RESEARCH ARTICLE

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Hearing Loss in Carotid Artery Stenosis: Influence of Age and Gender

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ABSTRACT

Carotid artery stenosis (CAS) is a major vascular disorder that can lead to reduced cerebral and cochlear perfusion, resulting in sensorineural hearing loss (SNHL) and tinnitus. The relationship between CAS severity and hearing impairment is an emerging area of interest in neuro-otology.

Objective

This study aims to analyze the effect of CAS on hearing function and tinnitus, considering age- and gender-related differences.

Methods

A retrospective study was conducted on 60 patients diagnosed with CAS (2022–2024) at the Department of Otorhinolaryngology, Tashkent State Medical University. All participants underwent Doppler ultrasonography and MRI to assess stenosis severity. Audiometry (250 Hz to 8000 Hz) was performed to evaluate SNHL. Tinnitus severity was assessed using the Tinnitus Handicap Inventory. Statistical analysis was carried out using SPSS 26.0 (chi-square tests and logistic regression). Patients were divided into age groups (40–59 years and ≥60 years) and analyzed by gender.

Results

- SNHL was detected in 36.7% of patients (n=22), while tinnitus was observed in 28.3% (n=17).

- SNHL prevalence was higher in patients aged ≥ 60 years (50%, n=15) compared to those aged 40–59 years (23.8%, n=5) ($p < 0.05$).

- Male patients exhibited a slightly higher SNHL rate (40%, n=12) than females (32%, n=10).

- Severe CAS (≥ 70% stenosis) significantly increased the likelihood of SNHL (OR=2.5, 95% CI: 1.4–4.2) and tinnitus (OR=2.1, 95% CI: 1.2–3.5).

- Bilateral CAS further elevated the risk of SNHL (OR=3.4) and tinnitus (OR=2.8).

Conclusion

- CAS is significantly associated with SNHL and tinnitus, particularly in older adults and patients with severe stenosis.

- Bilateral CAS further increases hearing impairment risk.

- Gender differences suggest potential protective mechanisms in females, warranting further research.

- Early detection of hearing dysfunction in CAS patients may improve vascular and auditory health outcomes.

Keywords: Carotid artery stenosis, hearing loss, tinnitus, age, gender, vascular disorders.

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INTRODUCTION

Carotid Artery Stenosis (CAS) is a critical vascular condition that leads to cerebral ischemia and various neurological disorders. Recent studies suggest that CAS may also contribute to inner ear dysfunction due to compromised cochlear blood flow[1-6]. The cochlea is highly sensitive to ischemic changes, and its microvascular integrity is essential for maintaining normal auditory function[7].

Patients with CAS may experience Sensorineural Hearing Loss (SNHL) and tinnitus due to decreased perfusion of the auditory pathway. However, the degree to which CAS affects hearing varies based on age, gender, and the severity of stenosis[8,9]. This study aims to investigate these associations and highlight the clinical implications of CAS-related auditory dysfunction.

MATERIALS & METHODS

This retrospective study included 60 patients diagnosed with CAS (2020–2024). Participants underwent:

- Doppler ultrasound and MRI to assess CAS severity.
- Audiometry to evaluate SNHL.
- Tinnitus questionnaires to determine tinnitus severity.
- Statistical analysis using SPSS 26.0 (chi-square tests and logistic regression).

Patients were divided into age groups (40–59 years, ≥ 60 years) and analyzed based on gender.--

RESULTS

Prevalence of Hearing Loss and Tinnitus

SNHL: 36.7% (n=22) The distribution of SNHL among subgroups demonstrated greater variability and elevated percentages in patients with ≥70% stenosis and bilateral involvement (**Figure 1**).

Tinnitus: 28.3% (n=17) Tinnitus prevalence followed a similar trend, with notably higher rates in cases of severe (≥70%) and bilateral stenosis (**Figure 2**).

Age and Gender Associations

SNHL was significantly higher in patients aged ≥ 60 years (50%, n=15) vs. 40-59 years (23.8%, n=5) ($p<0.05$). Age-related analysis revealed that individuals aged ≥ 60 years had significantly higher SNHL and tinnitus rates than younger patients (**Figure 3**), supporting the hypothesis of vascular aging impact on auditory function.

