Vestibular schwannoma tinnitus

- Congress of Neurological Surgeons Systematic Review and Evidence-Based Guidelines Update for the Role of Audiologic Screening in the Diagnosis and Management of Patients With Vestibular Schwannomas
- Early results with hypofractionated gamma knife radiotherapy for treatment of vestibular schwannoma
- The implementation of artificial intelligence in serial monitoring of post gamma knife vestibular schwannomas: A pilot study
- Unmasking vestibular schwannoma: A series of unusual cases
- Prospective Symptom Changes in Sporadic Vestibular Schwannoma: A Comparison of Observation, Microsurgery, and Radiosurgery
- Japanese translation of the Mayo Clinic Vestibular Schwannoma Quality of Life Index
- Spanish translation of the Mayo Clinic Vestibular Schwannoma Quality of Life Index
- French translation of the Mayo Clinic Vestibular Schwannoma Quality of Life Index

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Tinnitus, the perception of noise or ringing in the ears without an external source, is a common symptom associated with vestibular schwannomas. Patients with VS showed slightly elevated, but not statistically significant, mean thresholds compared to those without. Tinnitus, gradual hearing loss, and aural fullness were more common in patients with VS. Of these, only the presence of tinnitus was statistically significant [1)]

Mechanism

The exact mechanism by which vestibular schwannomas cause tinnitus is not fully understood, but it is believed to be related to the tumor's impact on the vestibulocochlear nerve (cranial nerve VIII), which is responsible for both hearing and balance. Compression or irritation of this nerve by the tumor can disrupt normal auditory processing, leading to the perception of sound when there is no external stimulus.

Tinnitus associated with vestibular schwannomas can vary in severity and may present as ringing, buzzing, hissing, or other sounds. Treatment options for vestibular schwannomas and associated tinnitus may include observation, radiation therapy, or surgical removal of the tumor, depending on factors such as tumor size, growth rate, and individual patient characteristics. Additionally, management of tinnitus symptoms may involve strategies such as sound therapy, cognitive behavioral therapy, or use of hearing aids or other assistive devices.

The presence of unilateral tinnitus alone is a sufficient reason to evaluate an individual for vestibular schwannoma.

Nearly two-thirds of patients with vestibular schwannoma (VS) are reporting a significantly impaired quality of life due to tinnitus. VS-associated tinnitus is attributed to anatomical and physiological damage of the hearing nerve by displacing the growth of the tumor. In contrast, the current pathophysiological concept of non-VS tinnitus hypothesizes maladaptive neuroplasticity of the central

nervous system to a (hidden) hearing impairment resulting in a subjective misperception. However, it is unclear whether this concept fits VS-associated tinnitus.

An analysis of Baguley et al. does not identify any single one mechanisms for tinnitus as being the obvious culprit. In fact, even in a homogeneous group of patients such as this, there is evidence of multiple mechanisms that are not mutually exclusive. The association between increased tinnitus severity in older patients, patients with canal pareses on caloric testing, and tinnitus as a principal presenting symptom should be borne in mind by the clinician [2)].

Tinnitus is attributed to partial sensory deafferentation resulting in central maladaptive neuroplasticity. Unfortunately, the agent of deafferentation is usually unknown or irreversible. In patients with unilateral vestibular schwannoma (VS), however, the auditory nerve is affected by a benign tumor. Hence, removal of the tumor can cease tinnitus. In turn, sustaining complaints after surgery indicate cortical neuroplasticity. A cross-sectional study aimed to track cortical structural changes by surface-based morphometry in 46 VS patients with sustained (i.e. centralized) or ceased (i.e. peripheral) tinnitus after surgery. A volumetric analysis of cortical and subcortical gray matter (GM) anatomy was performed on preoperative high-resolution MRI and related to the presence of hearing impairment, pre-and/or postoperative tinnitus. Patients with sustained (i.e. chronic) tinnitus showed an increased GM volume of the bilateral caudate nucleus, the contralateral superior colliculus, the middle frontal and middle temporal gyrus, the fusiform gyrus as well as the ipsilateral pars orbitalis when compared to those patients in whom tinnitus ceased postoperatively. Chronic tinnitus in VS patients is associated with characteristic structural changes in frontal, temporal, and subcortical areas. Notably, a significant GM change of the caudate nucleus was detected providing further support for the striatal gaiting model of tinnitus [3)].

A study aimed to determine the clinical predictors of VS-associated tinnitus to ascertain the compatibility of both pathophysiological concepts.

