

## RESEARCH ARTICLE

### Analysis of hearing loss by pure tone audiometry in patients with chronic suppurative otitis media

MD. Ejaz Ahmed Shariff

Department of Physiology, Al-Azhar Medical College, Ezhallloor, Thodupuzha, Kerala, India

Correspondence to: MD. Ejaz Ahmed Shariff, E-mail: drejaz@gmail.com

Received: March 02, 2019; Accepted: March 23, 2019

#### ABSTRACT

**Background:** Chronic suppurative otitis media (CSOM) are an infection of the middle ear and mastoid cavity. Hearing loss is a consequence of CSOM; the degree of hearing loss can be analyzed by audiometry. **Aims and Objectives:** The objective of the study is to analyze hearing loss by pure tone audiometry in patients with CSOM. **Materials and Methods:** A total of 32 patients between the age group of 10–40 years, with discharging ears of >12 weeks duration were examined in outpatient clinics of ENT Department of Al Azhar Medical College and super specialty hospital. Patients were subjected for audiometric examination to assess the hearing loss. Patients were categorized based on the degree of hearing loss into five group's mild (26–40 dB), moderate (41–55 dB), moderately severe (56–70 dB), severe (71–90 dB), and profound (>90 dB), respectively. **Results:** Most of the ears (85.9%) had mild-to-moderate hearing loss. Conductive hearing loss was 87.5% and mixed hearing loss was 12.5%. Average air-bone gap (ABG) was found to be 30.7 dB and 30.65 and maximum ABG was 50 and 45 dB in the right ear and left ear, respectively. **Conclusion:** Patients had mild-to-moderate conductive type of hearing loss. If these patients are left untreated may progress in developing mixed hearing loss. Audiometry is an important screening and diagnostic tool for assessing the degree of hearing loss. It also gives an idea for proper planning for surgery in these patients and to prevent hearing disability.

**KEY WORDS:** Audiometry; Chronic Suppurative Otitis Media; Conductive Deafness; Hearing Loss

#### INTRODUCTION

Chronic suppurative otitis media (CSOM) are the most common cause of hearing impairment and disability. The worldwide prevalence of CSOM is 65–330 million people and 60% of this population has a hearing impairment.<sup>[1]</sup> This disease is more common in developing countries, in India the prevalence of CSOM is 16/1000 in urban population and 46/1000 population.<sup>[2,4-7]</sup> CSOM is a condition characterized

by persistent or recurrent ear discharge (otorrhea) of 6–12 weeks duration through a perforation of the tympanic membrane leading to thickening of the mucosa and polyp. Sound waves are the pressure variations created by the vibrating objects, which is transmitted by air. In CSOM, due to the perforation in the tympanic membrane and erosion of the ossicular chain, there is defective middle ear function leading to hearing loss. This defect if not treated may lead to complications such as sensorineural hearing loss, intracranial infection, mastoiditis, meningitis, and subdural abscess.

The human ear can appreciate sound waves between the frequencies ranging from 20 to 20,000 Hz. Most of the speech sound waves are in the range from 500 to 4000 Hz, and the normal conversation is in between 45 and 60 dB.<sup>[2,3]</sup> Degree of hearing loss is dependent on the injury caused to the tympanic membrane, ossicular chain, and inner ear. Pure

Access this article online	
Website: <a href="http://www.njppp.com">www.njppp.com</a>	Quick Response code
DOI: 0.5455/njppp.2019.9.0308223032019	

National Journal of Physiology, Pharmacy and Pharmacology Online 2019. © 2019 MD. Ejaz Ahmed Shariff. This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), allowing third parties to copy and redistribute the material in any medium or format and to remix, transform, and build upon the material for any purpose, even commercially, provided the original work is properly cited and states its license.

tone audiometry helps us to identify hearing thresholds of an individual based on volume and pitch of the sound waves. Studies have shown that audiometry is a reliable investigation in predicting the severity of hearing loss and integrity of the tympano-ossicular system in patients of CSOM.<sup>[2,8]</sup> Since hearing loss is the most common complication associated with CSOM, which affects day to day activity and the quality of life of an individual. Hence, an attempt is made to analyze the hearing loss by audiometry in patients of CSOM.