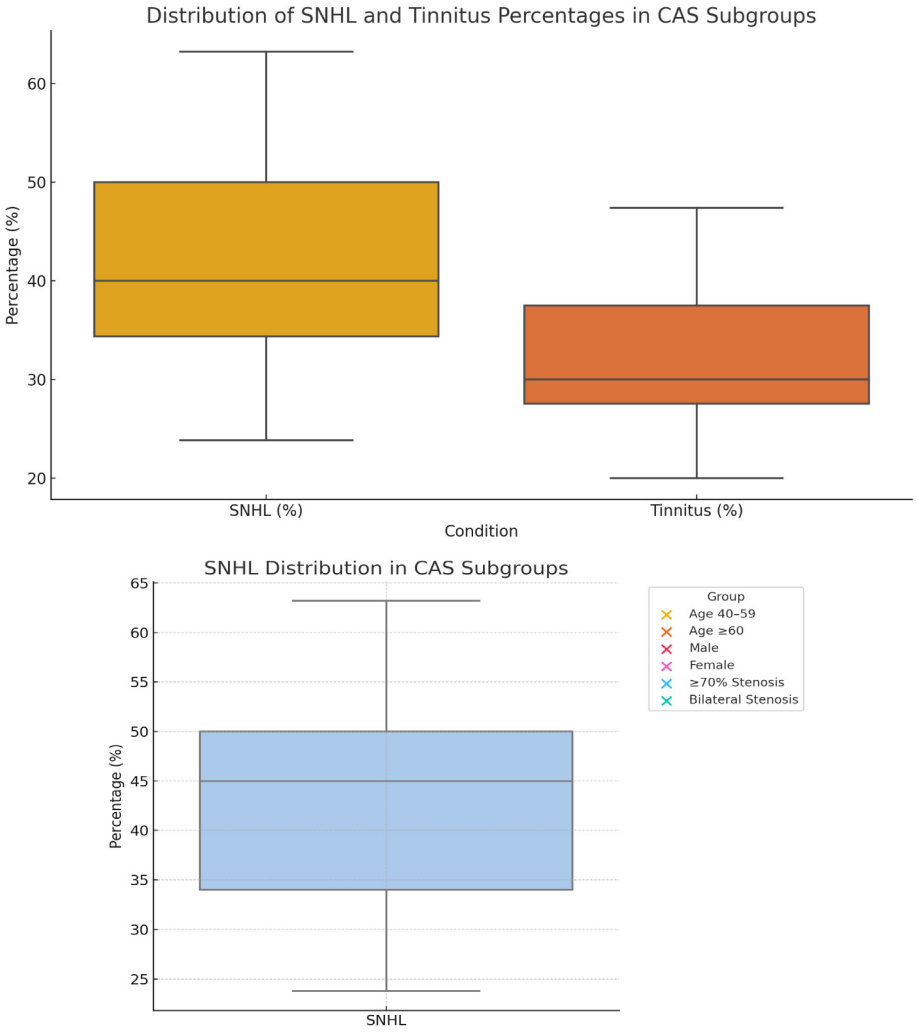

Figure 1: Shows the flow of our study.

Male patients had a 40% SNHL rate (n=12), while females had 32% (n=10) (p=0.08). Gender-based analysis showed a trend toward higher SNHL prevalence in males, though this difference did not reach statistical significance (**Figure 4**).

Figure 4. Boxplot comparing SNHL and tinnitus prevalence by gender. Although males had slightly higher percentages, no statistically significant difference was found.

Impact of CAS Severity

≥70% stenosis: Increased SNHL risk (OR=2.5, 95% CI: 1.4–4.2) and tinnitus (OR=2.1, 95% CI: 1.2–3.5) **(Table 1)**.

Bilateral CAS: Higher SNHL risk (OR=3.4) and tinnitus risk (OR=2.8).

SNHL is more prevalent in older individuals (≥ 60 years: 50%) compared to those aged 40–59 years (23.8%), with statistical significance ($p<0.05$).

