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Original Research Article

The evaluation of the incidence of sensorineural component of hearing loss in chronic suppurative otitis media

Shruti Jha, Rakesh Kumar Singh*

Department of ENT, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

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***Correspondence:**
Dr. Rakesh Kumar Singh,
E-mail: rksent5@gmail.com

ABSTRACT

Background: The sensorineural component of hearing loss either in form of pure sensorineural or Mixed components has since long been suspected to be a dreaded sequela of chronic suppurative otitis media (CSOM). The aim of this study is to access the incidence of sensorineural hearing loss (SNHL) or mixed hearing loss (MHL) amongst people suffering from both mucosal and squamosal variants of CSOM.
Methods: A prospective observational cohort study (control group: contralateral ear) was conducted at the E.N.T. department of tertiary care center from December 2020 to September 2022. 149 patients of ages 15-50 of either gender with unilateral CSOM were included in the study. The other normal ear of the same patient was taken as the control ear. The pure tone audiometry of both diseased and control ears at frequencies 500,1000,2000 and 4000 kHz were taken to determine SNHL or MHL.
Results: The mean age was 26.54±8.75 years of which, 79 males and 70 females. The mean duration of disease was 3.92±3.32. SNHL occurred in 25.5% of cases, while conductive and MHL affected 69.8% and 4.7 % of patients respectively.
Conclusions: SNHL and MHL occurred in a significant number of patients suffering from CSOM**.** Further research needs to be encouraged and management should be refined to decrease disease-related morbidity.

Keywords: Sensorineural, Mixed, Hearing loss, CSOM

INTRODUCTION

Chronic suppurative otitis media (CSOM) has been defined as chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharges or otorrhoea through a perforation in the tympanic membrane.[1,2] CSOM has been classified into various types - Inactive and Active mucosal CSOM, Inactive and Active squamosal CSOM, and Healed CSOM.[3,4] It has long been one of the most frequently encountered infectious diseases in the developing world and one of the main reasons for the decrease in hearing capacity in people of all ages. This severely limits the quality of life of the patient, adds to the global burden of chronic diseases, and can be extremely disabling. Hearing loss in CSOM can be conductive, sensorineural, or mixed. Conductive hearing loss occurs due to interference in the conduction of sound and can occur due to lesions in the tympanic membrane, middle, or ossicles. In CSOM, hearing loss can range from 5-21%, including all degrees and types in young children between 4-11 years.[5]

SNHL occurs due to lesions in the cochlea, the eighth nerve, or central auditory pathways. Traditionally, the hearing loss associated with CSOM is usually conductive, but many studies have established that sensorineural loss (SNHL) can also occur as sequelae in chronic infections of the middle ear. SNHL can occur due to the spread of inflammation into the cochlea via the round window

which damages the outer and inner hair cells. It usually is in the high-frequency range due to damage to hair cells at the base of the cochlea. It can also be present due to direct invasion of the inner ear by pathogens as well as the use of ear drops containing ototoxic antibiotics.[6] Conductive hearing loss is due to loss of pressure difference across the perforated tympanic membrane, ossicular damage, and the presence of mucosal edema and granulation which impedes sound conduction.[7]

The sensorineural component of hearing loss may be caused by CSOM whose, incidence and degree may be associated with the duration of disease age, size, and type of perforation. The study's hypothesis is to establish that SNHL can occur as a sequela of CSOM and whose degree and incidence are related to the above-mentioned factors. The advantages of this are to identify this complication early in the stage of the disease and mobilize healthcare resources and timely control of the disease, which will ultimately improve the quality of life in the affected individuals.[5,6]

The burden of CSOM and its ability to hamper the quality of life in both adults and children cannot be overstated. While conductive hearing loss has been classically associated with CSOM, the incidence of SNHL and its debilitating effects on patients have not been properly explored. Our objective in conducting this study is to access the incidence of SNHL or MHL amongst people suffering from both mucosal and squamosal variants of CSOM.

