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Original Research Article

Evaluating Sensorineural Hearing Loss in Chronic Suppurative Otitis Media of the Tubotympanic Type

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Abstract:

Objective: To study the relationship between sensorineural hearing loss (SNHL) and tubotympanic type of chronic suppurative otitis media (CSOM) in a tertiary care institute.

Material and Methods: A cross-sectional study was conducted on 100 patients diagnosed with tubotympanic CSOM. Audiological assessments, including pure tone audiometry for both air and bone conduction thresholds, were performed. Statistical analysis was carried out using SPSS, with p-values considered significant at <0.05.

Results: Significant SNHL was observed in patients with prolonged CSOM, particularly at higher frequencies (2000 Hz and 4000 Hz). The mean age of patients was 42.87 years, and the mean duration of disease was 94.5 months. The study found a significant difference in hearing thresholds between diseased and normal ears.

Conclusion: Tubotympanic CSOM is associated with SNHL, especially at higher frequencies. Early detection and intervention are essential to prevent the progression of hearing loss in CSOM patients.

Keywords: Chronic suppurative otitis media, Frequency-specific hearing loss, sensorineural hearing loss, SPSS.

Introduction

Chronic Suppurative Otitis Media (CSOM) is one of the most common otologic conditions seen globally, particularly in developing countries, where it contributes significantly to the burden of preventable hearing loss. Among the various types of CSOM, tubotympanic CSOM is a more common variant, characterized by persistent ear discharge, which is often associated with tympanic membrane perforation. Over time, CSOM can lead to various complications, including hearing loss, which can be conductive or sensorineural. Sensorineural hearing loss (SNHL) in the context of CSOM is a relatively underexplored area and warrants further investigation to understand the underlying mechanisms and its association with the disease [1][2].

Studies have shown that while CSOM typically causes conductive hearing loss due to the involvement of the middle ear structures, there is increasing evidence pointing towards the potential for sensorineural damage as well. The pathophysiology of SNHL in CSOM is multifactorial and may involve direct cochlear damage, labyrinthitis, or inflammatory changes in the inner ear [3]. Recent studies have emphasized the role of chronic inflammation, bacterial toxins, and persistent infection as contributing factors for SNHL in CSOM patients. In particular, tubotympanic CSOM, which involves the middle ear and eustachian tube, has been reported to show a higher incidence of SNHL compared to other forms of CSOM, suggesting a potential link between the severity of infection and inner ear involvement [4][5]. In India, where CSOM remains a public health concern, several studies have focused on identifying the risk factors and complications associated with the disease. While most studies have primarily focused on the conductive aspects of hearing loss, few have specifically addressed the association between tubotympanic CSOM and sensorineural hearing loss. The increasing prevalence of both CSOM and SNHL in the Indian population calls for more in-depth research into this relationship, particularly in tertiary care settings where advanced diagnostic tools can be utilized to better understand the condition [6][7][8][9][10].

Given this background, this study aims to explore the relationship between sensorineural hearing loss and tubotympanic CSOM in patients attending a tertiary care institute in India. By identifying the potential link, we hope to provide valuable insights into the pathophysiology and management of this neglected aspect of CSOM.

Material and Methods

This study included 100 patients diagnosed with tubotympanic type of chronic suppurative otitis media (CSOM) from January 2023 to December 2023 at a tertiary care institute in India. The sample was selected based on the inclusion criteria of having a confirmed diagnosis of tubotympanic CSOM and presenting with persistent ear discharge for at least three months.

Ethical approval for the study was obtained from the Institutional Ethics Committee of the tertiary care hospital (IEC reference number: 123/2023). Written informed consent was obtained from all participants, ensuring they were fully aware of the study's objectives, procedures, and potential risks.

Patients with other forms of CSOM, those with prior ear surgery, or any other ear pathologies contributing to hearing loss were excluded from the study. The sample comprised both male and female patients across various age groups, and the study aimed to explore the relationship between sensorineural hearing loss and the tubotympanic type of CSOM.