## MATERIALS AND METHODS

### Study Design

This study was undertaken in the Department of ENT of Al-Azhar Medical College and super specialty hospital. The Institutional Ethics Committee permission was taken before the commencement of the study. A total of 32 patients between the age group of 10 and 40 years of either gender, attending the outpatient clinics with complaints of ear discharge of >12 weeks and with perforation of tympanic membrane were included in the study. Patients with intracranial complications, traumatic perforation of tympanic membrane, mastoiditis, ototoxicity, and history of ear surgery were excluded from the study.

The patients included in the study underwent pure tone audiometry to record the hearing threshold for bone conduction and air conduction at 250, 500, 1K, 2K, 4K, and 8K Hz in each ear. Pure tone average (PTA) and air-bone gap (ABG) were calculated in each ear for every patient. Patients with active ear discharge were given topical and systemic antibiotics for 1 week, and pure tone audiometry was done after the active infection, ear discharge subsided. All patients underwent pure tone audiometry using the same audiometer; performed by the same audiologist in a soundproof room. Earphones were placed, and the audiologist used an audiometer to produce sounds of different frequencies and intensities. The patient taking the test was asked to indicate if he or she can hear the sounds being generated. The test was repeated using a small vibrator attached behind the ear which emits vibratory sounds conducted through the bones of the skull to the inner ear. This is called a pure tone bone conduction hearing test, which detects hearing loss from a structural or an obstructive cause. Results of the testing were recorded and printed on a graph called an audiogram. Masking was done in all cases for bone conduction and air conduction, only if ABG was >40 dB. PTA of >25 dB for bone conduction was considered as a sensorineural hearing loss. ABG of >10 dB was considered as a conductive hearing loss. The presence of both was considered as a mixed hearing loss.<sup>[2]</sup>

The parameters evaluated in the study were: Age, gender, PTA for air conduction threshold and bone conduction threshold, and ABG. With air and bone conduction threshold, the degree

and type of hearing the loss in each ear were determined. According to the WHO guidelines (1980), patients were categorized on the basis of degree of hearing loss into five groups: mild (26–40 dB), moderate (41–55 dB), moderately severe (56–70 dB), severe (71–90 dB), and profound (>90 dB), respectively. The data obtained were tabulated, analyzed by Excel and GraphPad prism Version 5.0. Mean values and the percentage were calculated, and average values were derived. The continuous variables were expressed as mean  $\pm$  standard deviation values.

## RESULTS

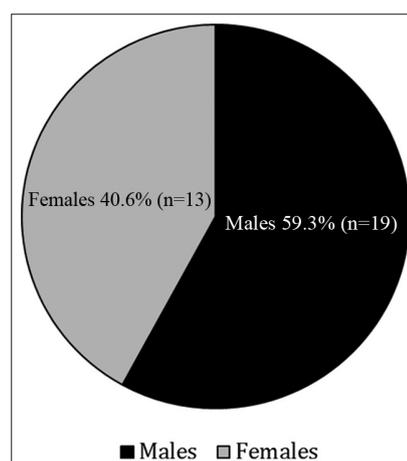
In this study, we analyzed pure tone audiograms from 32 patients suffering from CSOM of which 19 (59.3%) were males and 13 (40.6%) were female patients. The age for the male and female patients was ranging from 10 years to 40 and 10 to 30 years, respectively [Figure 1].

The average age group of male and female patients suffering from CSOM was  $18.92 \pm 17.9$  and  $18.02 \pm 13.9$ , respectively [Figure 2]. Among the 32 patients included in the study, 64 ears with CSOM and degree of hearing loss (in decibels) were assessed by audiometry. Most of the patients had mild (45.3%), moderate (40.6%), and moderately severe (14.1%) hearing loss [Figure 3]. Left ear (56.25%) was affected more than the right ear (43.75%), respectively.

We found most of our patients had conductive deafness accounting to 87.5% in relation to mixed hearing loss (conductive and sensorineural) of 12.5% [Table 1]. Average ABG in the right ear and left ear was found to be 30.7 dB and 30.65 dB, and the maximum ABG was found to be in the right ear was 50 dB and 45 dB, respectively [Table 2].