There is a lack of awareness and knowledge about the devastating consequences of the same amongst the masses. It is imperative to identify the incidence of SNHL and study its associated factors, which would aid in defining treatment indications.

METHODS

A prospective observational cohort study (control group: contralateral ear) was conducted at the E.N.T department of Indira Gandhi institute of medical sciences, Patna from January 2021 to September 2022. One hundred forty-nine patients between ages 15-50 of either gender, who presented to the outpatient department with complaints of ear discharge for more than 12 weeks with perforation of tympanic membrane were included in the study, based on further inclusion and exclusion criteria. The study began after receiving approval from the institute's ethics committee.

Inclusion criteria

All unilateral CSOM patients, age between 15-50 and ear discharge >12 weeks duration with tympanic membrane perforation were included in the study. The normal contralateral ear served as a control because it eliminates noise, hereditary cause, presbycusis, congenital and other variables.

Exclusion criteria

Patients younger than age 15 were excluded to eliminate the possibility of inaccuracies of audiological testing in children. Patients >50 years of age were excluded because of the increasing incidence of presbycusis in this age group. Patients suffering from diabetes mellitus, hypertension. Patients with a previous history of otological surgery, familial hearing loss. Patients with a history of syphilis and patients with prolonged exposure to noise and head trauma were excluded from the study.

Sampling population

Patients diagnosed with CSOM, undergoing myringoplasty, tympanoplasty, or tympano-mastoid exploration.

Sampling size

This study requires a minimum sample size of 100 patients. However, 149 patients are included in the final study as CSOM is an extremely common disease affecting a significant percentage of the global population.

The sample size was calculated based on a previous article (Elsherif et al) in which the incidence of SNHL was 7% among the study population. The sample size was calculated using the formula-[8] $n= z\alpha^2p(1-p)/e^2$

Where, n=sample size, Zα=1.96 (A point on a normal distribution with 95% confidence level), p=7 % (0.07)

q=1-p=100%-7%= 93% (0.93), e=0.05 (desired precision), n (Sample size)=$(1.96)^2\times0.07\times0.93/(0.05)^2$=100, sample size calculated was 100.

Case selection and evaluation protocol

After getting clearance from the ethical committee of the institute, all patients with complaints of ear discharge >12 weeks as per their chronological age were subjected to comprehensive E.N.T history and clinical examination, otoscopic, oto-endoscopic, and Examination under a microscope. Those with pars tensa or flaccida perforation were then subjected to pure tone audiometry by a designated audiologist, using the same audiometer in a soundproof room. Bone conduction thresholds for both diseased and control ears at frequencies 500,1000,2000 and 4000 kHz were taken to determine SNHL.

After meeting the candidacy criteria, pre-operative necessary investigations were done, and fitness clearance was obtained from the department of anaesthesia and was subsequently posted for surgery. Consent was taken from each participant for undergoing the study. Radiological investigations, namely HRCT temporal bone were done for patients with suspected extra or intracranial

complications, to visualize the status of the tegmen, the status of the seventh cranial nerve, and the inner ear.

Pre-operative parameters for assessment

Details of the patient's age, sex, duration of disease, and demographic details were noted. A detailed history was taken, and the Tympanic membrane was visualized with the help of an otoscope, oto- endoscope, or with the help of a microscope. The external ear, Pre and postauricular areas were examined for any other additional condition or complication. Size and type of perforation were also recorded for each candidate after otological examination, pre-operatively. Tuning fork tests were performed for all patients participating in the study.

Nose and throat and systemic examinations were also done on all the candidates undergoing the study. A pure tone audiometry test was subsequently conducted, and results were noted. HRCT temporal bone was done in patients with suspected extra or intracranial complications or wherever extensive disease was suspected. The final operative plan was made for each of the cases. Informed consent was taken from every candidate included in the study

Statistical analysis

Statistical analysis was carried out using statistical packages for IBM SPSS vs 22 for Windows. Continuous and categorical variables were expressed as mean ± SD and percentages, respectively. Two-sided p values were considered statistically significant at $p<0.05$.

