

## Original Research Article

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# A study of sensory neural hearing loss in chronic suppurative otitis media

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## ABSTRACT

**Background:** The role of chronic inflammatory disease of the middle ear as a cause of sensory neural hearing loss (SNHL) is still debatable. Therefore, the role of this study to see if there is a relation between SNHL and duration of chronic suppurative otitis media (CSOM), socio-economic (SE) status and age of patient.

**Methods:** The hospital based case series study was conducted on all CSOM patients coming to ENT out-patient department in S. Nijalingappa Medical College and Hanagal Shri Kumareshwar (HSK) Hospital, Bagalkot, Karnataka over a period of one and a half years. After clinical examination, hearing evaluation was done using PTA as main tool.

**Results:** Based on the present study, overall proportion of patients with SNHL was 20.66%. No relation of SNHL was found between sex and SE status of patient. No relation was found between severity of SNHL and age of patient. No relation was found between severity of SNHL and duration of CSOM. This present study shows that patients with CSOM with increased age have a greater chance of developing SNHL. Also, as the duration of CSOM increases there is a greater chance to develop SNHL.

**Conclusions:** This study shows that the chance of developing SNHL in CSOM increases with age and disease duration. Hence, we can conclude that CSOM should be treated appropriately as early as possible to reduce the risk of developing SNHL in patients with CSOM.

**Keywords:** Chronic disease, Chronic suppurative otitis media, Sensory neural hearing loss

## INTRODUCTION

The role of chronic inflammatory disease of the middle ear as a cause of sensory neural hearing loss (SNHL) is still debatable. The hearing impairment in patients with chronic suppurative otitis media (CSOM) has generally been observed to be of conductive deafness and less of sensorineural type. However, several investigators have reported a loss of cochlear function due to absorption of toxins across the round window, and hence SNHL does occur as a common sequel of long standing CSOM.

The role of chronic inflammatory disease of the middle ear as a cause of SNHL is still debatable. Paparella et al. in their research found that the toxins cross the round window membrane and cause irreversible cochlear hair cell loss mostly affecting the basal turn of the cochlea.<sup>1</sup> The repeated use of ototoxic ear drops in a setting of middle ear inflammation may lead to increased transfer of drug across round window leading to ototoxicity and SNHL.<sup>2</sup> In case of CSOM attico-antral disease (AAD), erosion of otic capsule and exposure of labyrinth make the patient susceptible to labyrinthitis that may account for SNHL. A study done by Kolo revealed a significant degree of SNHL amongst patients with CSOM. There

were no correlations between the degree of SNHL and the patients' age and duration of otorrhea.<sup>3</sup>

A study by Mohsin et al on 106 cases of unilateral CSOM TTD concluded that SNHL was found in 15.9% of CSOM tubotympanic variety patients and risk of developing SNHL increases with patient age, males, duration of disease. Higher frequencies are more affected than the lower frequencies.<sup>4</sup> Similar results were obtained in other studies.<sup>5,6</sup> Another study by Kirtane et al on 100 cases of COM showed no statistical difference between the sensorineural deafness produced by unsafe and safe types of COM.<sup>7</sup> Raquib et al found significant threshold elevation was observed in relation to the disease duration.<sup>8</sup> Azevedo et al found no correlation between duration of disease and SNHL.<sup>9</sup> A study by Park et al concluded that round window was the main spread pathway of inflammation from middle ear to inner ear.<sup>10</sup>

Da Costa and colleges concluded that cholesteatoma seems to cause additional differences in conduction thresholds only for 500 Hz when compared to COM ears without cholesteatoma.<sup>11</sup> Simpara found that 25% of CSOM cases had sensorineural hearing loss of cochlear variety of 40 dB or above at 4 KHz and 8 KHz.<sup>12</sup> Handa et al found that the patients with the longer disease duration have more chances of developing sensorineural loss.<sup>13</sup> Rohith et al, observed that mean BC threshold did not increase with the duration of discharge, but it does appear to rise with increasing age and presence of cholesteatoma.<sup>14</sup> Sayed found significant relationships between threshold elevation and the disease type and its duration. It is uncertain whether this results from cochlear damage or from changes in sound conduction mechanics. The investigator believes that both mechanisms are possible and not exclusive of each other and that they can occur either alone or together.<sup>15</sup> A study by Ramazan revealed no statistically significant relation between age, disease duration, existence of cholesteatoma and SNHL.<sup>16</sup> A study by Kaur K concluded that SNHL does occur in CSOM with particular involvement of higher frequencies.<sup>17</sup> A positive correlation between SNHL and duration of CSOM means an early intervention will be beneficial to the patient. Therefore, the role of this study to see if there is a relation between SNHL and duration of CSOM, socio-economic status and age of the patient.