## DISCUSSION

CSOM is one of the most common conditions seen by an ENT specialist in routine practice. The incidence of CSOM



**Figure 1:** Gender distribution of chronic suppurative otitis media

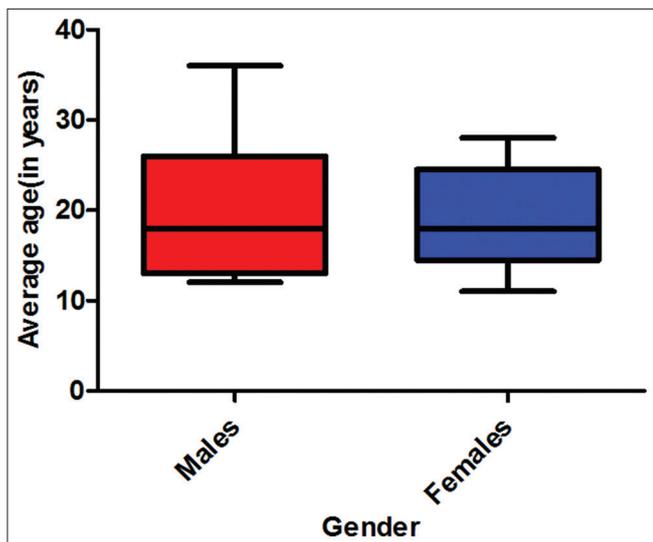


Figure 2: Average age group in which chronic suppurative otitis media is affected

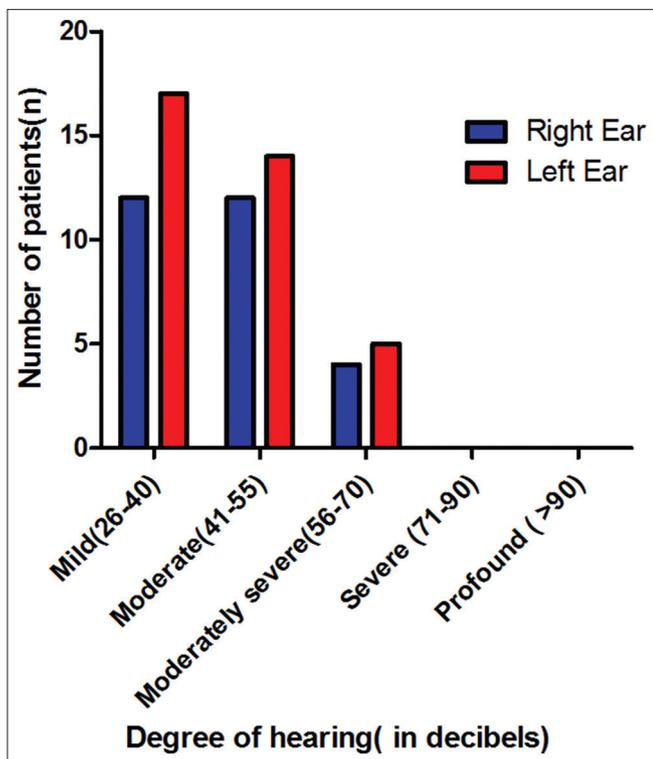


Figure 3: Degree of hearing loss in right and left ear (average pure tone)

is 0.5–5.7% with 22.6% of these patients occurring annually in under 5-year-old children. Otitis media-related hearing impairment has a prevalence of 30.82/10,000 globally. Hearing loss resulting from chronic otitis media is alarming because hearing loss results in impaired development of speech, language thereby affecting the learning and social interaction.<sup>[11]</sup> In this study assessing the hearing loss in patients with CSOM, there was slight female dominance for the occurrence of CSOM, with a male to female ratio at 1:1.17. This is similar to the observations made by Priyadarshini

Type of hearing loss	Number n (%)
Conductive deafness	56 (87.5)
Mixed deafness (conductive and sensorineural)	8 (12.5)

