ORIGINAL RESEARCH

Factors affecting the surgical outcome of microvascular decompression in trigeminal neuralgia

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ABSTRACT

Background: Microvascular decompression is an established surgical modality for treatment of trigeminal neuralgia with variable long-term success rates depending on numerous patient and disease related factors.

Methods: A prospective study was done including 31 patients, aged between 18 to 74 years who underwent microvascular decompression for primary trigeminal neuralgia at our institution. Barrows neurological institute pain intensity scale and facial numbness score were used to assess outcome till 1 year follow up period.

Results: 71% patients were suffering from typical trigeminal neuralgia with involvement of both V2 and V3 divisions being the most common presentation. All patients achieved favorable outcome based on BNI pain and numbness score in the immediate post-operative period however at one year 3 patients had un-favourable pain score. Younger age, longer duration of neuralgia before surgery, involvement of all three trigeminal nerve divisions, pure venous compression and presence of focal arachnoiditis were factors associated with poor outcome.

Conclusions: MVD is a safe and effective procedure in all age groups including elderly patients with both typical and atypical symptomatology. It is seen to be effective in relieving both arterial and mixed venous neurovascular conflict especially in patients with NVC grade III severity. However, the distribution of pain in all three divisions of trigeminal nerve, pure venous compression and presence of focal arachnoiditis seem to be associated with poorer outcome.

Keywords: Microvascular decompression, MVD, trigeminal neuralgia, prognostic factors

INTRODUCTION

Trigeminal neuralgia (TN) is a debilitating neuropathic disorder characterized by recurrent severe, paroxysmal bursts of pain in the form of sharp, repetitive, shock-like pain lasting from a fraction of a second up to 2 min, with pain free intervals of weeks to years between attacks.[10] Trigeminal neuralgia affects women (60%) more than men (40%) and average age

of onset is 53–57 years.[13,16] The major contributing factor for classical TN is compression of the trigeminal nerve by a blood vessel at or near the root entry zone.[7,11] Pharmacological management with anticonvulsants such as carbamazepine and oxcarbazepine are the first line treatment option, however some patients may be resistant to maximum doses of poly-pharmacotherapy or may not tolerate adverse effects of medications.[4] Various interventional modalities are available for these patients like microvascular decompression (MVD), percutaneous radiofrequency rhizotomy (PRR), percutaneous glycerol rhizotomy (PGR), percutaneous balloon compression (PBC), and stereotactic radiosurgery (SRS), including gamma knife radiosurgery (GKRS) or cyber-knife.[2,8,15,23]

Microvascular decompression has proven to be the most successful surgical procedure with success rates upto 80-96%.[18,5] However, failure rates of 15 to 35% for MVD have been reported in the literature.[2,12] We, therefore chose to undertake this study to identify the factors which influence the outcome after MVD. These factors may play a role in patient selection prior to MVD to better tailor and individualize the prognosis and management.

MATERIAL AND METHODS

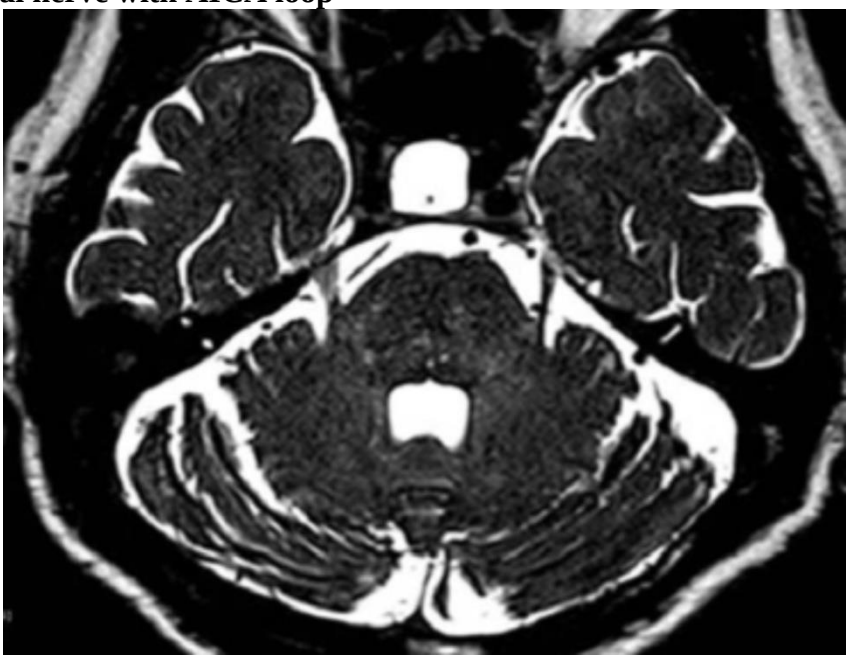
We performed a prospective study after clearance from institutional ethical committee including all cases of classical trigeminal neuralgia who presented to us between January 2019 to November 2020. The patients who were found to have symptomatic TN secondary to schwannoma, epidermoid cyst, aneurysm, Chiari's malformation, or Multiple Sclerosis or underwent previous MVD or ablative procedure were excluded from the study.