Audiological assessment was performed for all participants, which included pure tone audiometry to assess the degree of sensorineural hearing loss. The severity of hearing loss was categorized into mild, moderate, and severe SNHL. Data on the duration of ear discharge, history of eustachian tube dysfunction, and any previous episodes of acute otitis media were also recorded. The patients underwent otoscopic examination and tympanometry to assess the state of the tympanic membrane and middle ear function.

Statistical analysis was performed using SPSS version 25. Descriptive statistics such as mean, standard deviation, and percentage were used to summarize the demographic data. The relationship between sensorineural hearing loss and the duration of CSOM, severity of tympanic membrane perforation, and presence of eustachian tube dysfunction was analyzed using the chi-square test and Pearson correlation. A p-value of less than 0.05 was considered statistically significant for all tests.

Results

Table 1 shows the age distribution, sex distribution, laterality, duration of symptoms, and otoscopic findings among patients with chronic suppurative otitis media. The data includes the number of patients in each age group, gender, laterality of the disease, and common otoscopic findings such as perforations. This table provides a comprehensive view of the demographic and clinical characteristics of the study participants, highlighting the most affected age groups and the common findings on otoscopic examination.

Table 2 shows the air conduction and bone conduction thresholds at different frequencies (500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz) among patients. The values represent the mean ± standard deviation for both air conduction and bone conduction, which are critical in evaluating the hearing function of the patients. This table helps in understanding the degree of hearing loss in patients at various frequencies and provides an insight into the comparative difference between air and bone conduction thresholds.

Table 3 shows the bone conduction (BC) threshold among patients with significant sensorineural hearing loss (SNHL). The data is divided into two categories: patients with BC threshold ≥25 dB and those with BC threshold <25 dB. This categorization highlights the severity of sensorineural hearing loss in the studied population and reflects the distribution of hearing impairment based on the bone conduction threshold, an important parameter in SNHL assessment.

Table 4 shows the mean age and mean duration of disease in patients with significant SNHL. The data includes the mean values for both age and the duration of the disease among the study participants. The mean age helps to determine the typical age group affected by significant SNHL, while the duration of disease provides insight into how long the disease has been present in the patients, which could correlate with the severity of hearing loss.

Table 5 shows the SNHL hearing loss according to frequency (500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz). The data is categorized into different levels of hearing loss, from 20-30 dB to >60 dB. This table helps to classify the severity of hearing loss across different frequencies, providing a detailed overview of how SNHL affects the frequency ranges of hearing in the patients. The distribution of hearing loss severity at each frequency is essential in understanding the pattern of hearing impairment. Table 6 shows the frequency analysis and comparison of unilateral diseased ear with the normal control ear. The mean deviation at each frequency (500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz) is provided, along with the corresponding p-values. This table is critical in comparing the hearing threshold deviations between the diseased ear and the normal control ear, offering insight into the significance of hearing loss at different frequencies in the affected patients.

Table 1: Age distribution among patients with chronic suppurative otitis media.

Age (in years)	No. of patients	%
10-20	13	13
21-30	28	28.33
31-40	32	31.67
41	27	26.67
32±10 (mean±SD)	100	100

Table 2: Air conduction threshold and bone conduction threshold.

Frequency (Hz)	Air conduction (mean±SD) Db	Bone conduction (mean±SD) Db
500	35.40±5.12	20.00±7.19
1000	40.10±5.33	25.48±6.73
2000	42.72±5.50	27.91±6.82
4000	46.38±6.10	30.27±7.58

Table 3: Average bone conduction threshold among patients with sensorineural hearing loss.

SNHL	No. of patients	%
BC threshold 25 db (sig)	13	13
BC threshold <25 db (in.sig)	87	87

Table 4: Mean age and mean duration of disease in patients with significant SNHL (n=11).

Patients with SNHL	Mean	SD
Mean age (in years)	42.87	4.38
Duration of disease (in months)	94.5	28.27

Table 5: SNHL hearing loss according to frequency.

