Journal of Institute of Medicine Nepal
Institute of Medicine, Kathmandu, Nepal

Orginal Article

JIOM Nepal. 2026 April; 48(1):85-90

Magnetic Resonance Imaging Findings in Patients with Asymmetric Sensorineural Hearing Loss and Evaluation of the Clinical Features of Patients with Abnormal Imaging: A Retrospective Study

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ABSTRACT

Introduction

This study aims to review the magnetic resonance imaging (MRI) findings in cases with asymmetric sensorineural hearing loss (ASNHL) and to evaluate the clinical features in cases with abnormal findings in MRI that could act as the clinical predictors for intracranial pathology.

Methods

This study was conducted at the Department of ENT-HNS, T.U. Teaching Hospital, Kathmandu, Nepal. A review of prospectively recorded data from five years (October 2019 to October 2024) on MRI findings and clinical features of cases presenting with ASNHL loss was done.

Results

A total of 47 cases met the inclusion criteria. Most cases had sudden sensorineural hearing loss (35), while the rest (12) had progressive hearing loss. Seven cases had abnormal MRI findings with vestibular schwannoma being the commonest pathological finding. Symptoms such as tinnitus, imbalance, headache, and tingling sensation in one half of the face had a statistically significant association with the detection of pathological findings in MRI.

Conclusion

MRI of the brain focusing on the CPA should be advised in all cases with asymmetric hearing loss. However, in scenarios where ordering an MRI is not feasible or can add much more financial burden to the patients, clinical features like tinnitus, headache, imbalance, and symptoms resulting from nerve compression such as tingling sensation in one half of the face can be taken into consideration to selectively scrutinize the patients with MRI.

Keywords

Asymmetric; hearing loss; magnetic resonance imaging; sensorineural

DOI
https://doi.org/10.59779/jiomnepal.1452

Submitted
Jan 6, 2026

Accepted
Apr 11, 2026

INTRODUCTION

Asymmetric sensorineural hearing loss (ASNHL) is a frequently encountered audiological finding in otolaryngology practice. A myriad of pathologies can have ASNHL as an initial presentation. Of them, the possibility of tumors affecting the VIII nerve intracranially is the dreaded one and thus, makes a need for magnetic resonance imaging (MRI) of the brain prudent [1]. Vestibular Schwannoma (VS) by far is the most common tumor affecting the VIII nerve and every case with ASNHL should be sought with suspicion towards its possibility.

Apart from VS, cerebellopontine angle (CPA) tumors like meningiomas can also affect the VIII nerve. MRI can detect retro-cochlear lesions in 2-8% of cases with ASNHL [2]. The cost of imaging is a concerning factor for the economically deprived population. It would be a sound rationale if symptoms apart from ASNHL could be selectively used as a guide to decide the need for MRI in such patients.

Thus, our study aimed to review the MRI findings of the cases with ASNHL and to evaluate the clinical features of the patients with abnormal MRI findings that could act as the clinical predictors for intracranial pathology.

METHODS

This was a retrospective study conducted in the Department of ENT-HNS, T.U. Teaching Hospital, Kathmandu, Nepal, and the study was approved by the Institutional Research Committee. A review of prospectively recorded data from five years (October 2019 to October 2024) on MRI findings and clinical features of cases presenting with ASNHL was done. We advised MRI brain focusing on CPA (T1 weighted using Gadolinium-based contrast and T2 weighted) in cases presenting with an asymmetry of >15dB in bone conduction over two consecutive frequencies as per our departmental protocol.

However, cases with sudden sensorineural hearing loss (SSNHL) presenting with asymmetric hearing were advised for MRI only if no documented improvement is seen in pure tone audiometry (PTA) following a course of systemic or intratympanic steroids.

Cases with ASNHL having an obvious history of trauma, use of ototoxic medications, or classical features of Meniere's disease were also exempted from the need for MRI. Recorded data was assessed for demographic profiles of the cases, duration, degree, and side of hearing loss, MRI findings, and associated symptoms.

Data with incomplete documentation of any of the above variables were excluded from the study. If any organic lesion in the CPA or affecting the VIII nerve or inner ear was noted in MRI, it was considered pathological. We used Microsoft Excel for data recording and SPSS version 25 for data analysis. Fisher's exact test was used for data analysis with p-value <0.05 considered as statistically significant. This study was conducted in accordance with STROCCS guidelines.[3]

RESULTS

A total of 50 cases were included in the study, of which 47 met the inclusion criteria and three were excluded due to incomplete documentation. The male-to-female ratio was 3:1, with most cases occurring between the third and sixth decades of life. The right ear was affected in 25 cases and the left in 22 cases.