The demographic and clinical data of the included patients were recorded including gender, duration of symptoms, age at surgery, affected side, distribution of pain, type of TN (typical or atypical TN), preoperative facial numbness, concomitant symptoms, previous medication and dosages, and any systemic disorder like epilepsy or co-morbidities like hypertension or diabetes. All patients underwent preoperative neurological examination followed by magnetic resonance (MR) imaging using Constructive Interference in Steady State (CISS) sequences for preoperative assessment of vascular compression of trigeminal nerve with respect to the degree of neurovascular conflict (NCV) and location of NVC (Table 1, Figure 1).[19,9] The image was interpreted by neurosurgeons and neuro-radiologists jointly.

Table 1: NVC location and NVC severity[14,15]

NVC location	Root entry zone- area from the site of entry of the trigeminal nerve into the pons to 7 mm peripherally along the nerve Peripheral- >7 mm from the site of entry of the trigeminal nerve into the pons
NVC severity	Degree I severity-the vessel was in contact with the root without any visible indentation to the root. Degree II severity-there was displacement and/or distortion of the root, and Degree III severity -there was a marked indentation in the root

Fig 1: Pre-operative MRI brain CISS sequence showing neurovascular conflict of left side trigeminal nerve with AICA loop



Microvascular decompression was performed via a retro-sigmoid approach with the patient in a modified park bench or lateral position**.** The intra-operative data of the patient were also recorded (Figure 2, Figure 3), including the type of the compressing vessels (artery or vein or both), NVC severity and location along the length of the root (Table 1) along with presence of any focal arachnoiditis at the level of root.

Fig 2: Intra-operative picture-trigeminal nerve compressed by inferiorly by basilar artery, posteriorly by loop of AICA and superiorly by superior petrosal vein