Objectives of this study were to assess the proportion of patients with SNHL in CSOM coming to ENT out-patient department in S. Nijalingappa Medical College (SNMC) in the present year of study (2014-2015) and to establish a relation between SNHL and duration of CSOM, socio-economic status and age of the patient.

## METHODS

Hospital based case series study. From 1<sup>st</sup> January to 2014 to 30<sup>th</sup> June 2015.

This study was conducted in ENT out-patient Department in S Nijalingappa Medical College and Hanagal Shri Kumareshwar (HSK) Hospital, Bagalkot, Karnataka. A tertiary care teaching hospital.

The study involved all CSOM patients coming to ENT out-patient department in S Nijalingappa Medical College and Hanagal Shri Kumareshwar (HSK) Hospital in the present year of study (2014-2015).

## Sample size and sampling method

### Sampling frame

All CSOM patients coming to ENT out-patient department in S. Nijalingappa Medical College and HSK Hospital in the present year of study (2014-2015) who gave consent for study.

### Sample size

In a study done in Jaipur, incidence of SNHL in CSOM was found to be 24%.<sup>17</sup> So, the sample size has been calculated for anticipated prevalence of 24% taking 4.8% as relative error under 95% confidence limits.

So, considering details below,

P=% frequency prevalence: 24%,  
Relative error: 4.8% (20% of P),  
Design effect: 1,

Using open EPI package, the sample size was calculated using formula,

$$n = [Deff \times Np(1-p)] / [(d^2/z^2(1-\alpha/2) * (N-1) + p*(1-p)]$$

It comes to around: 305 as sample size

### Inclusion criteria

All CSOM patients coming to ENT out-patient department in S. Nijalingappa Medical College and HSK Hospital, Bagalkot, during the study period (2014-2015) was included in this study.

### Exclusion criteria

- Patients younger than age 11 are excluded to eliminate the possibility of inaccuracies of audiological testing in children.
- Patients older than 50 years of age were excluded because of the increased incidence of presbycusis in this age group
- Patients with history of previous otologic surgery, familial hearing loss, prolonged exposure to noise and head trauma.

### Sampling technique

All consecutive CSOM patients coming to out-patient department in S Nijalingappa Medical College and HSK Hospital in the present year of study (2014-2015).

### Methods

Subjects are selected based upon inclusion criteria and exclusion criteria. All the patients underwent complete history taking and clinical examination. Tuning fork tests were done to complement the PTA. In our study PTA was the main tool to assess the hearing of the patient. Pure tone audiometry was performed by a calibrated audiometer in a sound-proof room and narrow band masking was used when appropriate. The bone conduction thresholds were measured at 250, 500, 1000, 2000 and 4000 Hz and air conduction for

250, 500, 1000, 2000, 4000 and 8000 Hz. SE classification was done using modified B. G. Prasad classification.<sup>18,19</sup>

The bone conduction thresholds of unilateral CSOM cases were compared to the other normal ear which acts as control. The difference between the bone conduction

threshold difference between the diseased ear and the normal ear was compared to duration. This would help out to find out if there is any worsening of SNHL with increased duration.

### Statistical analysis

Data was tabulated using Microsoft excel and analyzed statistically by EPI-INFO software and SPSS V20. The categorical data was expressed as rates, ratios and proportions and association was analyzed using chi-square test. The continuous data such as age, duration of disease, hearing thresholds were analyzed using Pearson's correlation test. A probability value ('p' value) of less than or equal to 0.05 was considered as statistically significant.

