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A CLINICO-PATHOLOGICAL & AUDIOLOGICAL STUDY OF SENSORINEURAL HEARING LOSS IN PATIENTS WITH CHRONIC OTITIS MEDIA :-IS THERE A SIGNIFICANT CORRELATION ?

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ABSTRACT

Introduction: Chronic otitis media (COM) is one of the most common disorder in field of ENT. Hearing loss as a sequel of chronic otitis media (COM) is often conductive, but there has been a controversy in different studies with association of sensorineural hearing loss and COM . The aim of the study was to determine the association between COM and sensorineural hearing loss (SNHL) and to assess the influence of patient's age, duration of disease, type of COM and presence of cholesteatoma on the presence of SNHL.

Material & Methods: This was a cross sectional descriptive study of 100 subjects between the age group of 5 and 50 years. Patients having unilateral chronic otitis media of both mucosal and squamosal types, who met the inclusion criteria of unilateral otorrhea, normal contralateral ear on otoscopy, with no history of head trauma or ear surgery or familial hearing loss were selected. All patients were evaluated clinically and audiologically. The age, type, duration of disease and presence of cholestetoma is correlated with degree of sensorineural hearing loss. Interaural differences in bone conduction thresholds at 500 Hz, 1 kHz, 2 kHz and 4 kHz were also noted. Data analysis was performed using SPSS 13 with independent-samples t-test, Pearson correlation test, and twotailed analysis. A $p \leq 0.05$ was considered statistically significant.

Results: Significant higher BC thresholds were found in the affected ear than in the normal ear for each frequency ($p < 0.001$), which increased with increasing frequency (4.9 dB at the 500 Hz and 9.85 dB at the 4000 Hz). A strongly significant correlation was observed between patients' age and the degree of SNHL ($r = 0.401$, $p < 0.001$) but no significant correlation was in duration of the disease ($r = 0.108$, $p > 0.05$). There was no relationship between presence of cholesteatoma with SNHL across all frequencies ($p < 0.05$).

Conclusion: A significant association between SNHL and COM was found in this study. The difference in BC thresholds increased with increasing frequency. Patients' age was significantly correlated with the degree of SNHL, but no significant association was observed between SNHL with duration of disease. Presence of cholesteatoma and development of SNHL were found to be correlated in this study.

KEYWORDS : Chronic otitis media, Middle ear, Pure tone audiometry, Round window, Sensorineural hearing loss.

INTRODUCTION

Chronic otitis media (COM) has assumed a world-wide importance. COM is one of the most common disorder in field of ENT. In spite of the fact that the complications of COM can be fatal , it usually leads to a significant hearing impairment, sensorineural hearing loss being one of them [1]. The hearing impairment in patients with COM has generally been observed to be of conductive deafness and less of sensorineural type. The role of chronic inflammatory disease of the middle ear as a cause of SNHL is still debatable. It is hypothesized that in COM, bacterial toxins, toxins from cholesteatoma & topical antibiotics may enter through semi-permeable round window membrane causing damage to organ of corti. There exists a significant difference in the prevalence rate for ear disease is evident between developed countries and developing countries. Some of the reasons for this disparity are over-crowding, suboptimal hygiene, malnutrition, ignorance, passive smoking, high nasopharyngeal colonization with bacteria, inadequate access to required healthcare. A true estimate of the problem of deafness is not known in India. The round window membrane has been analyzed for it contribution to sensorineural hearing loss in chronic otitis media [2-6]. Due to semipermeable nature of round window membrane, toxins released during the course of COM may breach and causes biochemical changes in perilymph and endolymph finally leading to destruction of Organ of Corti [5]. It has been observed that chronic inflammation enhances increased vascular and macromolecular (protein) permeability within the perilymphatic space[7]. Chronic use of ototoxic ear drops have also been one of the concerns for sensorineural hearing loss component in com mixed hearing loss.

Different investigators have different findings over the relation between the duration of disease, type of pathology and development of sensorineural hearing loss in COM. Positive co- relation between duration and type of disease and development of sensorineural hearing loss implies that earlier the attempts are made to eradicate the disease, much better would be the outcome after treatment. A definitive co-relation between the duration or type of disease and development of sensorineural hearing loss would mandate the need for early detection and treatment of Chronic Otitis Media as a means to prevent sensorineural hearing loss.

Hence the present study is being undertaken to analyze clinically with respect to age of patient, duration of disease, the type of COM and presence of cholesteatoma on the development of sensorineural hearing loss.