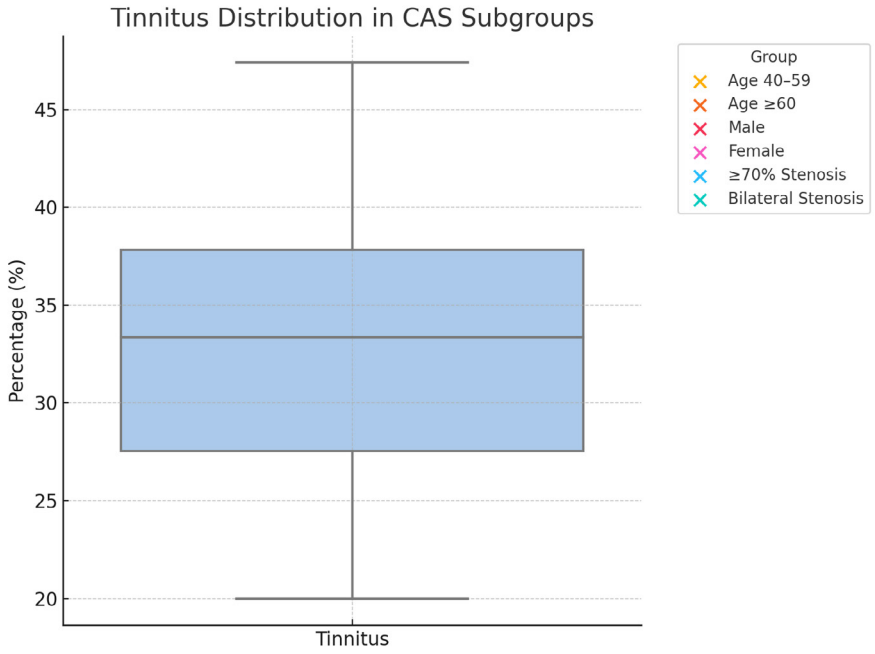

Figure 2: Boxplot showing the distribution of tinnitus prevalence across age, gender, and stenosis characteristics. The most significant increase was noted among patients with severe or bilateral CAS.

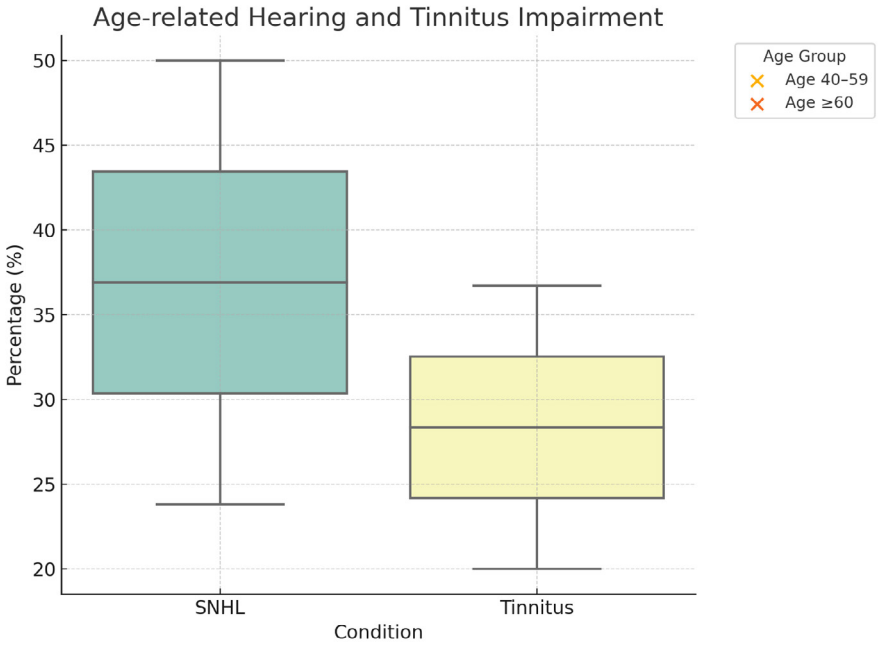

Figure 3: Age-related differences in sensorineural hearing loss (SNHL) and tinnitus. Patients aged ≥60 years showed significantly higher SNHL prevalence (50%, n=15) compared with those aged 40–59 years (23.8%, n=5) ($p < 0.05$). Age-related analysis also demonstrated increased tinnitus rates in the ≥60 age group, supporting the hypothesis that vascular aging contributes to auditory dysfunction.

