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UNVEILING THE CORRELATION BETWEEN THE SITE OF TYMPANIC MEMBRANE PERFORATION AND HEARING LOSS: OUR EXPERIENCE

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Abstract

Introduction- Hearing loss is one of the most common sensory deficits in humans which has negative influence on multiple aspects of individual's life. Tympanic membrane perforation because of chronic otitis media or trauma results to conductive hearing loss. Prompt management of chronic otitis media reduces complications related to tympanic membrane perforation, thereby enhancing the quality of life for patients.

Aim and objective-

To study the correlation between site of perforation with degree of hearing loss.

Method and Methodology- This prospective observational study was conducted from December 2020 to December 2022 on 60 patients in the Department of Otorhinolaryngology and Head & Neck Surgery at Medical college and hospital, India. All the patients in the age group of 18-50 years from both sexes having tympanic membrane perforation in the inactive stage were included in the study. Photo documentation of the tympanic membrane perforation of the patients was done using oto-endoscope. Based on the site, tympanic membrane perforation was divided into 3 categories- Anterior, Posterior and Combined.

Result- Majority of the patients (50%) were in the age group of 18-40 years having female preponderance. Most of the patients presented with ear discharge (83.3%). Majority of perforations were combined perforations (63%). We also noted that the highest mean conductive hearing loss was seen in the combined perforations at 25.88 (+/- 11.05) dB.

Conclusion- Degree of hearing impairment is affected by the site of perforation.

Key Words: Tympanic membrane, Perforation, conductive hearing loss, chronic otitis media.

Unveiling the correlation between the site of tympanic membrane perforation and hearing loss: Our experience

Introduction

Hearing loss is one of the most common sensory deficits in humans which has negative influence on multiple aspects of individual's life. It is the third most common cause of years lived with disability and affects over 1.57 billion people worldwide.[1] Helen Keller, in a well-known phrase, also expressed that blindness isolates us from things, whereas deafness isolates us from people. [2]

Hearing loss encompasses a broad spectrum of auditory impairments, ranging from subtle disruptions that may go unnoticed to complete loss of hearing. Hearing loss, according to the World Health Organization (WHO), is defined as an average pure tone threshold of more than 25 decibels at frequencies of 0.5, 1, 2, and 4 kilohertz in the ear with better hearing.[3] It can be categorised into three types- conductive, sensorineural and mixed type, on the basis of function and topography.[4] Conductive hearing loss comprises of better hearing threshold for bone conduction as compared to air conduction. It is associated with dysfuction at the level of external and/or middle ear. Sensorineural hearing loss is a result of dysfunction in cochlea or beyond that is at level of 8th nerve or in brain. Mixed hearing loss is a combination of both conductive and sensorineural damage to the same ear.[5] Common causes of hearing loss includes congenital causes including genetics, acquired causes including ageing, noise induced, birth complications, certain medications or toxins, trauma to ear and infections including chronic otitis media(COM).[6]

Chronic otitis media is one of the important causes of preventable hearing loss in developing countries like India. Poor nutrition and unhygienic and overcrowded living conditions can be attributed to widespread prevalence of COM in underdeveloped nations. It is a chronic infection leading to inflammation of mucoperiosteal layer of middle ear and mastoid. It is associated with chronic ear discharge (more than 6 weeks) through perforated tympanic membrane, not responding to oral or topical medications.[7] COM can be categorized into active- mucosal or squamosal, inactive- mucosal or squamosal and healed type.[8]

Intact tympanic membrane helps in conduction of sound by transferring vibrations to middle ear (stapes footplate). It also protects middle ear from infections and maintains phase difference for conduction of sound (Round window baffle).[9]

Tympanic membrane perforation because of COM or trauma results to conductive hearing loss. Larger the size of perforation, more will be the hearing loss due to loss of transformer action of middle ear.[10] The site of the perforation also has a substantial impact on the severity of hearing loss. Specifically, the posterior quadrant perforations are more severe than the anterior ones because of the direct exposure of the round window to sound waves. Perforations occurring at or near the handle of the malleus have more severe consequences compared to perforations of the same size at other locations.[11-12] COM involving ossicles leads to the conductive hearing loss of around 60dB.[13] In addition to this middle ear volume also has impact on hearing loss caused due to perforation.[14] Recurrent ear infection due to tympanic membrane perforation in COM can also result to sensorineural hearing loss(SNHL) because of absorption of toxins into cochlea.[15]

This research examines the relationship between the site of tympanic membrane perforation and the severity of hearing loss. This will help in prompt management and reduction of complications related to tympanic membrane perforation, thereby enhancing the quality of life for patients.

