Carbamazepine in the

treatment of trigeminal neuralgia: A meta-analysis. Pain Pract 2016;16:1083-91.
11. Zakrzewska JM, Linskey ME. Trigeminal neuralgia. BMJ Clin Evid 2014;2014:1207.

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