Bartindale M, et al., J Otolaryng Head Neck Surg 2017, 3: 016
DOI: 10.24966/OHNS-010X/100016

HERALD

HSOA Journal of Otolaryngology, Head & Neck Surgery

Retrospective Study

Neurotologic Complications Following Microvascular Decompression: A Retrospective Study

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Abstract

Microvascular Decompression (MVD) offers effective, long-term symptom relief for patients with pathologies related to neurovascular conflicts of cranial nerves in the posterior fossa. We aimed to determine the frequency of neurotologic complications following this surgery. This is a retrospective case review in a tertiary care referral center. A total of 215 consecutive MVD operations by a single surgeon between March 1996 and May 2016 were reviewed with 192 surgeries on 183 patients meeting inclusion criteria. The 52 males and 131 females had a mean age of 58.52 years (range 28-92 years). Indications for MVD were trigeminal neuralgia (n=162), hemifacial spasm (n=23), glossopharyngeal neuralgia (n=13), vagal palsy (n=1), and tinnitus (n=1). The outcomes examined were postoperative hearing loss, tinnitus, vertigo, and hemifacial paresis. At least one of these complications was present in 17.7% of patients. There were 4.17% with permanent hearing loss, 6.77% with transient hearing loss, 5.21% with tinnitus, 5.73% with vertigo, and 0.52% with hemifacial paresis. There was no significant difference in complication rates based on surgical indication. Complication rates in this study are consistent with those in the literature. We recommend perioperative audiometry in all patients undergoing MVD. It is important for otolaryngologists as well as neurosurgeons to be aware of neurotologic complications in order to adequately counsel patients preoperatively and identify them postoperatively.

Keywords: Cerebellopontine angle; Complications; Hearing loss; Hemifacial palsy; Microvascular decompression; Posterior fossa; Tinnitus; Vertigo

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Citation: Bartindale M, Mohamed A, Bell J, Kircher M, Hill J, et al. (2017) Neurotologic Complications Following Microvascular Decompression: A Retrospective Study. J Otolaryng Head Neck Surg 3: 016.

Received: September 20, 2017; **Accepted:** October 20, 2017; **Published:** November 02, 2017

Introduction

Vascular compression of the nerve root exit zone (Figure 1) is characteristic of Trigeminal Neuralgia (TN), Hemifacial Spasm (HFS) and Glossopharyngeal Neuralgia (GPN) [1,2]. TN is a chronic pain syndrome characterized by episodes of paroxysmal, lancinating pain accompanied by an electric shock sensation that affects one or more distributions of the fifth cranial nerve. Pain attacks can be triggered by typical daily activities such as chewing, brushing teeth, or drinking fluids [3]. HFS involves compression at the seventh cranial nerve and is characterized by involuntary, irregular, unilateral twitching of facial muscles [2]. GPN manifests as sharp, stabbing pulses of pain in the auricular and pharyngeal regions caused by neurovascular compression at the root exit zone of the glossopharyngeal nerve [1].

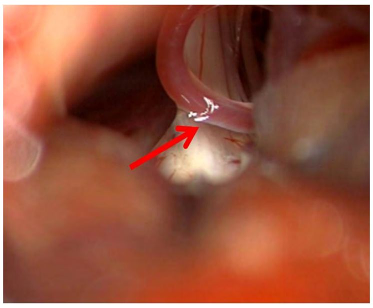

Figure 1: Intraoperative image of neurovascular conflict.

The first line of treatment for TN, HFS, and GPN is pharmacotherapy. Medical management may initially yield a satisfactory response, but persistence or recurrence of symptoms and side effects of the medications can be too severe for some patients to tolerate. For these patients, the next step in treatment may be surgical.

Peter Jannetta demonstrated the efficacy of Microvascular Decompression (MVD) in 1967 [4]. The procedure involves correcting the neurovascular conflict by repositioning the offending vessel and placing spacer material between it and the affected cranial nerve [2]. This decompresses the nerve root exit zone and has been shown to ameliorate symptoms. A retrosigmoid approach has historically been used to approach the Cerebellopontine Angle (CPA). Other options such as balloon compression, rhizotomy and radiosurgery are available, but MVD has been shown to be the procedure of choice for TN [5], HFS [2,6] and GPN [1]. MVD has also been shown to be effective for less common indications such as tinnitus and vagal palsy [7].