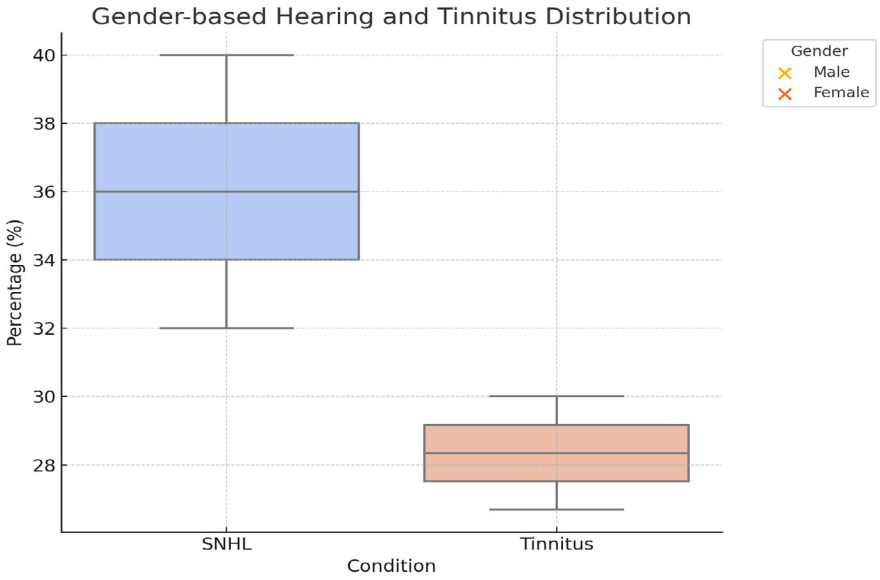

Figure 4: Boxplot comparing SNHL and tinnitus prevalence by gender. Although males had slightly higher percentages, no statistically significant difference was found.

Table 1: Calculation of COMPASS-31 score.

Score	Sum of items	Multiplies by
Orthostatic Intolerance-score	1-4	4
Vasomotor score	5-7	0.8333
Secretomotor score	8-11	2.1428571
Gastrointestinal score	12-23	0.8928571
Bladder-score	24-26	1.111
Pupillomotor score	27-31	0.333
COMPASS-31-score	Sum of all six domain scores	

Men have a slightly higher SNHL rate (40%) than women (32%).

Severe CAS (≥ 70% stenosis) significantly increases the odds of both SNHL (OR=2.5) and tinnitus (OR=2.1).

Bilateral CAS further elevates risk, with higher odds for SNHL (OR=3.4) and tinnitus (OR=2.8).

DISCUSSION

The present study provides compelling evidence of a significant relationship between Carotid Artery Stenosis (CAS) and auditory dysfunction, particularly Sensorineural Hearing Loss (SNHL) and tinnitus. This supports emerging neurovascular theories suggesting that cochlear structures, which depend on a rich microvascular supply, are highly susceptible to hemodynamic disturbances caused by CAS[10].

Age-Related Vulnerability

A higher prevalence of SNHL in individuals aged ≥60 years is consistent with known age-related degenerative and vascular changes affecting the auditory system[11]. The age-related decline in vascular elasticity, coupled with progressive atherosclerosis, likely exacerbates cochlear ischemia in patients with CAS. These findings support previous studies indicating that older adults are at greater risk of inner ear hypoperfusion and subsequent hearing damage in the presence of carotid pathology[12].

Gender Differences

Although the observed difference in SNHL prevalence between males (40%) and females (32%) did not reach statistical significance, it suggests a potential gender-based physiological variance in vascular resilience. Estrogen-related protective mechanisms, such as enhanced endothelial function and vasodilation, may contribute to relatively lower rates of auditory dysfunction in females[13]. Further research is warranted to elucidate these gender-related disparities.

Impact of CAS Severity and Laterality

The study found that patients with ≥ 70% stenosis were significantly more likely to develop SNHL and tinnitus, with odds ratios of 2.5 and 2.1, respectively. These results indicate that the degree of stenosis directly correlates with the extent of auditory damage, likely due to compromised cochlear perfusion[14]. Moreover, bilateral CAS was associated with the highest risk, suggesting that systemic or symmetrical vascular compromise amplifies the likelihood of cochlear ischemia[15].

Clinical Implications

These findings underscore the need to incorporate auditory screening-such as audiometry and tinnitus assessment-into the clinical evaluation of patients with CAS, particularly those with advanced age or severe

bilateral disease. Early identification of hearing changes in this population may serve as a non-invasive marker of cerebral hypoperfusion and guide timely therapeutic intervention[16-20]. Furthermore, understanding the auditory impact of CAS may improve multidisciplinary management, bridging otolaryngology, neurology, and vascular medicine[21-27].

CONCLUSION

This study confirms that carotid artery stenosis is significantly associated with sensorineural hearing loss and tinnitus. The risk is particularly elevated in patients over 60 years of age, those with ≥ 70% stenosis, and individuals with bilateral involvement. Although gender differences in SNHL were not statistically significant, the slightly lower rates in females suggest a potential protective effect that warrants further exploration.

Incorporating auditory assessments into the diagnostic work-up of CAS patients can enhance early detection of vascular-related hearing dysfunction. Such integrative approaches may lead to improved outcomes in both auditory and cerebrovascular health, supporting a more comprehensive model of care for patients with vascular comorbidities.

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