## RESULTS

The present study was conducted in the department of ENT, S. N. Medical College and HSK Hospital, Bagalkot, Karnataka from January 2014 to June 2015. A total of 305 patients with CSOM were selected based on inclusion and exclusion criteria. In the present study, 53.44% of patients were males and 46.57% of patients were females. The male to female ratio was 1.15:1.

**Table 1: Mean bone conduction thresholds in unilateral cases (n=204).**

Bone conduction frequencies	Groups	Unilateral cases	Mean thresholds (dB)	Std. deviation	Std. error of mean
250 Hz	Diseased ear	204	12.2304	6.34018	0.4439
	Normal ear	204	7.1814	4.55091	0.31863
512 Hz	Diseased ear	204	15.4167	5.93046	0.41522
	Normal ear	204	8.7745	4.14849	0.29045
1000 Hz	Diseased ear	204	16.5686	6.41275	0.44898
	Normal ear	204	9.0441	4.29148	0.30046
2000 Hz	Diseased ear	204	17.1078	6.60035	0.46212
	Normal ear	204	9.2892	4.42337	0.3097
4000 Hz	Diseased ear	204	17.598	7.0267	0.49197
	Normal ear	204	9.8333	5.34538	0.37425

**Table 2: Independent samples test on bone conduction threshold means.**

Bone conduction frequencies	t	df	Sig. (2-tailed)	Mean difference	Std. error difference
250 Hz	9.24	406	0	5.04902	0.54642
512 Hz	13.108	406	0	6.64216	0.50672
1000 Hz	13.928	406	0	7.52451	0.54024
2000 Hz	14.055	406	0	7.81863	0.5563
4000 Hz	12.561	406	0	7.76471	0.61814

In the present study, maximum number of patients were aged 11 to 20 years (32.13%). Minimum number of patients were aged 41 to 50 years (15.08%). The mean age was 28±11 years.

In this study the maximum number of patients belonged to Modified B. G. Prasad class IV SE status (30.82%). Minimum number of patients belonged to class I (6.30%).

In the present study 35.08% of patients had disease of left ear, 31.80% of patients had right sided disease and 33.11% had bilateral ear involvement.

In the present study maximum number of patients had disease duration between 1 to 5 years (46.23%) and minimum patients had duration more than 20 years (4.26%).

**Table 3: Correlations between age and threshold differences of bone conduction frequencies between diseased and normal ears.**

Bone conduction threshold differences	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
<b>Age of patient/ Pearson correlation</b>	-0.205	-0.156	-0.174	-0.075	-0.0
<b>Sig. (2-tailed)</b>	0.316	0.447	0.394	0.714	0.637
<b>N</b>	26	26	26	26	26

**Table 4: Correlations between duration of disease and threshold differences of bone conduction frequencies between diseased and normal ears.**

Bone conduction threshold differences	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
<b>Duration of disease/ Pearson correlation</b>	0.07	-0.02	-0.048	-0.205	-0.023
<b>Sig. (2-tailed)</b>	0.733	0.921	0.815	0.316	0.258
<b>N</b>	26	26	26	26	26

In present study 23% of females and 18% of male patients had SNHL. This was not statistically significant. ( $p=0.299$ ).

In this study, most of the cases with SNHL were in the two extremities of age groups. Maximum number of patients were in age group 11 to 20 years (21%) or in 41 to 50-year group (46%). However maximum proportion of patients with hearing loss (46%) was noted in the 41 to 50 years group. The association between age and hearing loss was statistically significant ( $p<0.05$ ).

In the present study maximum number of patients with SNHL had a SE status of grade IV. SNHL was least found in patients with grade I economic status. However, this association was not found statistically significant ( $p>0.05$ ).

In the present study, majority of patients with SNHL had Moderately Severe hearing loss (42.86%). Overall 63 patients had SNHL (20.66%).

In the present study maximum number of patients with SNHL had disease duration of 1 to 5 years. However highest proportion of patients with SNHL had disease more than 20 years (46%). The association between duration of disease and SNHL was statistically significant ( $p<0.001$ ).

There was a total of 204 unilateral cases of CSOM. The mean values of bone for 250, 500, 1000, 2000, 4000 Hz in diseased and normal ears were calculated (Table 1).

On comparison of mean bone conduction thresholds of diseased ears with that of normal ears, a statistically significant association was noted ( $p<0.001$ ) (Table 1).