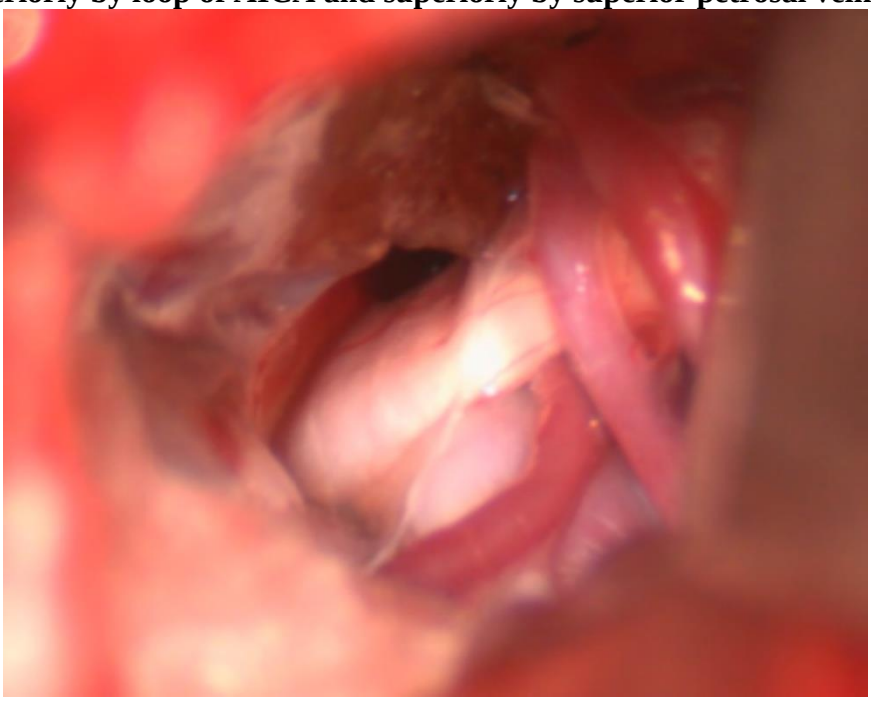
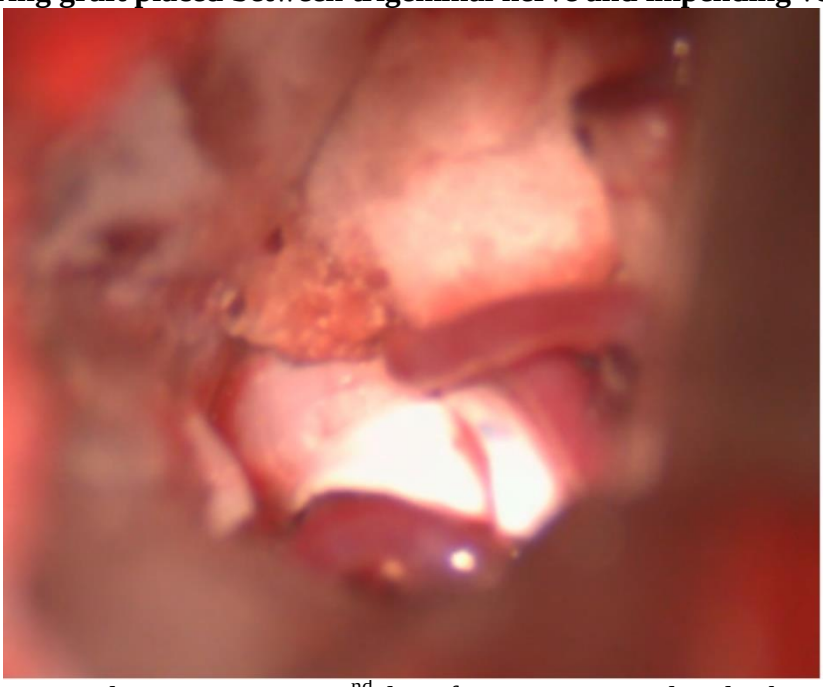


Fig 3: Teflon ring graft placed between trigeminal nerve and impending vessel



We assessed the immediate outcomes at 2nd day after operation and at discharge on 7th to 10th post-operative day. The outcome was further assessed by visits to the outpatient department or by telephone at 3-monthly intervals for 1 year. The operative complications were measured during follow-up visits (e.g., Head/Face/Neck Paresthesia, CSF Leak, Infection, Auditory alteration). Barrow Neurological Institute (BNI) Pain Intensity Scale (P) and BNI facial numbness score (N) were used to assess the postoperative outcomes (Table 2).[20] Pain was considered recurrent when, after an initial success, the patient reported trigeminal pain again, necessitating resumption of medication, and if this medical therapy was not sufficient, underwent re-surgery.

Table 2: Defining favorable and unfavorable outcomes following MVD using BNI facial pain (P) and facial numbness (N) score[16]

	Favorable		Unfavorable	
Pain	P-1	No pain, no medication	P-3	Some pain, adequately controlled with medication
	P-2	Occasional pain, not requiring medication	P-4	Some pain, not adequately controlled with medication
			P-5	Severe pain/no pain relief
Numbness	N-1	No facial numbness	N-3	Facial numbness, somewhat bothersome
	N-2	Mild facial numbness, not bothersome	N-4	Facial numbness, very bothersome

All statistical analyses were performed using SPSS version 24.0 (IBM, Armonk, New York, USA). The categorical variables were presented as numbers and percentages and compared using chi-square and Mann Whitney U test. Continuous variables were described as mean values, medians and standard deviations and compared using t-test. P-value <0.05 was considered statistically significant.