This retrospective study includes a group of 478 neurosurgical patients with unilateral sporadic VS evaluated preoperatively regarding the occurrence of ipsilateral tinnitus depending on different clinical factors, i.e., age, gender, tumor side, tumor size (T1-T4 according to the Hannover classification), and hearing impairment (Gardner-Robertson classification, GR1-5), using a binary logistic regression.

61.8% of patients complain about preoperative tinnitus. The binary logistic regression analysis identified male gender [OR 1.90 (1.25-2.75); $p = 0.002$] and hearing impairment GR3 [OR 1.90 (1.08-3.35); $p = 0.026$] and GR4 [OR 8.21 (2.29-29.50); $p = 0.001$] as positive predictors. In contrast, patients with large T4 tumors [OR 0.33 (0.13-0.86); $p = 0.024$] and complete hearing loss GR5 [OR 0.36 (0.15-0.84); $p = 0.017$] were less likely to develop tinnitus. Yet, 60% of the patients with good clinical hearing (GR1) and 25% of patients with complete hearing loss (GR5) suffered from tinnitus.

These data are in good accordance with literature about non-VS tinnitus indicating hearing impairment as the main risk factor. In contrast, complete hearing loss appears a negative predictor for tinnitus. For the first time, these findings indicate a non-linear relationship between hearing impairment and tinnitus in unilateral sporadic VS. Our results suggest similar pathophysiology in VS-

associated and non-VS tinnitus [4].

Observational cohort studies

One hundred seventy-three patients diagnosed with unilateral vestibular schwannoma operated via the retrosigmoid approach were included in a study from the People's Liberation Army General Hospital Beijing. All patients underwent relevant examinations and completed the Tinnitus Handicap Inventory scale before surgery and 6 months after surgery. The prognosis of tinnitus was evaluated according to the changes in THI.

Of the 129 preoperative tinnitus patients, postoperative tinnitus resolved in 12.4%, improved in 29.5%, remained unchanged in 28.6%, and worsened in 29.5%. 18.2% of 44 patients without preoperative tinnitus appeared new-onset tinnitus postoperatively. Thirty-six patients never had tinnitus. Patients with smaller tumor sizes (≤ 3 cm) were more likely to experience preoperative tinnitus. Younger patients and those with serviceable hearing preoperatively were more likely to report their tinnitus unchanged or worsened. A new onset of postoperative tinnitus in the preoperative non-tinnitus group was found in better preoperative hearing function.

70% of patients had persistent tinnitus after vestibular schwannoma resection. The tinnitus prognosis was influenced by age and preoperative hearing function. Tinnitus is a bothersome symptom and is often underestimated by doctors. Assessment of tinnitus is mandatory during the vestibular schwannoma management [5]

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Kortebein S, Gu S, Dai K, Zhao E, Riska K, Kaylie D, Hoa M. MRI Screening in Vestibular Schwannoma: A Deep Learning-based Analysis of Clinical and Audiometric Data. Otol Neurotol Open. 2023 Mar 9;3(1):e028. doi: 10.1097/ONO.0000000000000028. PMID: 38516318; PMCID: PMC10950172.
2)
Baguley DM, Humphriss RL, Axon PR, Moffat DA. The clinical characteristics of tinnitus in patients with vestibular schwannoma. Skull Base. 2006 May;16(2):49-58. doi: 10.1055/s-2005-926216. PMID: 17077869; PMCID: PMC1502033.
3)
Trakolis L, Bender B, Ebner FH, Ernemann U, Tatagiba M, Naros G. Cortical and subcortical gray matter changes in patients with chronic tinnitus sustaining after vestibular schwannoma surgery. Sci Rep. 2021 Apr 16;11(1):8411. doi: 10.1038/s41598-021-87915-3. PMID: 33863965.
4)
Naros G, Sandritter J, Liebsch M, Ofori A, Rizk AR, Del Moro G, Ebner F, Tatagiba M. Predictors of Preoperative Tinnitus in Unilateral Sporadic Vestibular Schwannoma. Front Neurol. 2017 Aug 3;8:378. doi: 10.3389/fneur.2017.00378. eCollection 2017. PubMed PMID: 28824535; PubMed Central PMCID: PMC5541055.
5)
You N, Zhang J, Zhang D, Zhao Y, Zhang J, Xu B. Predictive factors of tinnitus after vestibular schwannoma surgery: a case-control study. Chin Neurosurg J. 2024 Apr 3;10(1):10. doi: 10.1186/s41016-024-00363-6. PMID: 38566173.