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Correlation Between Cerebellar Retraction and Hearing Loss After Microvascular Decompression for Hemifacial Spasm: A Prospective Study

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■ BACKGROUND: **This study prospectively investigated the relationship between cerebellar retraction factors measured on preoperative magnetic resonance and the development of postoperative hearing loss and evaluated their potential role in predicting the possibility of hearing loss after microvascular decompression (MVD) for hemifacial spasm (HFS).**

■ METHODS: **The study included 110 patients clinically diagnosed with primary HFS who underwent MVD in our department. The cerebellar retraction factors were quantitatively measured on preoperative magnetic resonance. Associations of cerebellar retraction and other risk factors with postoperative hearing loss were analyzed.**

■ RESULTS: **Eleven patients (10%) developed nonserviceable hearing loss after MVD. Compared with the group without hearing loss, the cerebellar retraction distance and depth of the group with hearing loss were significantly greater ($P < 0.05$). Multivariate logistic regression analysis showed that greater cerebellar retraction depth was significantly associated with the higher incidence of postoperative hearing loss ($P < 0.05$).**

■ CONCLUSIONS: **The results in this study strongly suggested the correlation between the cerebellar retraction depth and the possibility of hearing loss after MVD for HFS. In addition, cerebellar retraction depth could be considered as a useful tool to predict the risk of post-MVD hearing loss.**

INTRODUCTION

Microvascular decompression (MVD) of the facial nerve is the etiologic treatment option of hemifacial spasm (HFS) with an average success rate of 83%–89% in term of permanent freedom of symptoms.[1-4] Although MVD has been considered as an effective and safe procedure for HFS, neurologic complications including facial palsy, hearing loss, and vocal cord paralysis still exist for MVD. Among them, sensorineural hearing loss is the most common and seriously diminishes quality of life. Many studies have shown the development of hearing loss after MVD for HFS in 1.9%–20% of cases, according to different diagnostic criteria.[1,5-9] Mechanical stretching of cranial nerve (CN) VIII and vascular insufficiency of the nerve, mainly as a result of cerebellar retraction, were proposed to be the main causes of the development of sensorineural hearing loss after MVD.[5,6,10-12] However, to our knowledge, there was no prospective study validly showing the relationship between cerebellar retraction and hearing loss after MVD.

The aim of this study is to prospectively investigate the relationship between cerebellar retraction factors measured on preoperative magnetic resonance (MR) and the development of post-MVD hearing loss and evaluate their potential role in predicting the possibility of hearing loss after MVD.

METHODS

Patient Demographics

The study included patients clinically diagnosed with primary HFS who underwent MVD in the neurosurgery department of Rui Jin Hospital from April 2016 to October 2016. All the MVD surgical procedures were performed by one surgeon (W.-G.Z.). Inclusion

Key words
- Cerebellar retraction
- Hearing loss
- Hemifacial spasm
- Microvascular decompression
- Predictor

Abbreviations and Acronyms
3D: Three-dimensional
AAO-HNS: American Association of Otolaryngology Head and Neck Surgery
BEAP: Brainstem auditory evoked potential
CN: Cranial nerve
HFS: Hemifacial spasm
MR: Magnetic resonance
MVD: Microvascular decompression
PTA: Pure tone audiometry
REZ: Root exit zone
SDS: Speech Discrimination Score

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criteria included: 1) patient with typical primary HFS; 2) patient younger than 70 years; 3) patient with normal preoperative hearing function on the surgery side, defined as pure tone audiometry (PTA) <30 dB and/or Speech Discrimination Score (SDS) >70% within the speech range of frequencies (American Association of Otolaryngology Head and Neck Surgery [AAO-HNS] classification system, class A).[13] The following subject characteristics were collected from each patient: gender, age, affected side, preoperative MR results, preoperative and postoperative auditory function, surgical findings, operative outcome, and complications. Written informed consent was obtained. The study design was approved by the Rui Jin Hospital ethics committee.

Preoperative MR Imaging

All patients underwent preoperative evaluation by MR imaging and facial nerve MR tomographic angiography. MR was obtained at 3.0 T (General Electric Medical System, Erlangen, USA). The imaging protocol included conventional T1-weighted imaging, T2-weighted imaging, three-dimensional (3D) time-of-flight imaging, and 3D T2 volume isotropic fast spin echo acquisition imaging.