Most of the cases (35) in our study had a history of sudden hearing loss and all the cases met the criteria of SSNHL. The degree of hearing loss in these cases ranged from severe to profound. One case had an associated history of vertigo and continuous tinnitus and one had pulsatile tinnitus in the contralateral ear. No pathological MRI findings were seen in any of these cases. However, the anteroinferior cerebellar artery (AICA) loop was seen abutting the 7th and 8th cranial nerve on the same side of hearing loss in three cases and on the opposite side in one case. Of the cases with AICA loop identified in MRI, one case had pulsatile tinnitus and this symptom was attributed to the vascular loop. However, the symptom was present in the contralateral non-affected ear. We considered the AICA loop as an incidental finding rather than the pathology causing SNHL due to a lack of supporting data that these loops can cause sensorineural hearing loss.

Twelve cases had a history of progressive hearing loss with the duration of hearing loss ranging from 8 months to 10 years. The degree

of hearing loss ranged from moderate to profound. Apart from hearing loss, some cases had other associated symptoms like tinnitus in the affected ear (six cases), imbalance (two cases), tingling sensation in the affected side of the face (one case), episodic vertigo (one case), and headache (one case). The tinnitus was pulsatile in one case and continuous in the rest of the five cases. In MRI, three cases were found to have unilateral VS (Figure 1). Unilateral glomus jugulare, bilateral VS (Figure 2), skull base meningioma (Figure 3), and epidermoid cyst of the right temporal bone (Figure 4) were seen in one case each. Table 1 summarizes the MRI findings in cases with ASNHL.