RESULTS

A total of 31 patients with TN were selected with age at surgery between 18 to 74 years (mean 52.38 years) with 54.8% males. The duration of symptom before surgery was 1-15 years with median duration of 4 years. 32.3% of patients had symptoms of trigeminal

neuralgia for more than 6 years. Hypertension was the most commonly associated co-morbidity seen in 35.48% cases.

The clinical presentation of neuralgia was only of the paroxysmal type and was therefore considered strictly typical in 22 patients (71%). In the other 09 patients (29%) neuralgia was atypical because the paroxysmal crises were superimposed on a baseline of predominantly aching/burning pain. Right side (n=17; 54.8%) was found to be more commonly affected side. Isolated V2 involvement was seen only in 6.5% (n=2) patients with V2 and V3 involvement being the most common (32.3%). Eight patients were found to have involvement of all three divisions of trigeminal nerve whereas involvement of two divisions was the most common presentation.

54.8% patients were found to have NVC grade III involvement with displacement and/or distortion of the trigeminal root. The most common artery causing Neurovascular conflict was superior cerebellar artery (SCA) 48.50% followed by Anterior Inferior Cerebellar Artery (AICA) in 12.9% cases. A vein was found to be impinging in the nerve in 15 cases (48.38%), 08 (25.8%) of which were associated with an arterial compression as well. The most common zone of neurovascular conflict was root entry zone (REZ) (87.10%).

In the immediate post-operative period, all the patients achieved favorable outcome based on BNI pain and numbness score (Table 2). However, at the time of discharge one patient had pain which was adequately controlled on medications. At 3-month follow up, 2 patients had unfavorable pain scores which increased to 3 at one year. 2 patients were seen to have developed facial numbness at 3-month interval which remained stable at one year follow up.

Thesuccess rate of MVD didn't vary significantly between male and female patients at discharge or one year follow up. The older age group (>70 years) showed excellent response to MVD (100% favorable pain score at 1 year) but the effect didn't reach statistical significance (Table 3). The relief of symptom was the same for both with typical as well as atypical pain. Distribution of pain in all three divisions of trigeminal nerve was found to negatively affect outcome at one year (p=0.008). Patients with NVC grade III compression showed better long-term response to MVD with no unfavorable outcome at one year but the effect didn't reach statistical significance (Table 4). Pure venous compression was predictive of poor outcome at 3-month (p=0.045) as well as one year (p=0.008) follow up. The presence of focal arachnoiditis was shown to associated with unfavourable outcome (p=0.049) at one year.

Table 3: Prognostic factors: Clinical parameters

Prognostic factors: Patient related parameters						
Patient characteristics No. of patients	**No. of patient success at discharge (30)**	**P value**	**No. of patient success at 3 Months (29)**	**P value**	**No. of patient success at 12 Months (28)**	**P value**
Gender		1		0.488		1
Male (17)	16 (94.11%)		15 (88.23%)		15 (88.23%)	
Female (14)	14 (100%)		14 (100%)		13 (92.85%)	
Age		0.441		0.732		0.485
<50 years (12)	12 (100%)		11 (91.66%)		11 (91.66%)	
50-70 years (12)	11 (91.66%)		11 (91.66%)		10 (83.33%)	
>70 years (7)	7 (100%)		7(100%)		7 (100%)	
Hypertension		0.355		1		1
Present (11)	10 (90.90%)		10 (90.90%)		10 (90.90%)	
Absent (20)	20 (100%)		19 (95%)		18 (90%)	
Duration of		0.338		0.732		0.646