Aim and objective-

To study the correlation between site of perforation with degree of hearing loss.

Methodology-

This prospective observational study was conducted from December 2020 to December 2022 in the Department of Otorhinolaryngology and Head & Neck Surgery at Medical college and hospital, India after getting the ethical clearance from the institutional ethical committee. The sample size consisted of 60 patients. Informed written consent was taken from the participants. All the patients in the age group of 18-50 years from both sexes having tympanic membrane perforation in the inactive stage were included in the study. Patients with tympanosclerosis, any previous history of ear operation,

having sensorineural or mixed hearing loss and who refused for giving consent were excluded from the study.

Detailed history along with general physical and otorhinolaryngological examination was done for all the cases. Photo documentation of the tympanic membrane perforation of the patients was done using otoendoscope. Handle of malleus orientation was used to determine the side of the ear and the site of the perforation. Based on the site, TM perforation was divided into 3 categories:

Anterior – perforations occupying the area anterior to the imaginary line passing through the handle of the malleus on the pars tensa (Antero inferior and antero superior quadrant perforation).

Posterior – perforations occupying the area posterior to the imaginary line passing through the handle of the malleus on the pars tensa (Postero inferior and postero superior quadrant perforation).

Combined – perforation occupying both anterior and posterior perforation (Multiple quadrant perforation). (Figure-1)

Audiometric analysis was done by Pure Tone Audiometry using ALPS Advanced Digital Audiometer AD21OO in a sound buffered room. The selected reference frequencies for this study ranged from 125 to 8000 Hz. Masking techniques were used, where appropriate, to estimate the thresholds for air and bone conduction.

The air conduction threshold was assessed for frequencies ranging from 125 to 8000 Hz, while the bone conduction threshold was assessed for frequencies ranging from 250 to 4000 Hz. Air-bone gap(ABG) was also evaluated. Audiometric results with an air-bone gap (ABG) equal to or more than 20 decibels (dB) were identified as indicative of conductive hearing loss, whereas an ABG of less than or equal to 20 dB indicated sensorineural hearing loss. The mixed hearing loss was characterized by an air-bone gap (ABG) of at least 20 decibels, accompanied with a discernible reduction in bone conduction. WHO guideleines for hearing impairement assessment were used for the classification of hearing loss[16], as described below-

S.No.	Hearing impairment category	Better ear hearing level (dBHL)
1	Unilateral	Less than 20 in the better ear; more than/equal to 35 in the worse ear
2	Mild	20-34
3	Moderate	35-49
4	Moderately severe	50-64
5	Severe	65-79
6	Profound	80-94

STATISTICAL ANALYSIS

The data were entered and statistical analysis of the data was done using SPSS(Statistical Package for Social Services) software. The Chi-square test was used to make comparisons, with a p-value <0.05 being deemed statistically significant.

Figure- 1: Combined perforation (Large central) of Right ear

Results

This hospital-based study was conducted on 60 patients having tympanic membrane perforation in inactive stage. Majority of the patients (50%) were in the age group of 18-40 years having female preponderance, with male: female ratio being 1:1.13. Most of the patients (47 patients) were from lower socioeconomic background, that is below poverty line category, which was confirmed based on their ration cards. Most of the patients presented with ear discharge (83.3%) followed by decreased hearing (51.7%). Other complaints were otalgia (38.3%) and ear itching (31.7%).

We observed that the majority of perforations were combined perforations (63%), while anterior perforations were 23% and Posterior perforations were the least seen in 13% of the participants. (Table-1). Among anterior perforation, 6 perforations involved anterosuperior quadrant (42.86%) and 8 perforations involved anteroinferior quadrant (57.14%). Among posterior perforation, 6 perforations involved posterosuperior quadrant (75%) and 2 perforations involved posteroinferior quadrant (25%).

Site of perforation	Frequency	Percentage
Anterior	14	23%
Posterior	8	13%
Combined	38	63%

Table -1 Depicts the frequency of distribution of perforations according to the site.