RESULTS

In this study, on 149 participants, demographic details, extensive clinical examination pre-operatively, and intra-operative findings were taken into consideration to obtain descriptive data and the association of SNHL with various demographic variables, side of the ear, site, and type of perforation. In terms of descriptive statistics, most of the patients affected with both mucosal and squamosal variants of CSOM were between 21-40 years of age (57.7%), followed by the 10-20 years of age (31.5%) study population.

The least commonly affected were patients who were over between 41-59 years of age with 10.7 percent of the total. The results also suggested that those males were affected more (53%) than females (47%).

The duration of the disease was maximally between 1- 4 years (64.4%), followed by 5 to 10 years (28.2%). About 4.7% of patients had been affected with the disease for less than 1 year and 2.7% of patients had the disease for more than 10 years. The right ear was seen to be more frequently affected (59.1%) than the left (40.9%) ear. Clinical examination was done on the first contact with the patient and subsequently under a microscope intra-operatively revealed that the most common type of perforation was central, present in 113 of 149 respondents (75.85%). Attic perforation was present in 19 (12.8%) and the rest 17 of the participants (11.4%) had marginal perforation. Cholesteatoma was present in the affected ear in 30 of the patients and absent in the rest 119 (79.9%). All the participants in the study underwent pure tone audiometry, SNHL was present in a significant 38 of 149 (25.5%) participants, the majority being conductive hearing loss 104 (69.8%) and the least common was MHL in 7 (4.7%) of patients. Most of the documented hearing loss was mild in terms of the grade of hearing loss, with 40.3%. Moderate was close second in 30.2%, followed by moderately severe (21.5%). Severe and profound hearing loss affected 4% of patients respectively (Table 1).

Table 1: Descriptive statistics, (n=149).

Variables	N	Percentage (%)
Age group (Year)		
10-20	47	31.5
21-40	86	57.7
41-59	16	10.8
Mean ± SD	26.54±8.75	
Sex		
Male	79	53.0
Female	70	47.0
Duration of disease		
Less than 1 year	7	4.7
1 year to 4 years	96	64.4
5 years to 10 years	42	28.2
>10 year	4	2.7
Mean±SD	3.92±3.32	
Side		
Left ear	61	40.9
Right ear	88	59.1
Type of perforation		
Attic	19	12.8
Central	113	75.8
Marginal	17	11.4
Cholesteatoma		
Present	30	20.1
Absent	119	79.9
Grade of hearing loss		
Mild (26-40 dB)	60	40.3
Moderate (41-55 dB)	45	30.2
Moderately severe (56-70 dB)	32	21.5
Severe (71-90 dB)	6	4.0
Profound (>91 dB)	6	4.0
Pure tone audiometry		
SNHL	38	25.5
CHL	104	69.8
MHL	7	4.7

We calculated the association of the type of hearing loss with the age group. SNHL was present in 23.7% of respondents who were between 10-20 years of age,55.3%

who belonged to 21-40 years of age, and 21.1% in 41-59 years of age. With a p=0.008, this was association was found to be statistically significant (Table 2).

The association of the type of hearing loss with the type of perforation was subsequently taken out, and most of the patients who had a purely sensorineural component of hearing loss had central perforation (29 out of 38). Seven had attic and 2 had marginal perforation. This was found to be statistically not significant with p=0.106 (Figure 1).

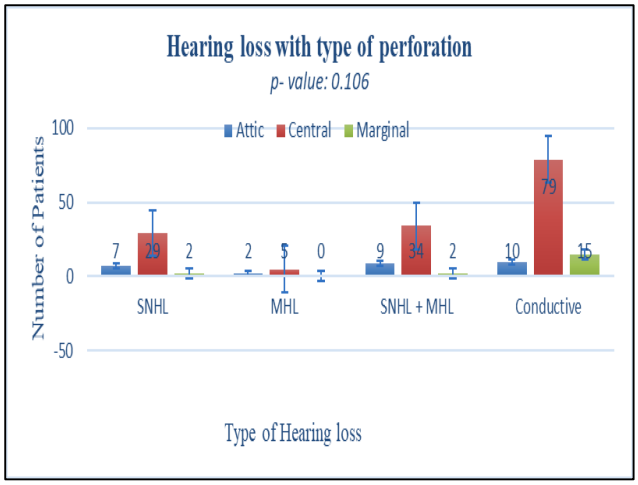

Figure 1: Association of type of hearing loss with the type of perforation.