ABG	Right ear (dB)	Left ear (dB)
Average ABG	30.7	30.65
Maximum ABG	50	45

ABG: Air-bone gap

*et al.* and Nagle *et al.* in their studies.<sup>[12,13]</sup> The average age group of male and female patients suffering from CSOM was  $18.92 \pm 17.9$  and  $18.02 \pm 13.9$ , respectively. In this study, most of the CSOM patients (85.9%) with hearing loss were found in the age group of 10–40 years, which is comparable to the observations made in the studies conducted by Priyadarshini *et al.*, Nagle *et al.*, and Singh *et al.*<sup>[11-13]</sup>

It is observed from our study that 64 ears with CSOM, degree of hearing loss (in decibels) had mild (45.3%), moderate (40.6%), and moderately severe (14.1%) hearing loss. Our findings were in line with findings of Handi *et al.*, Patil *et al.*, and Deviana and Indrasworo.<sup>[2,8,10]</sup> Most of our patients were with tubotympanic type, which is characterized by copious purulent ear discharge. This compelled the patients to seek medical attention. Hearing loss depends on the size of the perforation; the bigger size of the perforation results in increase hearing loss.<sup>[14]</sup> We found mild-to-moderate hearing loss in 87.5% of the ears. Only 12.5% had moderately severe to severe hearing loss. This is similar to the observations by Priyadarshini *et al.*<sup>[11]</sup> We found an average hearing loss of 30.7 dB, which is in line with studies conducted by Paparella *et al.*<sup>[15]</sup> Average ABG in the right ear and left ear was found to be 30.7 dB and 30.65 dB, and the maximum ABG was found to be in the right ear 50 dB and 45 dB, respectively. Our findings were in agreement with other studies<sup>[2]</sup> where average ABG observed was 31 dB. Maximum ABG observed was 55 dB on the right side and 50 dB on the left side, respectively. CSOM was found more affected in left ear (56.25%) in comparison to the right ear (43.75%). This is similar to the observations made by Handi *et al.*, Patil *et al.*, and Gupta *et al.*<sup>[2,8,9]</sup> Left ear was more commonly involved than the right ear. The infection can spread from the middle ear to involve the mastoid, facial nerve paralysis, deafness, subdural abscess, and meningitis. It is the most common preventable complication of CSOM. Potential hearing loss as a result of CSOM has important consequences on the development of speech and cognitive abilities.<sup>[9]</sup>

The extent of hearing loss continues to worsen with longer duration of CSOM. This is due to multiple factors such as ossicular resorption and necrosis with long-standing infection in the middle ear cleft, mastoid air cell sclerosis

leading to decline in the mastoid air cell volume, and also due to the passage of bacterial toxins into the scala tympani through round window membrane resulting in a sensorineural component of mixed hearing loss.<sup>[12]</sup> These findings suggest that, if a patient with chronic otitis media undergoes surgery early, it not only improves the hearing but also prevents worsening of hearing loss which may have occurred over time. Conventionally, a conductive hearing loss is predictable in a patient with CSOM, but a sensorineural hearing loss does occur with long-standing infections due to the diffusion of bacterial toxins through the round window membrane into the inner ear.<sup>[11]</sup>

Experimental studies conducted by Paparella *et al.*, Spandow *et al.*, and Goycoolea *et al.*<sup>[15-17]</sup> have shown the association between sensorineural hearing loss and chronic otitis media highlighting the deleterious consequences of chronic ear discharge on the inner ear. The cochlear damage has been attributed to the passage of toxins through the round window membrane, causing damage to the hair cells, particularly in the cochlear base. Recurrent inflammation over long time coupled with chronic ear discharge increases the round window's permeability to bacterial toxins.<sup>[11,13]</sup> A higher prevalence of sensorineural hearing loss is observed in CSOM patients of low socioeconomic status.<sup>[11,17]</sup> This is possible because these patients have poor access to health care, lack of adequate follow-up during treatment, poor hygiene and lack of education. Improving health care access of these patients and educating them regarding the complications of CSOM may help in them seeking intervention early and may reduce the prevalence of hearing loss due to CSOM.