neuralgia						
<2 years (6)	6 (100%)		6 (100%)		6 (100%)	
2-6 years (15)	15 (100%)		14 (93.33%)		13 (86.66%)	
>6 years (10)	9(90%)		9 (90%)		9 (90%)	
Prognostic factors: Anatomical parameters						
Type of pain		1		1		1
Typical (22)	21 (95.45%)		20(90.90%)		20 (90.90%)	
Atypical (9)	9 (100%)		9(100%)		8 (88.88%)	
Site of pain		0.452		0.196		0.081
Right (17)	17 (100%)		17 (100%)		17 (100%)	
Left (14)	13 (92.85%)		12 (85.71%)		11 (78.57%)	
Extent		0.226		**0.046**		**0.008**
One division (7)	7 (100%)		7 (100%)		7 (100%)	
Two division (16)	16 (100%)		16 (100%)		16 (100%)	
Three division (8)	7 (87.5%)		6 (75%)		5 (62.5%)	

Table 4: prognostic factors: anatomical factors

Patient characteristics No. of patients	No. of patient success at discharge (30)	P value	No. of patient success at 3 Month (29)	P value	No. of patient success at 12 Month (28)	P Value
NVC Severity		0.170		0.273		0.088
Degree 1 (7)	7 (100%)		6 (85.71%)		6 (85.71%)	
Degree 2 (7)	6 (85.71%)		6(85.71%%)		5 (71.4%)	
Degree 3 (17)	17 (100%)		17 (100%)		17 (100%)	
Cause of TN		0.226		**0.045**		**0.008**
Pure venous (7)	6 (85.71%)		5 (71.4%)		4 (57.14%)	
Artery,Artery+Vein (24)	24 (100%)		24 (100%)		24 (100%)	
Arachnoiditis		0.387		0.142		**0.049**
Absent 19	19 (100%)		19 (100%)		19 (100%)	
Present (12)	11 (91.66%)		10 (83.33%)		9 (75%)	
Location		1.000		1.00		1.000
REZ (27)	26 (96.29%)		25 (92.59%)		24 (88.88%)	
Peripheral neurovascular contact 4)	4 (100 %)		4 (100 %)		4 (100 %)	

DISCUSSION

MVD is widely regarded as the gold standard surgical procedure for TN with immediate pain relief rates up to 90 to 95% however it's efficacy abates over time (recurrence rate= 17% at 15 years; recurrence=30% over 6.2 years). [21,1] Most of the instances of symptomatic recurrence post MVD have been seen to develop within the first 2 years. There are several factors that may associate with poor outcomes after MVD including female sex, younger age, longer pain duration, atypical features and, venous compression.[2,26]

In our study, we had a male predominant (54.8%) population which contrasts against the female predominant pattern generally seen with 29% patients suffering from atypical TN which was similar to that reported by Sindou et al (atypical TN 24.5%) and Zhang et al (atypical TN 36%). [1,27]TN affecting mandibular and maxillary (32.3%) divisions was the commonest pattern which is similar to that seen in the literature (V2 and V3 involvememt in 30.7% patients).[1]

The most common offender causing Neurovascular conflict was SCA (48.50%) followed by AICA (12.90%) with 22.6% showing exclusively venous compression. SCA involvement was previously reported in 74.3% and AICA in 6% patients however, pure venous contact with nerve in was found in only 3.3% patients.[18] In this study all but a single patient achieved immediate pain relief (96.8%) following surgery which is similar to the figures reported by other authors.[1,6]

PROGNOSTIC CHARACTERS: CLINICAL PARAMETERS

In our study gender, history of systemic hypertension and other co-morbidities, duration of neuralgia before MVD did not influence the surgical outcome. Sindou et al. and Ruiquan Liu et al., reported similar results in terms of demographic profile.[1,25] Contrary to this Bederson JB et al. and Szapiro et al., reported women having a higher rate of failures or recurrence.[3,24]
All of the older age group (>70 years) experienced favourable pain scores in post-operative period (n=7, 100%) and the effect was sustained at one year follow up. Other investigators have found similar outcome with older patients experiencing better pain relief but there are some reports suggesting opposite or no effect of age on prognosis.[1,25] We found that longer preoperative duration of TN was associated with lower degree of pain relief in short term (90% pain relief at discharge and 3 months) however long-term pain relief was not adversely affected (success rate remained 90% at 1 year) which was similar to the experience of other reearchers.[1,22]