Chi-square test; p>0.05 not significant.

In this study, we also calculated the association of hearing loss gender, pure SNHL affected 13 males and 25 females respectively. The sensorineural component of hearing loss, which comprised both SNHL and MHL was present in 15 males and 30 females, suggesting a greater affliction in females. This association was found to be statistically significant with a p=0.008 (Figure 2).

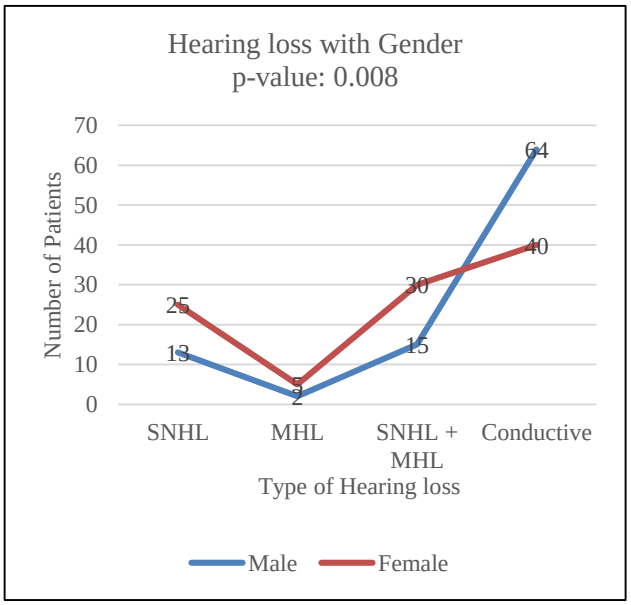

Figure 2: Association of types of hearing loss with sex.

Chi-square test; *p<0.05 significant.

Table 2: Association of type of hearing loss with age group.

Age group (Year)	SNHL		SNHL+ MHL		CHL	P value		
	N=38		N=45		N=104			
10-20	9	23.7	10	10	22.2	37	35.6	0.008*
21-40	21	55.3	25	25	55.6	61	58.7	
41-59	8	21.0	10	10	22.2	6	5.8	
Mean ± SD (Independent test-test)	25.50±10.44		30.20±10.24		69.80±7.55	0.002*		

Chi-square test; *p<0.05 significant.

Table 3: The comparative observations of other researchers with the present study.

Researchers	Type of study	Sample size	Control group	Mean age group (Years)	Mean duration of disease	Incidence of sensorineural components
Rajput et al, 2020, Pakistan[1]	Retrospective observation study	154	No control	26	variable	30 (19.5%)
Amali et al, 2017, Iran[8]	Retrospective	70	Contralateral ear	37.9±15	6.5±7.06 years	7 to 9 dB higher BC thresholds in affected
Deviana, 2016, Malang[7]	Retrospective	186	No control	31	variable	35 (18.81%)
Subramaniam et al, 2020, India[6]	Prospective observational cross-sectional	137	Cohort group	11 to 45	3 years	69.20%
Kaur et al, 2016,	Retrospective	100	Contralateral	28.72±8.68	Below 5	19 (19%)

Continued.