## CONCLUSION

The present study showed, mild to moderate type of conductive hearing loss. These patients may progress to mixed hearing loss (conductive and sensorineural) if left treated. Hearing loss depends on the size of the perforation of tympanic membrane; it increases as the size of the perforation increases. Audiometry is an important screening and diagnostic tool for assessing the degree of hearing loss. It also gives an idea for early diagnosis and proper planning for surgery to repair the defect in the tympanic membrane and to improve the quality of life.

## REFERENCES

1. Acuin J. Chronic suppurative otitis media. *BMJ Clin Evid* 2007;2007:507.
2. Handi PS, Mallikarjun PN, Presenkumar KR. Evaluation of hearing loss by pure tone audiometry in chronic suppurative otitis media. *Int J Otorhinolaryngol Head Neck Surg* 2018;

- 4:1173-6.
3. Dobie RA, Hemel V. *Hearing Loss. Basics of Sound, the Ear and Hearing.* Washington: National Academics Press (US); 2004.
4. Karaman M, Tek A. Does middle ear pathologies have relationship with hearing level in chronic suppurative otitis media. *Med J Umranıye* 2009;2:99-110.
5. Devashri UP, Kiran SB, Shreeya VK, Vandana S, Chaitanya B. Correlation of the puretone audiometry findings with intraoperative findings in patients with chronic suppurative otitis media. *MVP J Med Sci* 2015;2:4-14.
6. Dudda R, Rangaiah ST, Prasad MH, Balaji NK. Correlation between degree of hearing loss and intraoperative findings in tubotympanic type of chronic suppurative otitis media. *Int J Otorhinolaryngol Head Neck Surg* 2018;4:537-41.
7. Namita K, Saurabh V, Sampan SB, Sanjeev B, Sarita M, Vinish A. Pre and postoperative evaluation of hearing in chronic suppurative otitis media. *Ind J Otol* 2013;19:164-8.
8. Patil DU, Burse KS, Kulkarni S, Sancheti V, Bharadwaj C. Correlation of the puretone audiometry findings with intraoperative findings in patients with chronic suppurative otitis media. *MVP J Med Sci* 2015;2:4-14.
9. Gupta R, Mittal M. A study on clinical and epidemiological profile of chronic suppurative otitis media (CSOM) at a tertiary care center. *Int J Med Sci Public Health* 2016;5:1021-24.
10. Deviana, Indrasworo D. Pattern and degree of hearing loss in chronic suppurative otitis media. *J Med Dent Sci* 2016;15:73-80.
11. Sruthi SS, Viswanatha B, Satish HS, Ravikumar R, Vijayashree MS, Datta RK, *et al.* A comparative study of sensorineural hearing loss in mucosal and squamous type of chronic otitis media. *Res Otolaryngol* 2015;4:13-7.
12. Priyadarshini G, Sowmiya M, Febin J. Clinical and audiological study of chronic suppurative otitis media tubotympanic type. *Int J Otorhinolaryngol Head Neck Surg* 2017;3:671-5.
13. Nagle SK, Jagade MV, Gandhi SR, Pawar PV. Comparative study of outcome of Type 1 tympanoplasty in dry and wet ear. *Ind J Otolaryngol Head Neck Surg* 2009;61:138-40.
14. Maharjan M, Kaf P, Bista M, Shrestha S, Toran KC. Observation of hearing loss in patients with chronic suppurative otitis media tubotympanic type. *Kathmandu Univ Med J (KUMJ)* 2009; 7:397-401.
15. Paparella MM. Sensorineural hearing loss in otitis media. *Ann Otol Rhinol Laryngol* 1984;93:623-9.
16. Spandow O, Anniko M, Hellstrom S. Inner ear disturbances following inoculation of endotoxin into the middle ear. *Acta Otolaryngol (Stockh)* 1989;107:90-6.
17. Goycoolea MV, Paparella MM, Juhn SK, Carpenter AM. Oval and round window changes in otitis media. Potential pathways between middle and inner ear. *Laryngoscope* 1980;90:1387-91.

**How to cite this article:** Shariff MEA. Analysis of hearing loss by pure tone audiometry in patients with chronic suppurative otitis media. *Natl J Physiol Pharm Pharmacol* 2019;9(6):515-518.

**Source of Support:** Nil, **Conflict of Interest:** None declared.