Figure 1. MRI scan showing right CP angle vestibular schwannomas

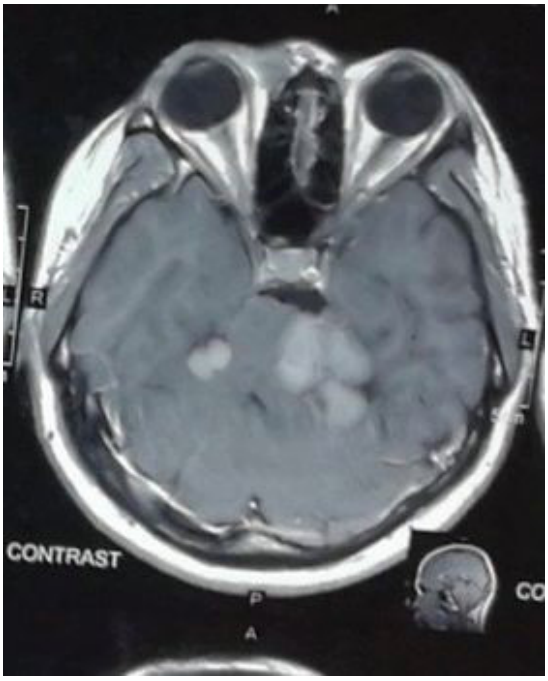

Figure 2. MRI scan showing bilateral neurofibromatosis

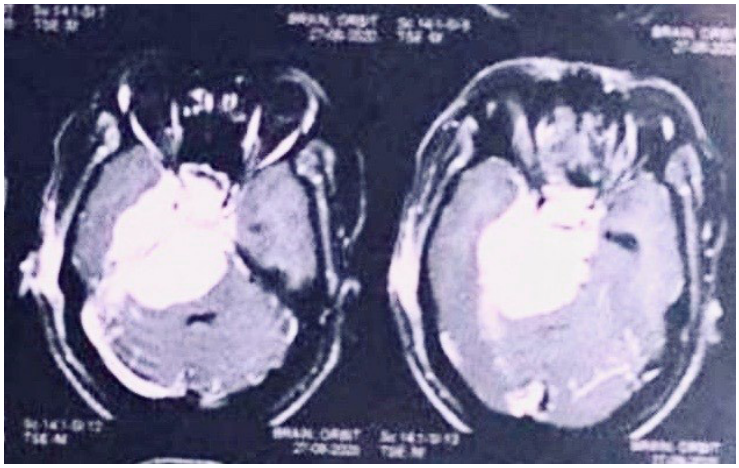

Figure 3. MRI scan showing a large skull meningioma

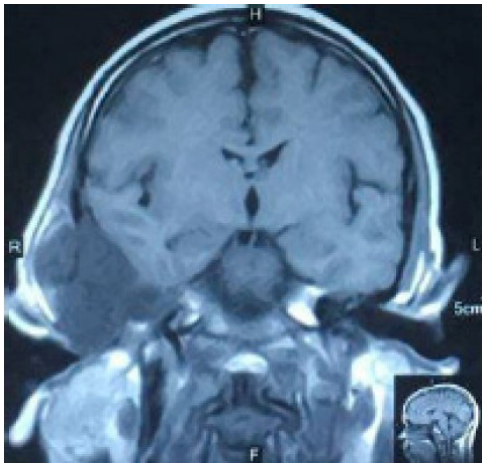

Figure 4. MRI scan showing right temporal region epidermoid cyst

Table 1. MRI findings in cases with ASNHL

MRI scan findings	Number of the patients
Normal finding	36
Incidental finding • AICA loop abutting VIII nerve	4

Pathological findings	
• Vestibular Schwannoma	3
• Neurofibromatosis Type 2	1
• Glomus Jugulare	1
• Skull base meningioma	1
• Epidermoid cyst	1

None of the cases presenting with sudden sensorineural hearing loss had abnormal MRI findings whereas, 58.3% of cases with progressive asymmetric hearing loss had pathological MRI findings. This finding was statistically highly significant (p-value < 0.001). Similarly, symptoms such as unilateral tingling sensation in the face, tinnitus, headache, and imbalance had a statistically significant association with pathological MRI findings. No significant association could be yielded between the degree of hearing loss and vertigo (Table 2).

Table 1. Comparison of clinical features between cases with normal and pathological findings in MRI

Clinical features	Normal MRI scan	Pathological findings in MRI	Fisher's exact test
Onset of hearing loss			
Sudden	35	0	<0.001
Progressive	5	7	
Degree of hearing loss			
Moderate	3	0	
Severe	14	2	0.673
Profound	23	5	
Associated symptoms			
Vertigo	1	1	0.154
Tingling sensation in one half of the face	0	1	0.001
Headache	0	1	0.016
Imbalance	0	2	0.001
Pulsatile tinnitus	1	1	0.154
Continuous tinnitus	1	5	<0.001

DISCUSSION

A range of definitions for ASNHL has been put forth to warrant further evaluation to rule out retro-cochlear pathologies.[4] However, a consensus has not been established so far and various criteria are being followed worldwide for defining ASNHL. A difference in hearing level that is considered significant and needs further evaluation is seen to range from 10-20 dB in one or more frequencies in various literature.[5–7] A review by Durakovic et al. recommends considering an inter-aural difference of hearing level ≥20 dB at two consecutive frequencies or ≥15 dB at any two frequencies ranging from 2 kHz to 8 kHz. [4]

Contrast-enhanced MRI is considered the imaging of choice in cases with ASNHL to rule out retro-cochlear pathology.[8] A survey of a group of American neurotologists showed almost 95% ordered MRI scans in cases with ASNHL. The major driving factor was the medico-legal concerns for missing out on intracranial tumors.[2] While MRI has a good catchhold on detecting retro-cochlear lesions, there is still a high yield of negative results. Moreover, the cost of imaging often makes it difficult for the attending clinicians to order an MRI in every single case with ASNHL. In this scenario, the decision should be patient-tailored considering other clinical features along with the asymmetry in hearing loss, as a guide to suspect retro-cochlear lesions.

The SSNHL served a major bulk of the cases with ASNHL in our study, however, none of them were found to have significant pathological findings in MRI. An earlier study by Shaia et al. reported that 1% of cases with SSNHL had an acoustic tumor. [9] However, with the widespread use of MRI, the prevalence seems to increase. Lee et al. reported VS in 4% of cases with SSNHL, however, three of 12 cases had VS in the contralateral ear. Four of the 12 cases had hearing loss improved following the use of steroids despite having VS.[10] Similar findings were reported by Aronzon et al. [11] Considering these shreds of evidence, improvement in

hearing after the use of steroids in SSNHL doesn't opt out of the need for MRI.