MVD has consistently been validated with reports of high satisfaction rates and long term results [8-12]. However, some patients suffer postoperative neurotologic complications such as hearing loss, tinnitus, vertigo, and hemifacial paresis [13]. Neurotologic complications are thought to be secondary to: stretching of CN VII and VIII during cerebellar retraction, direct trauma to CN VII or VIII, excessive manipulation of vasculature (especially the labyrinthine artery and anteroinferior cerebellar artery) or neocompression of nerves with the spacer placement [14,15].

There have been several studies that examined hearing loss, but very few have evaluated tinnitus, vertigo and hemifacial paresis [14,16]. There is also a relative lack of studies distinguishing between transient, Conductive Hearing Loss (CHL) and permanent Sensorineural Hearing Loss (SNHL). Our study aims to determine the frequency of neurotologic complications after posterior fossa MVD in our past 20 year experience.

Patients and Methods

This study was approved by the LUMC institutional review board (LU 208129). This retrospective study analyzed 215 consecutive patients who underwent posterior fossa MVD at Loyola University Medical Center (LUMC) between March 1996 and May 2016. The operations were all performed by a single neurosurgeon (Douglas Anderson). A stealth directed retrosigmoid craniotomy was used to access the CPA to identify the neurovascular conflict. After microdissection was performed, decompression was achieved by placing an autologous muscle graft or Teflon between the offending artery and cranial nerve.

Patients were excluded if they had undergone previous radio surgery, had a history of CPA tumor, had a previous surgery in the CPA other than MVD, or had follow-up of less than two weeks. A total of 32 patients were excluded based on these criteria. Neurotologic complications examined were hearing loss, tinnitus, dizziness, and hemifacial paresis. During postoperative visits patients were consistently asked about these conditions and cranial nerve exams were performed. Intraoperative brainstem auditory evoked potential monitoring and cranial nerve monitoring were not routinely used. P-values for the comparison of complication rates were calculated using a two-tailed fisher exact probability test.

Results

Demographic data is displayed in table 1. A total of 192 surgeries were performed on 183 patients. In those patients who underwent revision operations, 13 of the primary MVD operations were performed at an outside institution, and nine were performed by the Douglas Anderson. Four patients had two ipsilateral surgeries, one patient had three ipsilateral surgeries, and one patient had three surgeries on one side and two on the other. In total, 34 patients had at least one neurotologic complication postoperatively (17.71%). There was no significant difference in risk for having a neurotologic complication between TN and HFS (RR=0.7704, p=0.5502) or between primary and revision surgery (RR=0.4830, p=0.2934).There were no complications for the patients whose indication for surgery was tinnitus (n=1) or vagal palsy (n=1).

Age (n=183)	
Range	28-92 y
Mean ± SD	58.52 ± 14.36 y
Sex (n=183)	
Male	52
Female	131
MVD indication (n=200)a	
TN	162
HFS	23
GPN	13
Vagal palsy	1
Tinnitus	1
Follow-up duration (n=183)	
Range	0.5-208 mos
Mean ± SD	35.42 ± 47.21 mos
Side of operation (n=192)	
Left	95
Right	97
MVD revision operations	22

Table 1: Demographics data.

[a]n is greater than the total number of surgeries because several patients had more than one indication for the same operation

Hearing loss

Permanent SNHL was documented in eight cases (4.17%; Figure 2). All of these patients had at least four months of follow-up. The mean age for patients with hearing loss was 59.75 years, with standard deviation 17.97 and range 38-87 years. Six were females and two were males. Indications for surgery were TN for five patients, HFS for two patients and GPN for one patient (Figure 3). These all represented primary MVD. Two of the eight patients had preoperative audiograms, both of which were normal. Based on the 1995 American Academy of Otolaryngology-Head and Neck Surgery hearing classification system (Figure 4) [17], postoperative audiograms revealed that four patients were class B and two were class D (Figure 5). One of these patients had new bilateral hearing loss which was slightly worse on the contralateral side. Two patients refused an audiogram but significant ipsilateral hearing loss was consistently documented.

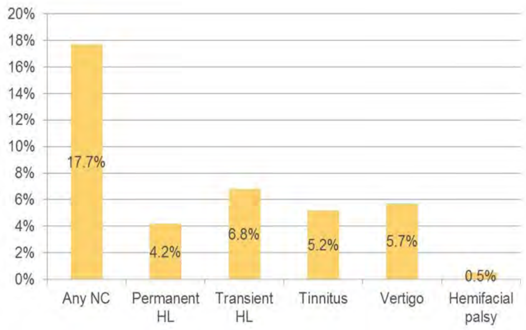

Figure 2: Frequency of neurotologic complications.