MATERIAL & METHODS:

Research Design And Participants

A cross-sectional study was carried out from Feb 2018 to Aug 2019 at Calcutta National Medical College, Kolkata, India. 100 patients with unilateral COM are selected consecutively as and when they present during the study period based on the following inclusion and exclusion criterias :

1) presence of unilateral otorrhea lasting at least for 3 months and tympanic membrane perforation on otoscopy;
2) normal tympanic membrane in contralateral ear based on otoscopy;
3) patients with age ranging from 5–50 years. Patients were excluded if they had a history of head trauma or traumatic tympanic membrane perforation, meningoencephalitis, Labrynthitis, chronic exposure to noise, prior ear surgery, and family history of congenital or acquired hearing loss.

Measurement Tool And Data Collection

Demographic variables, duration of the disease, main symptoms, and pure tone audiometry results were obtained from the patients' medical records by a qualified otorhinolaryngologist and recorded in valid and reliable data forms. Bone conduction (BC) hearing thresholds for both diseased and control ear At frequencies 500, 1000, 2000, and 4000 Hz were extracted to determine the SNHL.

Ethical Consideration

The institutional review board of our university approved this study and aspects of its research ethics. Patients' information during and after the study remained confidential.

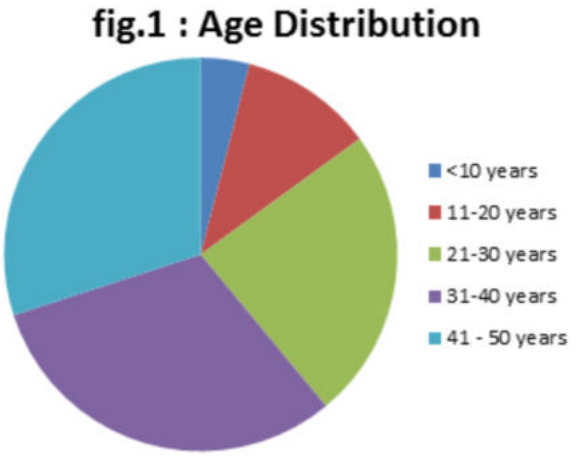
Statistical Analysis

Data analysis was performed using SPSS 13 (SPSS Inc., Chicago, Illinois, United States of America). Independent- samples t-test was used to evaluate differences between bone-conduction thresholds for affected and control ears for each patient. A Pearson correlation test

was used to determine the association among age, duration of disease, and degree of SNHL as well. Two-tailed analysis was applied for all of these tests, and a $p \leq 0.05$ was considered statistically significant.

RESULTS:

The study included of 100 patients of COM, including 57 males (57%) and 43 females (43%) with mean age ± SD of 33.49 ±11.21 years(fig.1) (ranging from 5 to 50 years). Mean duration ± SD of the disease was 5.5±6.02 years ranging from 3 months to 25 years.



Most common symptoms of the patients were hearing loss(92%), Otorrhea (80%), tinnitus (36%), otalgia (24%), and vertigo (10%). The mean BC threshold in the affected ear was 20.56 dB (SD = 16.84), and 12.41 dB (SD = 10.12) in the normal ear ($p < 0.001$). Table (1) shows paired bone-conduction threshold averages for the affected and normal ears across the frequencies (500, 1000, 2000, and 4000 Hz). There were higher thresholds in the affected ear than in the normal ear for each frequency. All of them were statistically significant ($p < 0.001$) The mean BC threshold differences between affected and normal ears range from 4.9 dB to 9.85 dB across the frequencies, which tend to increase with increasing frequency.

A significant correlation between the patients' age and degree of SNHL was observed across the tested frequencies ($r = 0.256$, $p = 0.018$; $r = 0.316$, $p = 0.003$; $r = 0.364$, $p = 0.019$; $r = 0.416$, $p < 0.004$ for the frequencies 500, 1000, 2000 and 4000 respectively).

Although the correlation between duration of the disease(Table 2) and degree of SNHL was investigated, no statistically significant correlation was found between them ($r = 0.062$, $p > 0.05$; $r = 0.078$, $p > 0.05$, $r = 0.138$, $p > 0.05$; $r = 0.121$, $p > 0.05$ for the frequencies 500, 1000, 2000, and 4000 respectively). Squamosal type of CSOM was found to be in 18% of the study ears. Tubotympanic type of CSOM was seen in the remaining 82% ears. Although some patients with tubotympanic variety also had SNHL component in there hearing loss but significant correlation with SNHL could only be seen with squamosal variety of chronic ottitis media. Twelve patients (12%) had cholesteatoma in their post operative surgical histopathology reports(Histologically a multilayered squamous epithelium (matrix) is surrounded by a mesenchymatous granulation tissue (perimatrix). Table (3 & 4) shows the correlation between SNHL in the affected ear based on the presence of cholesteatoma. A significant difference was found between ears with cholesteatoma across all frequencies ($p < 0.05$).

Table 1. Paired Bone-conduction Threshold Averages For The Affected And Normal Ears.