We also noted that the highest mean conductive hearing loss was seen in the combined perforations at 25.88 (+/- 11.05) dB, while anterior and posterior perforations had 11.16 (+/- 4.91) dB and 10.62 (+/- 6.61) dB respectively. (Table-2) On comparing the mean hearing loss, on the basis of site of perforation, significant statistical difference was found.

Site of perforation	Frequency	Percentage	Mean conductive hearing loss (dB)	Standard deviation (dB)
Anterior	14	23%	11.160714	4.9142719
Posterior	8	13%	10.625	6.614378
Combined	38	63%	25.88816	11.05464

Table-2 Depicts the mean conductive hearing loss according to different sites of perforation.

Discussion

Tympanic membrane perforation (TMP) ranks high among the most prevalent causes of hearing loss. In impoverished nations, the major cause of TMP is a secondary infection (Acute or chronic otitis media) that develops as a result of upper respiratory tract infections and inadequate hygiene practices. Ear plucking, probing, syringing, and other similar practices may cause injuries that can progress to TMP (Traumatic). Although conductive hearing loss is the most common result of tympanic membrane perforation, sensorineural hearing loss may occur as a result of inner ear damage caused by tympanic membrane rupture as a result of head accidents, blast injuries, etc.[17] In this study, 60 individuals with tympanic membrane perforations in an inactive stage were examined to determine the relationship between the location of the tympanic membrane perforation and the degree of hearing loss.

Majority of the patients in this study were in the age group of 18-40 years. This finding was in accordance with Sood et al.[9] and Prasansuk et al.[18] This could be justified by the fact that most people in this group are health concerned and socially active. Furthermore, we discovered a higher proportion of females in comparison to males. In the research conducted by Sood et al[9], a similar observation

was made, with 63% of the participants being females and 37% being males. This statistic contradicts the majority of studies that typically show a higher prevalence of males compared to females.
In our study most of the patients were from lower socioeconomic background (78.33%). This disparity may be attributed to factors such as low literacy rates, unsanitary environments, inadequate personal cleanliness and overcrowding among those in lower socioeconomic groups, which therefore results in a higher prevalence of diseases among this population. Similar findings were seen in study by Ramanuj et al.[19]
In our research, the prevailing symptoms were ear discharge (83.3%), followed by reduced hearing (51.7%), otalgia (38.3%), and ear itching (31.7%). In their research, Sood et al[9] found similar results, with otorrhoea being the most prevalent symptom reported by 98% of patients, followed by decreased hearing in 97%, itching in 55%, tinnitus in 25%, otalgia in 19%, and vertigo in 4%. In their investigation, Gulati et al. found that ear discharge and hearing loss were the primary symptoms.[20]
In our study, we divided the site of perforation into anterior, posterior, and combined. Comparison of the hearing loss in relation to the location of perforation was the maximum for combined perforation (63.33%). This could be attributed to the larger size of the perforation causing a hearing loss of 25.88 (+/-10.7) dB. Both anterior (23.33%) and posterior (13.33%) perforations were small-sized perforations, with a mean hearing loss of 11.16 (+/-4.7 dB) and 10.62 (+/- 6.8 dB) dB, respectively. Hence the combined perforation had more hearing loss than the anterior and posterior perforations which was statistically more significant with F-value = 17.2052 and P-value <0.001. Combined and anterior perforations also had greater hearing loss than the posterior perforations. The posterior perforations are traditionally thought to cause higher amounts of hearing loss than the anterior perforations. This is attributed to the loss of the Round window shielding effect of the tympanic membrane, which leads to a loss in sound transmissions to the Oval window. Our result contradicted the findings of the studies conducted by Nahata et al and Blaci et al, where the posterior perforations caused greater hearing loss than the anterior perforations and were significant indicators for ossicular chain defect.[21-22] This observation may be explained by the fact that sound wavelengths below 4 kHz are greater than the size of the middle ear. As a result, the phase cancellation effect should theoretically be consistent across all locations of perforations. [23-24] Studies by Virk et al and Pannu et al supported the results of this study.[25-26]

Conclusion

We concluded that the site of perforation affects the extent of hearing impairment. The combined and anterior perforations have greater hearing loss than the posterior perforations.
The primary constraint of this research was the limited sample size. Despite its modest size, this research will contribute to improved patient counseling and more accurate prediction of surgical outcomes.

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