NC=Neurotologic Complication; HL=Hearing Loss

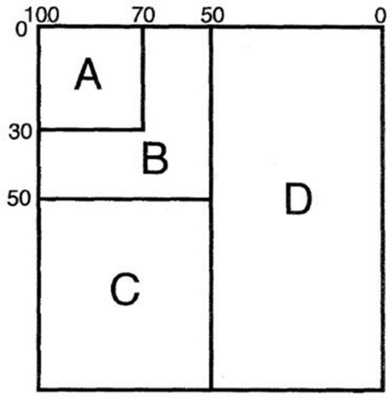

Figure 3: Nomogram of the hearing classification system for the AAO-HNS guidelines for the evaluation of hearing preservation in vestibular schwannoma [17].

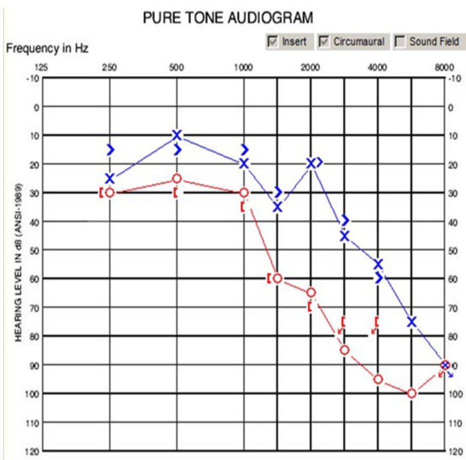

Figure 4: Audiogram revealing right sided sensorineural hearing loss in a patient who underwent microvascular decompression for trigeminal neuralgia three months previously.

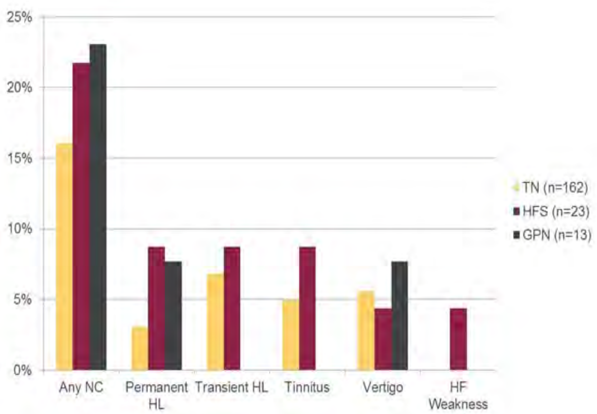

Figure 5: Frequency of neurotologic complications by indication.

NC=Neurotologic Complication; HL=Hearing Loss; HF=Hemifacial

Thirteen patients had transient hearing loss postoperatively (6.77%). The mean age for these patients was 55.31 years, with standard deviation 11.85 years and range 37-74 years. Nine were females and four were males. Indications for surgery were TN for 11 patients, HFS for one patient, and both TN and HFS for one patient. These all represented primary MVD. The consistent complaints for these patients were aural fullness or muffled hearing. All complaints resolved within four weeks and none of the patients underwent an audiogram.

There were 12 patients who had a documented hearing loss prior to surgery that remained stable postoperatively. Only five of these patients had preoperative audiograms in their medical record. The others denied worsening of their hearing loss postoperatively.

There was no significant difference in risk for permanent (Relative Risk (RR)=0.3395, p=0.1797) or transient (RR=1.4938, p=0.6938) hearing loss between TN and HFS. There was also no significant difference in risk of hearing loss between primary and revision surgery (permanent; RR=0.4373, p=0.5652, transient; RR=0.2754, p=0.3648).

Tinnitus

Ten patients complained of tinnitus postoperatively (5.21%). Five of those had associated hearing loss (two permanent, three transient) and one had vertigo. The mean age for these patients was 58.40 years (SD 15.09 years, range 37-77 years). Five were males and five were females. Two of these surgeries were revisions. Indications for surgery were TN for eight patients and HFS for two patients. Four additional patients had preoperative tinnitus which was stable postoperatively, including the patient whose indication for surgery was tinnitus. There was no significant difference in risk of postoperative tinnitus between TN and HFS (RR=0.5432, p=0.4203) or primary and revision surgery (RR=1.6970, p=0.4796).