All cases with pathological MRI findings in our study had severe to profound progressive hearing loss. Apart from the hearing loss, the cases with pathological MRI findings had other clinical features as well e.g., VS (vertigo, imbalance, continuous tinnitus, tingling sensation in one half of face), meningioma (headache, continuous tinnitus), glomus jugulare (pulsatile tinnitus), and neurofibromatosis (continuous tinnitus). Except for vertigo and pulsatile tinnitus, all other clinical features had a statistically significant association with positive detection of pathological findings in MRI. Ahsan et al. reviewed the clinical predictors in cases with ASNHL with abnormal MRI findings. Their study comprised 451 patients. The commonest lesion encountered was CPA/internal auditory canal mass followed by labyrinthitis. Unilateral tinnitus, asymmetry of 15dB at 3kHz, and vertigo/dizziness had a statistically significant association with abnormal MRI findings.[8] Another similar study by Quynh-Nhu Vu et al., however, showed no statistically significant association between different clinical features and MRI findings.[12]

The most common clinical presentation of vestibular schwannoma is hearing loss. However, 15% of cases might present with normal hearing.[13] While it is unilateral most of the time, in cases with Neurofibromatosis type 2, patients usually present with bilateral VS along with other intracranial tumors like meningioma and glioma.[14] Along with hearing loss, a retrospective review of 1009 patients with vestibular schwannoma by Huang et al. showed facial paresthesia and paralysis, gait instability, and tinnitus as the most common symptoms and absent corneal reflex as the most common sign. Thus, any presentation of asymmetric hearing loss with vestibular symptoms or any other cranial nerve deficit, e.g. V nerve, VII nerve, etc., should always warrant a high index of suspicion for intracranial pathology.[15] Asymmetric hearing loss is a straightforward indication for an MRI, however, NF 2 may pose a diagnostic challenge if there is symmetrical bilateral SNHL. In these case scenarios, family history, earlier onset of disease, and other associated clinical features such as café-au-lait spots, ocular findings like cataracts, skin tumors, etc. can guide for advising MRI. In our study, three cases had sporadic VS and one had NF-2 without other clinical features. In this case, the presentation of the patient with ASNHL helped us do early imaging which led to the diagnosis of bilateral VS. Following vestibular schwannoma, meningioma is the second most common tumor affecting the CP angle.[16] These are mostly benign tumors arising from the arachnoid villi of the meninges but can be malignant at times.[17] Baguley et al. in their review of 25 cases with CPA meningioma found symptoms such as progressive hearing loss, tinnitus, imbalance, headache, and facial weakness as the predominant ones which was similar to our study.[16] Glomus Jugulare was one of the pathologies we encountered during MRI. Hearing loss and pulsatile tinnitus are the most common presenting symptoms and these tumors are often seen in otoscopy. An earlier review of 13 cases of glomus tumors by Baguley et al. found hearing loss, pulsatile tinnitus, facial numbness, and bleeding from the ear as the predominant clinical features.[18] The hearing loss, contrary to the CPA lesions, can be conductive, sensorineural, or mixed. A case with a huge temporal region epidermoid cyst presented with ASNHL in our study. In this case, the indication for MRI was to assess the extent of the lesion and its association with the VIII nerve. SNHL in this case was due to the extension of the lesion into the inner ear rather than the compression of the nerve at CPA. AICA loop abutting the VIII nerve was seen in four cases in our study. The prevalence of vascular loops of AICA within the internal auditory meatus is estimated to be 12.3% based on post-mortem studies.[19] The role of this vascular loop in causing vascular compression syndrome is still a topic of debate and various studies have found no association between the presence of the AICA loop and associated neurotological findings.[19,20]

The low sample size was a major drawback of our study. A well-designed prospective study with a good sample size would have added more valuable data than the current study. Also, the cases with SSNHL in our study underwent imaging only if they didn't respond to steroid therapy. As discussed earlier, the cases with VS presenting with SSNHL can have improved hearing with steroid therapy. Thus, the data from this study cannot be generalized to all cases with SSNHL.

CONCLUSION

MRI of the brain, focusing on the CPA, should be advised in all cases with asymmetric hearing loss. However, in scenarios where ordering an MRI is not feasible or can add much more financial burden to the patients, clinical features like tinnitus, headache,

imbalance, and symptoms resulting from nerve compression, such as tingling sensation in one half of the face, can be taken into consideration to selectively scrutinize the patients with MRI. This could be useful, especially in developing regions like Nepal, where financial issues are a major hurdle to accessing healthcare.

CONFLICT OF INTEREST

None

ACKNOWLEDGEMENTS

None

FINANCIAL SUPPORT

None

AUTHOR CONTRIBUTIONS

Bigyan Raj Gyawali: Project Administration, Original writing- review and editing.
Rabindra Pradhananga: Project Administration, Original writing-review and editing.
Kripa Dongol: Supervision and Validation
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