The mean threshold differences (TD) between the diseased and normal ears was calculated. This is the hearing loss directly attributable to the CSOM in the diseased ears (Table 2). These threshold differences were

than compared with disease duration and the age of the patient.

The correlation of patient's age and the mean threshold difference was not statistically significant ( $p>0.05$ ) (Table 3).

The correlation of disease duration and threshold differences was not statistically significant ( $p>0.05$ ) (Table 4).

## DISCUSSION

This present study was conducted in the ENT out-patient Department in S. Nijalingappa Medical College and Hanagal Shri Kumareshwar (HSK) Hospital, Bagalkot from 1<sup>st</sup> January 2014 to 30<sup>th</sup> June 2015. A total of 305 patients were selected for the study based on inclusion and exclusion criteria. Their age ranged from 11 to 50 years.

Overall 63 out of 305 patients had SNHL (20.66%). The proportion of SNHL in CSOM was found to be different by different authors: 16% by Mohsin et al, 13% by Azevedo et al, 24% by Kaur et al.<sup>4,9,17</sup>

In this study, a greater number of males (53.44%) had CSOM compared to females (46.57%). The male to female ratio was 1.15:1. A similar high male to female ratio was noted by Kolo et al, Kalsiwal in their study on SNHL in CSOM.<sup>3,6</sup> No association was found between SNHL and sex of the patient.

In this study most of the patients with SNHL had moderately severe hearing loss.

Minimal number of patients had mild and profound hearing loss respectively.

In the present study 35.08% of patients had disease of left ear, 31.80% of patients had right sided disease and 33.11% had bilateral ear involvement.



The age of the patients ranged from 11 to 50 years. In the present study, 32.13% patients were aged 11 to 20 years, 30.16% were aged 21 to 30 years, 22.62% were aged 31 to 40 years and 15.08% were aged 41 to 50 years. Hence a majority of patients comprised of younger patients aged 11 to 30 years. Least number of patients were aged 41 to 50 in present study. The mean age was  $28 \pm 11$  years. This observation was similar to study by Kolo et al.<sup>3</sup>

When the association of age of the patient was compared to distribution of CSOM, a statistically significant relation was obtained. Maximum proportion of patients with hearing loss (46%) was noted in the 41 to 50 years group. Similar results have been obtained by Kalsiwal, Dekhil, Azevedo et al.<sup>5,6,9</sup>

On the other hand, when age was compared to the bone conduction TD between diseased and normal ear, no statistically significant association was found. Similar result was found by Kolo et al.<sup>3</sup> Hence based on the present study we can say that there is a greater chance of developing SNHL with increased age of patients with CSOM. However, the increase in severity of the SNHL has no relation to patient's age. It is to be noted that the patients in this study were aged less than 50 years to eliminate age related hearing loss.

In the present study maximum number of patients with SNHL had a SE status of grade IV. SNHL was least found in patients with grade I economic status. However, this association was not found statistically significant. Hence based on the present study, no relation of CSOM was found to SE status of patients. This result is contrary to other studies, however since this is a Hospital based study, the proportion of patients of different socio-economic groups may vary from region to region.<sup>6</sup>

In the present study maximum number of patients had disease duration between 1 to 5 years. However highest proportion of patients with SNHL had disease more than 20 years (46%). There was a definite correlation between duration of disease and occurrence of SNHL in patients with CSOM. Similar results have been obtained in other studies also.<sup>4,6,16</sup>

The association between severity of SNHL was analyzed with duration of disease. It was not statistically significant. This result is similar to that of Kolo et al and Sharma.<sup>3,14</sup>

Hence based on the present study we can say that there is a greater chance of developing SNHL with increased duration of CSOM. However the increase in severity of the SNHL has no relation to duration of CSOM.

## CONCLUSION

The CSOM is a common disease affecting millions of people especially in developing countries. CSOM is the most common cause of hearing loss. Although conductive

hearing loss is commonly seen in patients with CSOM, a significant number of patients with CSOM develop SNHL. So, the present study was conducted to analyse SNHL in patients with CSOM. Based on the present study, overall proportion of patients with CSOM was 20.66%. No relation of SNHL was found between sex and SE status of patient. No relation was found between severity of SNHL and age of patient. No relation was found between severity of SNHL and duration of CSOM.