PROGNOSTIC CHARACTERS: NEURALGIA-RELATED FACTORS

In our study, atypical presentation did not have a negative effect on outcome with cure rates same as seen with typical neuralgia (88.8% vs 90.9%; p=1) which is in concordance with the results reported by Sindou et al., and Ruiquan Liu et al.[1,25] However, Li et al., reported that atypical manifestations had a significant negative effect both at 1 and 15 years of follow up.[14] The effectiveness of MVD was similar for typical and atypical TN in our study which could be explained by the reason that our criteria for defining atypical TN was very restrictive.
In current study the extent of the neuralgia to one or two divisions had no negative impact on outcome. However, when all three divisions were affected the success rate was lower and this difference was significant at 1-year follow-up (p = 0.008). According to other studies involvement of all three divisions of the trigeminal nerve had a negative effect on outcome of MVD.[25] One possible reason our result may be that involvement of all three divisions could mean a severe alteration of the trigeminal nerve, perhaps an underlying neuropathy, which is hardly ever reversible.

PROGNOSTIC FACTORS: ANATOMICAL FACTORS

Lower success rate was seen for pure venous compression over arterial compression i.e.71.4% at 3 month for venous compression compared with 100% for arterial compression (p=0.045) and at 1 year of follow-up success rate was 57.14% (p=0.008). Similar to our result a lower success rate was recorded for pure venous compression by Barker et al., Sun et al., and Li et al.[2,22,19] Contrary to this, Sindou et al. and Zhang et al., did not find any relationship between the offending vascular type and pain relief.[1,3] Arterial decompression is easier than venous as it is difficult to segregate vein from REZ by placing any graft between vein and nerve and venous coagulation may also be not acceptable as they were quite big veins.
In our study at 6 month and 1year of follow-up, patients with degree III NVC severity had cure rates of 100% with degree I and degree II cure rates of 85.7% and 71.4 % respectively. In our study cohort higher severe of NVC was associated with better outcome at 6 month and 1 year (p=0.088). Studies done by Sindou et al., Zhang et al., Szapiro et al., and Burchiel et al., had shown a strong correlation between the degree of the vessel compression observed

intra-operatively and the rates of favorable long-term outcome.[1,3,22]Sindou et al., proposed that in TN with NVC Degree I, some other (adjuvant) factor must be the cause of the neuralgia. 21Prediction of the severity of NVC with a preoperative imaging study may be useful in differentiating symptomatic NVC from innocent neurovascular contact, which may be valuable for patient selection for MVD treatment.

The presence of local arachnoiditis and adhesion to the root had a negative effect on success rate at 1 year (75% with p = 0.049). Sindou et al., similarly reported focal arachnoiditis to have a negative long-term effect with a cure rate of only 58.7% after 15 years of follow-up (p = 0.002)[21] with Mazzucchi et al., reporting only 42.2% success rate at 15 years post MVD. We also found that the site of neurovascular conflict, whether peripheral or REZ, doesn't seem to affect the outcome which corresponds to the findings of other researchers.[17]

Our study is limited by virtue of being a single centre study with a relatively small sample size It therefore may have lacked sufficient power to identify all significant associations. No diffusion tenser imaging (DTI) was done preoperatively which can give good idea about compressing vessel over nerve and possible outcome post MVD. Follow-up period of our study was only 12-months, a longer follow-up period would help to more accurately determine the long-term efficacy of MVD.

CONCLUSIONS

MVD is a safe and effective procedure in all age groups including elderly patients with both typical and atypical symptomatology. It is seen to be effective in relieving both arterial and mixed venous neurovascular conflict especially in patients with NVC grade III severity. However, the distribution of pain in all three divisions of trigeminal nerve, pure venous compression and presence of focal arachnoiditis seem to be associated with poorer outcome.

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Nil

SOURCE OF SUPPORT

Nil

CONFLICT OF INTEREST

Nil

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