Frequency (Hz)	Bone conduction thresholds		p-value
	Affected ear	Normal ear	
500	16.55+-7.09	11.65 +-2.75	<0.001
1000	19.05 +-7.096	12.05 +- 2.76	<0.001
2000	22 +-10.66	13.3 +- 3.12	<0.001
4000	26.25 +-17.52884	16.45+- 3.71	<0.001

Table 2 : Duration of Disease in sample population.

Valid	Frequency(years)	Percent
< 2 yrs	9	9.0
2 yrs to 5 yrs	50	50.0
> 5 yrs	41	41.0
Total	100	100.0

Table 3 : Cholesteotoma & SNHL Correlation:

			SNHL		Total
			Present	Absent	
Cholesteotoma	Present	Count	6	6	12
		% within Cholesteotoma	50.0%	50.0%	100.0%
	Absent	Count	18	70	88
		% within Cholesteotoma	20.5%	79.5%	100.0%
Total		Count	24	76	100
		% within Cholesteotoma	24.0%	76.0%	100.0%

Table 4: Statistical Tests(Chi-Square Tests)

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.054[a]	1	.025		
Continuity Correction[b]	3.564	1	.059		
Likelihood Ratio	4.412	1	.036		
Fisher's Exact Test				.035	.035
Linear-by-Linear Association	5.003	1	.025		
N of Valid Cases	100				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.88.

DISCUSSION :

Although several studies have proposed the association between COM and SNHL, there is still lack of consensus about its importance. In the current study, we investigated 100 patients of the unilateral COM, to evaluate the association among SNHL and COM, age, duration of disease, and presence of cholesteatoma . A significant increase was found in BC thresholds in the diseased ear in comparison with the normal ear across the speech frequencies (500, 1000, 2000, and 4000 Hz). There was a greater difference in the high frequencies than in the low frequencies (4.9 dB at 500 Hz increasing to 9.85 dB dB at 4000 Hz). Our findings comply with those found by Noordzij et al. [8] and Levine et al. [9]. In a similar study, MacAndie and O'Reilly (10) found a significant degree of SNHL in the diseased ear, which tended to be increased in higher frequencies. These findings supports the hypothesis that proposes middle ear inflammation may change the permeability of round window membrane, so remnants of the bacteria such as endotoxins could pass through it and cause dysfunction of the inner ear, especially in high-frequency region anatomically located close to the round window [11, 12]. A direct and strongly significant correlation was observed between patients' age and the degree of SNHL ($r = 0.401$, $p < 0.001$).

Redaelli et al. [13) and Vartiainen [14] also have reported similar findings. It seemed that older patients are more vulnerable to the effects of middle ear inflammation on cochlear function, and this can intensify hearing impairment due to aging. Age-related hearing loss (ARHL) or presbycusis is one of the most common disabilities in elderly people, which affects approximately 27.6% of individuals between 65 to 79 years and 36.5% of those aged 80 and older [15]. To decrease the effect of ARHL, we excluded patients older than 50 years and considered the mean BC threshold differences for analysis because presbycusis often cause bilateral and symmetric hearing loss. There was no significant correlation between duration of disease and degree of SNHL. ($r = 0.108$, $p > 0.05$). Our findings are consistent with those found in several studies [8,10]. In contrary, Papp [16] found that bone conduction threshold at either the speech frequencies or at 4 kHz increased gradually according to the duration of the CSOM. In a study with similar methodology, SNHL was progressively increased with increasing the CSOM duration . Comparison of the ears with and without cholesteatoma showed significant association between presence of cholesteatoma and SNHL; nevertheless, there were only twelve patients with cholesteatoma and such number of patients might be not enough to judge about it. This is in contrast with the findings of MacAndie [10] in his study. Although the number and proportion of

CSOM patients with cholesteatoma in their studies was greater than our study, they found no difference in SNHL between patients with or without cholesteatoma. Histologically a multilayered squamous epithelium (matrix) was surrounded by a mesenchymatous granulation tissue (perimatrix) in the cases with cholesteatoma.

CONCLUSION :

A significant association between SNHL and COM was found in this study. The difference in BC thresholds increased with increasing frequency. Patients' age was significantly correlated with the degree of SNHL, but no significant association was observed between SNHL with duration of disease. Histologically a multilayered squamous epithelium (matrix) is surrounded by a mesenchymatous granulation tissue (perimatrix) in the 12 cases with cholesteatoma. Presence of cholesteatoma and development of SNHL were found to be correlated in this study. This supports the hypothesis that proposes middle ear inflammation may change the permeability of round window membrane, so remnants of the bacteria such as endotoxins could pass through it and cause dysfunction of the inner ear, especially in high-frequency region, which is anatomically located close to the round window. However, these findings demonstrate significant audiometric cochlear damage in COM. Further clinical relevancy should be evaluated in more future studies.

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(c)Funding - None/If any
(d)Written consent of patient- Taken

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