This present study shows that patients with CSOM with increased age have a greater chance of developing SNHL. Also, as the duration of CSOM increases there is a greater chance to develop SNHL. Hence attention must be paid for early appropriate medical and surgical management of patients with CSOM to prevent development of SNHL in them.

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## REFERENCES

1. Paparella MM, Oda M, Hiraide F, Brady D. Pathology of sensorineural hearing loss in otitis media. *Ann Otol Rhinol Laryngol.* 1972;81(5):632-47.
2. Haynes DS, Rutka J, Hawke M, Roland PS. Ototoxicity of ototopical drops- an update. *Otolaryngol Clin North Am.* 2007;40(3):669-83.
3. Kolo ES, Salisu AD, Yaro AM, Nwaorgu OG. Sensorineural hearing loss in patients with chronic suppurative otitis media. *Indian J Otolaryngol Head Neck Surg.* 2012;64(1):59-62.
4. Mohsin AM, Kumar MR, Reddy B, Ravikumar D. Sensorineural hearing loss in chronic suppurative otitis media of tubotympanic variety. *National J Otorhinolaryngol Head Neck Surg.* 2013;1(10):3-4.
5. Dekhil KR. Sensorineural hearing loss associated with chronic suppurative otitis media (CSOM). *Med J Babylon.* 2014;7:2.
6. Kasliwal N, Joshi S, Pareek SM. Determinants of sensorineural hearing loss in chronic middle-ear disease. *Indian J Otolaryngol Head Neck Surg.* 2004;56(4):269-73.
7. Kirtane MV, Merchant SN, Raje AR, Zantye SP, Shah KL. Sensorineural hearing loss in chronic otitis media- a statistical evaluation. *J Postgrad Med.* 1985;31(4):183-6.
8. Raquib A, Taous A, Haque R. Sensorineural component in chronic suppurative otitis media. *Bangladesh J Otorhinolaryngol.* 2009;15(2):69-74.
9. de Azevedo AF, Pinto DC, de Souza NJ, Greco DB, Gonçalves DU. Sensorineural hearing loss in chronic suppurative otitis media with and without cholesteatoma. *Braz J Otorhinolaryngol.* 2007;73(5):671-4.

10. Park J, Park S, Kim Y, Park M. Sensorineural hearing loss: a complication of acute otitis media in adults. *Eur Arch Otorhinolaryngol.* 2013;271(7):1879-84.
11. Costa S, Rosito L, Dornelles C. Sensorineural hearing loss in patients with chronic otitis media. *Eur Arch Otorhinolaryngol.* 2008;266(2):221-4.
12. Siampara L, Mann SBS, Panda NK, Mehra YN. Audiovestibular profile in unilateral chronic suppurative otitis media. *Indian J Otolaryngol Head Neck Surg.* 1997;49(2):107-11.
13. Handa KK, Mann SBS, Gupta AK, Handa A. Sensorineural loss in unsafe chronic suppurative otitis media in paediatric age group. *Indian J Otolaryngol Head Neck Surg.* 1996;48(2):4.
14. Sharma R, Sharma V. Analysis of sensorineural hearing loss in chronic suppurative otitis media with and without cholesteatoma. *Indian J Otol.* 2012;18(2):65-8.
15. El-Sayed Y. Bone conduction impairment in uncomplicated chronic suppurative otitis media. *Am J Otolaryngol.* 1998;19(3):149-53.
16. Ramazan G. The relationship of sensorineural hearing loss with age, disease duration and the presence of cholesteatoma in chronic suppurative otitis media. *Dicle Med J.* 2009;36(2):117-22.
17. Kaur K, Sonkhya N, Bapna AS. sensorineural hearing loss: Is there a correlation? *Indian J Otolaryngol Head Neck Surg.* 2003;55(1):21-4.
18. Consumer price index (Industrial worker). Available at: <http://labourbureau.nic.in/indtab.html>. Accessed on 14 January 2014.
19. Modified BG Prasad socioeconomic status. Available at: <http://prasadscaleupdate.weebly.com/> Accessed on 14 January 2014.

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