Evaluation of Auditory Function

PTA and SDS were performed on all patients 1 day before and 7 days after MVD surgery. PTA was determined for each ear at frequencies from 0.25 kHz to 8 kHz. The average PTA was defined as the mean of the thresholds measured at 0.5 kHz, 1 kHz, 2 kHz, and 4 kHz. Postoperative hearing loss was assessed using the AAO-HNS classification system for nonserviceable hearing loss (class C/D), defined as PTA >50 dB and/or SDS <50% within the speech range of frequencies.[13] We excluded effusion and hemotympanium using otoscopic examination by otologists.

MVD Surgery

MVD was performed in a lateral decubitus position through a retromastoid craniectomy. A 6-cm to 8-cm retroauricular straight incision was made and a bone window craniotomy was performed to expose the sigmoid sinus edge. CNs VII and VIII were approached inferolaterally. After adequate cerebrospinal fluid drainage, the cerebellum was gently retracted to expose the entire intracranial facial nerve. After the offending vessel was identified, appropriated Teflon pledget was implanted between the facial nerve and the offending vessel. The intraoperative brainstem auditory evoked potential (BEAP) was performed and monitored by a neurophysiologist during surgery from anesthesia administration to dural closure. In this study, persistent decreases in amplitude greater than 50% of wave V and/or delayed latency of peak V more than 1.0 milliseconds were considered as alarm criteria. During surgery, the surgical manipulation was paused for a few minutes when the operator was informed that the alarming changes in BEAP appeared.

Measurements

The neurovascular compression point could be jointly determined on a 3D T2 volume isotropic fast spin echo acquisition axial plane by an experienced neurosurgeon and a neuroradiologist. At the level of the neurovascular compression point, a line from the medial aspect of the sigmoid sinus to the neurovascular compression point could be drawn as the assumed surgical route to the neurovascular compression site. Because the surgical route could not cross over the sigmoid sinus, this line was regarded as the base line for measurement. A line parallel to the base line, going through the highest point of the cerebellar or flocculonodular surface, was regarded as the measure line. In this study, cerebellar retraction distance was defined as the distance between the medial aspect of the sigmoid sinus to the neurovascular compression point. Cerebellar retraction depth was defined as the vertical distance between the measure line and the base line. The measurements were performed on PACS (picture archiving and communication system). The measuring procedure was repeated twice and average values were recorded for analysis. The retraction distance and depth were assumed to correspond to the degree of cerebellar retraction (**Figures 1** and **2**).

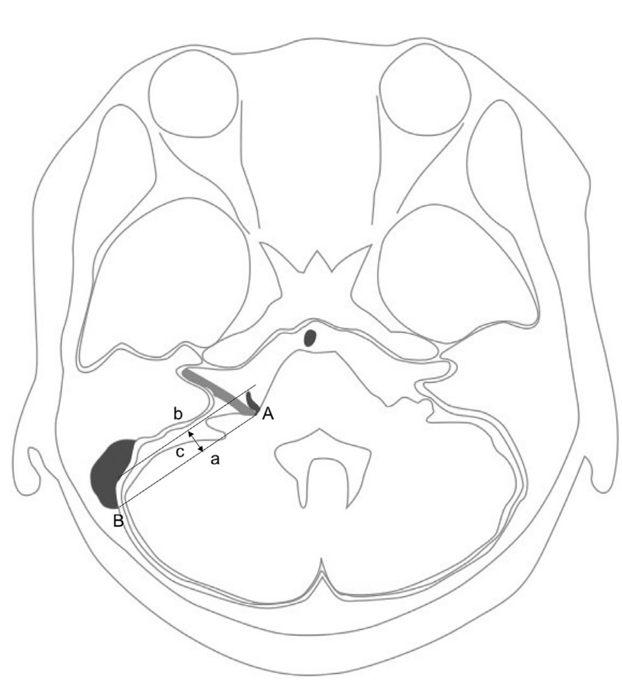

Figure 1. Illustration of measurement at the level of neurovascular compression point. *Point A*, neurovascular compression point. *Point B*, medial aspect of sigmoid sinus; *Line a* (base line), the line between *point A* and *point B*; *line b* (measure line), the line parallel to the base line and going through the highest point of cerebellar or flocculonodular surface. Cerebellar retraction distance: the distance between *point A* and *B*. Cerebellar retraction depth (*c*): vertical distance between base line and measure line.

Statistical Analysis

Categorical variables (gender, affected side) were compared between the group with and without postoperative hearing loss by using a χ^2 test. Continuous variables (age, preoperative PTA, retraction distance, and retraction depth) were compared by using a *t* test between 2 groups. The results were considered significant when the *P* value was <0.05. Multivariate logistic regression

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