Researchers	Type of study	Sample size	Control group	Mean age group (Years)	Mean duration of disease	Incidence of sensorineural components
India[11]	study		ear		years	
De Azevedo, 2007, Brazil[12]	Retrospective cohort study	115	Contralateral ear	26.3 (SD=15.66),	12.4 SD 10.9	15 (13%)
Tang et al, 2022, China[13]	Retrospective data analysis	79	No control	42.11	Not mentioned	51 (64.55%)
Rana et al, 2019, India[14]	Prospective cross-section study	840	Contralateral ear	41.45±8.90	Not mentioned	146 (17.38%)
Present study	Prospective observational	149	Contralateral ear	26.54±8.75	3.92±3.32	49 (31.5%)

DISCUSSION

CSOM has been a chronic disease that has inflicted mankind since time immemorial. Since prehistoric times, it has affected both children and adults globally, inflicting them intellectually, psychologically, and linguistically.[9] In our study, we studied 149 patients and found that 57.7% of them were between 21-40 years, firmly establishing the fact that CSOM is a disease that despite affecting people of all age groups, is particularly debilitating for the younger age group. In this study, males were affected more (53%) than females (47%), in terms of the more common ear involved, the right ear was affected in 59.1% of cases versus 40.9% of the left ear. All the participants in our study, underwent pure tone audiometry tests for evaluation of their hearing, pure SNHL was found in 25.5% of subjects, 4.7% of them suffered from MHL while 69.8% of them had the conductive type of hearing loss.

Hence, the overall sensorineural components affected by the disease were 31.5%. In similar research done by Jesic et al, they found that in their 100 subjects.[10] 30 of them had SNHL, with the disease affecting 53.3% of males versus 46.67% of females. However, they did not consider the mixed component of hearing loss affected by the disease hence, the sensorineural components of MHL were missing in Jesic S.D. study. Although his similar gender-based observations further cement and support our results of the disease being more debilitating to the young and males. However, Rajput et al, Amali et al, Deviana, Subramaniam et al, Kaur et al, De Azevedo, Tang et al and Rana et al were reported their observation of sensorineural components in case of CSOM as 19.5%, 7 to 9 dB higher BC thresholds in affected, 18.81, 69.20, 19, 13, 64.55, 17.38 percent respectively while in the present study it was observed as 31.5% (Table 3).[1,6-8,11-14]

The type of perforation in our study was central in 75.8% of our patients, attic in 12.8%, and marginal in 11.4% while cholesteatoma affected 20.1% of the respondents. Kaur et al, where 91%. Patients had central perforation, with the most common type of hearing loss being conductive type (80%) and the most affected grade of hearing loss being mild.[11] The difference between the degree of hearing loss between our study and the study of Kaur et al was due to the inclusion of fewer cases of marginal and attic peroration in the study counterpart. It simply reflects the sensorineural component of hearing loss would have been more severe in the case of marginal and attic perforation. However, it needs to be verified with a further large sample size since the present study did not conclude it because no statistical significance was found between the association of hearing loss with the type of perforation (p=0.106).

In the study, we undertook, the most common grade of hearing loss was mild as well, between 26-40 dB (40.3%). We investigated the association of type of hearing loss with age group, type of perforation, and sex and found that the associations of hearing loss with age group and sex were statistically significant, with p=0.002 and 0.008 respectively. De Azevedo et al in their investigative study also concluded that there was an association between the incidence of SNHL and MHL with age and sex, which seems to suggest the plausibility of the same.[12] We found these huge variations in frequency of SNHL and its predictors in above studies was due to variation in sample size, study design, methodology, data collection, and data analysis. Hence, we recommend uniformity in study methods to come up with a strong consensus on the frequency of SNHL components of hearing loss due to CSOM. That might be helpful to eliminate the risk factors by making effective healthcare facilities.

CONCLUSION

Based on the evidence gathered from the study the burden of SNHL and MHL in CSOM is bothersome and significant, especially with the establishment of the fact that it can be a cause of SNHL or MHL in people of younger age groups with far-reaching consequences on the overall quality of life. The need of the hour is early identification and recognition of this problem and reaching an acceptable solution.

Limitations

Given the high incidence and prevalence of CSOM in the Indian population, a larger sample size and several other trials are needed to reach a concrete conclusion.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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