Vertigo

Eleven patients complained of vertigo postoperatively (5.73%). The vertigo was transient in five of the patients. One patient was later diagnosed with migraine associated vertigo. Two of these patients had associated hearing loss and one also had tinnitus. The mean age for these patients were 63.82 years, with standard deviation 12.15 years and range 38-83 years. Three were males and eight were females. None of the surgeries were revisions. Indications for surgery were TN for nine patients, HFS for one patient and GPN for one patient. There was no significant difference in risk of postoperative vertigo between TN and HFS (RR=1.3333, p=0.7803) or primary or revision surgery (RR=0.3233, p=0.4289).

Hemifacial paresis

One patient had hemifacial paresis postoperatively (0.52%). He was a 65 year old male who had primary MVD for HFS with postoperative ipsilateral house-brackmann grade II facial weakness which has been stable over time. He also complained of tinnitus postoperatively.

Discussion

MVD offers effective, long-term symptom relief for patients with pathologies related to neurovascular conflicts of cranial nerves in the posterior fossa [5]. However, postoperative neurotologic complications such as hearing loss, tinnitus, vertigo and hemifacial paresis are serious complications which can significantly impact patients' quality of life [18]. The complication rates in our study are similar to ranges reported in current literature [16,19,20].

Following post-auricular operations, effusions can frequently evolve in the middle ear leading to CHL. Patients describe this as muffled hearing or aural fullness [16]. It is appropriate to wait at least two months postoperatively before pursuing an audiogram in order to allow a potential effusion to resolve. At that point, an audiogram should be performed with air and bone conduction thresholds. SNHL is far more likely to be permanent than CHL.

Injuries to the vestibulocochlear nerve or inner ear vasculature can also result in potentially disabling postoperative tinnitus. Tinnitus tends to correlate with hearing loss, and patients will often complain of the ringing more than their hearing loss [21,22]. Since tinnitus often resolves in conjunction with hearing loss, it is also appropriate to wait at least two months postoperatively before any intervention is pursued.

Patients may also experience vestibular dysfunction after CPA surgery, which may be temporary or permanent. In the short-term, the patient may suffer transient vertigo that prolongs the hospital stay [18]. In the long-term, the patient may note persistent imbalance, made worse with fatigue, alcohol consumption, and visual loss.

Hemifacial paresis is another complication that can occur after MVD. While considerably less common than the other neurotologic complications, it can be the most distressing to patients. Corticosteroid treatment is recommended in these patients, however their efficacy after MVD is unclear at this point [23,24].

There was no significant difference in complication rates between TN and HFS. It is logical to expect that HFS would have a higher complication rate given its closer proximity to both the CN VII/CN VIII bundle and the inner ear vasculature. It is possible that in a study with a larger sample size a significant difference would be revealed.

While some neurotologic complications are inevitable, all possible measures to minimize their occurrence and severity should be undertaken. This includes limiting cerebellar retraction, minimizing trauma to CN VII and VIII, and protecting vessels that are important for inner ear function [25]. Utilizing intraoperative monitoring of brainstem auditory evoked potentials has generally been shown to decrease the risk of hearing impairment after MVD [26,27].

To underscore the importance of appropriate preoperative audiometric documentation, twelve of our patients had written documentation of preoperative hearing loss, but only five had preoperative audiograms to quantify this loss. The lack of a preoperative audiogram for the other seven patients made it impossible to objectively assess whether their postoperative hearing loss was stable, worse, or improved. Insufficient perioperative audiometric evaluation in such cases leaves neurosurgeons vulnerable to medicolegal ramifications in situations where they may not have even caused a supposed complication. To prevent this, it is critical that perioperative audiograms are performed on a routine basis.

Counselling patients before surgery to ensure understanding of the neurotologic risks of undergoing MVD is critical. It is also important to monitor patients postoperatively for these complications with thorough histories and physical exams. We recommend an audiogram within six months before surgery and then another two to three months postoperatively in all patients.

Conclusion

MVD carries significant risks of neurotologic complications such as hearing loss, tinnitus, vertigo, and hemifacial paresis. We emphasize the importance of evaluating perioperative audiometric function and ensuring patient understanding of potential neurotologic complications following MVD.

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