Can Vascular Compression Be Reliably Identified on Pre-Operative Images in Microvascular Decompression Cases?

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Abstract

Since Dr. Jannetta pioneered the belief in vascular compression as an etiology for trigeminal neuralgia (TN), microvascular decompression (MVD) has become the most direct and curative intervention for treating cranial nerve neuralgias. However, MVD outcomes are varied. The current literature suggests recurrence rates can approach 30%. Evidence of neurovascular compression on pre-operative imaging has been shown to predict better surgical outcomes. In our study, we evaluated our institution's experience with microvascular decompression and pre-operative imaging studies to examine factors that might better predict post-operative outcomes.

Introduction

Trigeminal neuralgia (TN) is a neurological syndrome that classically presents with unilateral, paroxysmal facial pain. Most cases present in middle age, though it is also associated with an earlier onset in the second and third decades among females.[1,2] Despite its prominent symptoms, this syndrome is relatively rare with an incidence of approximately 27 per 100,000 individuals each year.[3] The most common causes of TN are due to vascular compression of the trigeminal nerve within the cerebellopontine cistern, mainly by aberrant branches of neighboring arteries such as the posterior-inferior cerebellar (PICA), anterior-inferior cerebellar (AICA), and superior cerebellar (SCA) arteries.[4] It is hypothesized that this compression leads to demyelination of the nerve itself, resulting in ectopic impulse transmission that elicits the characteristic pain observed with this condition.[5] Pharmacological therapy is indicated as the first-line treatment for TN with medications such as sodium-channel blockers successfully managing symptoms in many patients. Neurosurgical intervention is indicated for patients with intolerable pharmacologic side effects or symptoms recalcitrant to conservative management.[6] Microvascular decompression (MVD) represents the first-choice surgical treatment for such cases of TN by identifying the affected region of the trigeminal nerve and subsequently, physically separating the offending vessel from the nerve.[4] The literature generally boasts a roughly 90% initial pain relief among patients post-MVD with over 70% remaining pain-free at the 5-year timepoint; MVD is an effective and largely curative intervention for TN with minimal morbidity.[6,7] Prior to surgical intervention, magnetic resonance imaging (MRI) is recommended to rule out any alternative diagnoses that might explain the symptoms (i.e. multiple sclerosis) but has more recently, been employed for accurate identification of the offending vessel due to differences between symptomatic presentation and true regions of compression.[4] Accurate identification of these vessels is nevertheless subject to error with interpretation of the images as well as the quality of the images causing discrepancies in pre- and post-operative vessel identification. In our study, we plan to compare blinded neuroradiologist reads of pre-operative imaging studies to operative findings to better ascertain the extent of such discrepancies and assess the need for potential refinement of the TN diagnostic algorithm.

Methods and Materials

We performed a retrospective chart review of patients presenting to University of Arkansas for Medical Sciences (UAMS) hospital from May of 2014 (date Epic was instituted) to January 2023 who underwent microvascular decompression for a cranial nerve neuralgia (CPT code 61458). We collected pre-operative data as well as post-operative outcome data. Three blinded neuroradiologists are reviewing select pre-operative MRI sequences to determine if vascular compression of a cranial nerve is present or not. This study was reviewed and approved by the UAMS Institutional Review Board (IRB# 276505).

Results

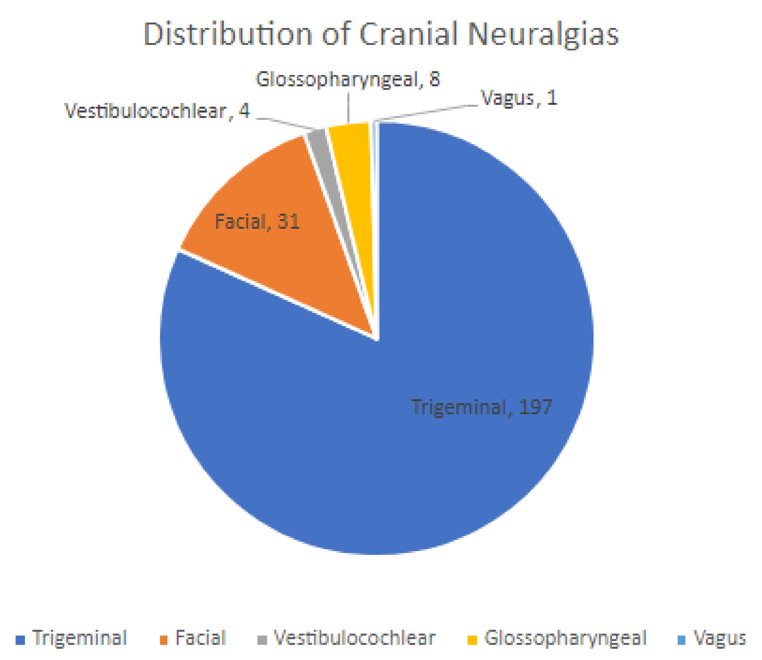
In our preliminary results, we have a sample size of 227 patients with 254 total surgeries (17 re-operations and 10 surgeries of the contralateral side). The majority of surgeries were for trigeminal neuralgia (197) with a small component of hemifacial spasm (31) and lower cranial nerve neuralgias (13). We had 4 total intra-operative complications (3 related to major vascular injury and 1 related to decrease in facial nerve potentials with associated post-operative weakness). 75 total surgeries had a named pre-operative vessel. Of these, 80% were the correct offending vessel as described in the operative report. Venous compression was identified in 126 cases although mostly in conjunction with arterial compression; isolated venous compression was found only 38 times. We had 151 patients present to 3 months follow up. At this visit, we had a recurrence rate of 21%.

Breakdown of Selected Pre-Operative Interventions

Intervention	Number of times performed prior to surgery
No prior intervention	176
Prior MVD	48
Radiation therapy	7
Ablation	7

Breakdown of Pre-Operative Suspected Vascular Offender

Vessel	Number of times labeled as pre-op perpetrator
No pre-operative vessel described	126
SCA	45
Vein	16
AICA	9
PICA	9
Basilar	4
Vertebral	1



Does the Pre-Op Vessel Identified by the Neurosurgeon Correspond with the Intra-Operative Findings?

Pre-Op Vessel Corresponds to Vessel in Op Note?	Surgeries (254 total cases) (n=75 with named pre op vessel)
Correct	60 (80% correct when vessel named pre-operatively)
Incorrect	15 (20% incorrect when vessel named pre-operatively)
Indeterminate	179

Breakdown of What Vessels Were Gotten Correct

Vessel	Number of Times Correctly Identified from Pre-Op to Op Note (n=60)
SCA	39 (65%)
PICA	8 (13%)
AICA	6 (10%)
Vein	5 (8%)
Basilar	1 (1.6%)
Vertebral	1 (1.6%)

Discussion

We are optimistic our forthcoming comparison between blinded neuroradiologists and intra-operative findings can offer a fuller picture of pre-operative evaluations for microvascular decompression. Given our robust sample size, we expect our complete findings to provide a more comprehensive understanding of cranial nerve neuralgias and outcomes with microvascular decompression.

Conclusions

Ultimately, MVD remains an excellent option for patients with TN. Optimizing pre-operative selection based on pre-operative standard-of-care imaging has the potential to act as a valuable adjunct in clinical decision-making.

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