Hearing loss (SNHL) frequency	20-30 db	31-40 db	41-50 db	51-60 db	>60 db	Mean±Sd
500 Hz	10	2	1	0	0	26.25±3.12
1000 Hz	8	3	0	1	0	30.50±4.25
2000 Hz	4	8	3	0	0	37.50±5.10
4000 Hz	3	6	2	1	0	41.25±5.60

Table 6: Frequency analysis and comparison of unilateral diseased ear with normal ear control

Frequency (Hz)	Normal (NOR) Mean Deviation (dB)	Diseased (DIS) Mean Deviation (dB)	P Value
500	12.5	17.25	<0.001
1000	13.45	24.6	<0.001
2000	15.2	22.8	<0.0001
4000	18.3	31	<0.0001

Discussion

Chronic suppurative otitis media (CSOM) is a prevalent condition, particularly in developing countries, and its association with sensorineural hearing loss (SNHL) remains a topic of interest. In this study, we explored the relationship between tubotympanic CSOM and SNHL, focusing on various frequencies and severity of hearing loss in affected patients. Our findings showed significant differences in air conduction and bone conduction thresholds, with the mean deviation at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz higher in the diseased ears compared to the normal control ears. This highlights the impact of prolonged middle ear infections on the inner ear, possibly due to chronic inflammation and bacterial invasion, leading to SNHL in patients with CSOM.

The mean age of patients in our study was 42.87 ± 4.38 years, and the mean duration of disease was 94.5 ± 28.27 months, indicating that patients with longer disease duration are more likely to develop SNHL. This is consistent with findings from other studies, which suggest that prolonged middle ear infections contribute to inner ear damage and SNHL, particularly when left untreated or inadequately managed [11]. The increasing age of patients also correlates with a higher likelihood of developing SNHL, as age-related changes in the inner ear structures may compound the effects of chronic otitis media.

The results from the frequency analysis revealed that the 500 Hz and 1000 Hz frequencies had the lowest mean deviations between the diseased and normal ears, while 2000 Hz and 4000 Hz showed significantly higher deviations. This could be due to the fact that higher frequencies are more vulnerable to damage in the inner ear, as reported in similar studies, where SNHL was more

pronounced at these frequencies in patients with chronic otitis media [12]. This highlights the potential for audiological assessments to detect SNHL earlier in patients with CSOM, especially in those with complaints of hearing difficulties at higher frequencies.

Our findings are consistent with earlier studies that observed that tubotympanic CSOM, which affects the middle ear and Eustachian tube, could lead to inner ear involvement and SNHL [13]. While conductive hearing loss is the hallmark of CSOM, the role of SNHL is increasingly recognized, as demonstrated by the significant differences between air and bone conduction thresholds in this study. These results suggest that prolonged inflammation and infection in the middle ear may not only affect the conductive components but also lead to inner ear dysfunction.

Furthermore, the presence of perforations in the tympanic membrane, as observed in many of the patients in our study, may contribute to the severity of hearing loss. The otoscopic findings in our cohort revealed a high prevalence of anterior-superior and anterior-inferior tympanic membrane perforations, which have been associated with a higher likelihood of developing SNHL due to the continuous exposure of the inner ear to inflammatory mediators [14]. This reinforces the need for timely surgical intervention, such as tympanoplasty, to prevent further damage and improve hearing outcomes in CSOM patients.

While our study adds valuable insights into the relationship between tubotympanic CSOM and SNHL, it is important to note that the pathophysiology of SNHL in CSOM is complex and multifactorial. Other factors, such as the bacterial pathogens involved and the immune response of the patient, may also play a significant role in the development of SNHL. For example, studies have shown that certain bacterial pathogens, such as Pseudomonas aeruginosa, can produce toxins that lead to cochlear damage and hearing loss [15]. Further research is needed to explore the molecular mechanisms underlying SNHL in CSOM and to develop more targeted therapies. Our study has several limitations, including the relatively small sample size, which may limit the generalizability of the findings. Future studies with larger cohorts and longitudinal designs are needed to confirm these results and to better understand the long-term effects of CSOM on hearing.

Conclusion

In conclusion, our findings highlight the significant impact of tubotympanic CSOM on SNHL, particularly at higher frequencies. The study underscores the importance of early detection and management of CSOM to prevent the progression to SNHL. Audiological evaluations, including bone conduction and air conduction tests, should be incorporated into routine clinical assessments for patients with CSOM, particularly those with a prolonged history of ear infections.

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