

*Original Article*

**The Utility of Antibiogram in Prevention of Hearing Impairment Caused by Chronic Suppurative Otitis Media (CSOM): A Prospective Study from Rural Area of Maharashtra, India**

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**Abstract**

**Background:** Chronic suppurative otitis media (CSOM) is a common cause of hearing impairment, especially in rural population. **Objective:** To determine the bacteria associated with CSOM and their antibiotic sensitivity pattern for better management of the disease and to reduce morbidity due to CSOM. **Methods:** Patients with clinical diagnosis of CSOM were included in the study. Ear swabs were collected from the discharging ear. Culture and sensitivity studies were done as per conventional methods. Patients with hearing impairment were tested using the tuning fork examination to determine whether the impairment was conductive or sensorineural. **Results:** The present study consists of 789 clinically diagnosed patients of CSOM. Most of the patients (62.73%) were in pediatric age group. Otorrhea was a constant presentation among all patients, followed by hearing loss. Majority of the patients were having conductive hearing loss (87%) followed by sensorineural hearing loss (9%) and mixed hearing loss (4%). Analysis of isolated organisms showed preponderance of Gram-negative bacilli. The most commonly isolated organism was *Pseudomonas aeruginosa* (40 %) followed by *Staphylococcus aureus* (33%) and *Klebsiella* species (10%). Gentamicin and Ciprofloxacin commonly used topical agents showed good activity against most of the isolates. **Conclusion:** With the development and widespread use of antibiotics, the type of pathogenic microorganism and their resistance to antibiotics have changed. Continuous and periodic evaluation of microbiological patterns and antibiotic sensitivity of isolates is necessary to decrease the potential risk of complications by early institutions of appropriate treatment.

**Keywords:** Chronic suppurative otitis media, hearing impairment, antibiogram

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**Introduction**

Chronic suppurative otitis media (CSOM) is defined as chronic inflammation of middle ear and mastoid cavity that may present with recurrent ear discharges through a tympanic perforation.<sup>1</sup> It is a persistent disease with irreversible sequelae and can proceed to serious intra extracranial complications.<sup>2</sup> Common causative microorganisms are bacteria, fungi and virus resulting in inflammation of mucosal lining of middle ear. If not treated it leads to partial or total loss of tympanic membrane and ossicles resulting in acquired hearing loss.<sup>3</sup>

As per National Sample Survey Office (NSSO) data, the estimated prevalence of adult onset deafness in India was found to be 7.6 % and childhood onset deafness to be 2%. Currently there are 291 persons per one lakh population who are suffering from mild to severe hearing loss. Of these a large percentage of children are between the age group of 0 to 14 years. With such a large number of hearing impaired young Indians, it amounts to a severe loss of productivity, both physically and economically. It has been noted by WHO that half of the causes of deafness are preventable and about 30% though not preventable, are treatable or they

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can be managed with assistive devices. CSOM is an important cause of hearing loss that can be treated before it causes deafness.<sup>4</sup> Inadequate and inappropriate treatment of CSOM can result in a wide range of complications. These may be due to the spread of organisms to structures adjacent to ear or local damage in the middle ear itself.<sup>5</sup>

Various organisms are responsible for CSOM; therefore, the microbial culture and sensitivity will help in appropriate management and thus preventing the emergence of resistant bacterial strain. With this the present study was carried out to know the organisms that cause CSOM and their antibiotic sensitivity pattern among the patients who attended ENT OPD in a rural hospital in Maharashtra, India.

### Methods

This is a prospective study conducted in the rural medical college and hospital of Maharashtra. The study was conducted for a period of 6 months. Ethical committee clearance was obtained before the study. A written consent was obtained from all patients. A total of 789 patients with CSOM were selected based on inclusion and exclusion criteria. Patients coming with chronic ear discharge, perforation of tympanic membrane of all age groups and both genders were included in the study. Patients on antibiotic treatment for 5 or more days, children who are not cooperative and cases of otitis externa and acute otitis media were excluded from the study. On otoscopy conditions of tympanic membrane perforation, condition of middle ear mucosa and ossicles were also noted. Pure tone audiometry, impedance audiometry and tuning fork test were performed in every case for confirmation of deafness. According to the WHO guidelines(1980), patients were categorized on the basis of degree of hearing loss into five groups - mild (26 to 40 dB), moderate(41 to 55 dB), moderately severe (56 to 70 dB), severe (71 to 90 dB) and profound (>90 dB) respectively. Patients with hearing impairment were tested using the tuning fork examination to determine whether the impairment was conductive or sensorineural. A tuning fork with a frequency of 512 Hz was considered to be an ideal test of air conduction (AC) and bone conduction (BC) in conjunction with the Rinne test and Weber test. Using the microscope excess discharge is sucked out of the external acoustic canal.<sup>6,7</sup> Then specimen is collected through the perforation with small, sterile cotton

swab and sent for microbiological analysis. Two swabs were collected. In the laboratory, the first swab was used for Gram staining and second swab was inoculated on Nutrient Agar, Mac Conkey Agar, Blood Agar for bacterial isolation.<sup>8,9</sup> The plates were incubated overnight at 37 degree centigrade. The bacteria were identified with standard biochemical tests. Antibiotic sensitivity testing was done by Kirby Bauer disc diffusion methods.<sup>10</sup>

### Results

The present study consists of 789 clinically diagnosed patients of CSOM (430 males and 359 females). The majority of patients (62.73%) were in pediatric age group (Table 1). Otorrhea was a constant presentation among all patients, followed by diminished hearing. Unilateral ear discharge was found in 78% patients and bilateral in 22% patients (Table 2). The most common site of perforation was anteroinferior quadrant 32% followed by posteroinferior quadrant 26%. (Table 3). Majority of the patients were having conductive hearing loss 87% followed by sensorineural hearing loss 9% and mixed hearing loss in 4% (Table 4). Majority of the patients were having mild to moderate hearing loss (82%) and moderately severe to severe hearing loss (9%) (Table 5). In a total of 789 ear swab culture, 640 (81.11%) organisms were isolated. Among them 538 were monomicrobial and 102 were polymicrobial whereas in 149 (18.88%) cultures no organism was grown even after 48 hours of incubation. Analysis of isolated organisms showed preponderance of Gram-negative bacilli. The most isolated organism was *Pseudomonas aeruginosa* 40% followed by *Staphylococcus aureus* 33%, and *Klebsiella species* 10% (Table 6). In vitro Gentamicin showed sensitivity to *Klebsiella* and *Proteus* 100% , *E.coli* 80%, and *Pseudomonas aeruginosa* 80% (Table 7).

**Table 1:** Age and sex distribution (n= 789)

| Age/ Sex | Pediatric age group | Adult age group | Total no. of cases |
|----------|---------------------|-----------------|--------------------|
| Male     | 280                 | 150             | 430                |
| emale    | 215                 | 144             | 359                |
| Total    | 495                 | 294             | 789                |

**Table 2:**Symptoms of patients (n= 789)

| Symptoms                    | No. of patients (%) |
|-----------------------------|---------------------|
| Otorrhea                    | 100%                |
| Diminished hearing          | 98%                 |
| Upper respiratory infection | 22%                 |
| Pain in the ear             | 15%                 |
| Itching                     | 10%                 |

**Table 3:** Site of perforation

| Site of Perforation      | No. of patients (%) |
|--------------------------|---------------------|
| Anteroinferior           | 32%                 |
| Posteroinferior          | 26%                 |
| Inferior                 | 13%                 |
| Anterior                 | 10%                 |
| Posterosuperior marginal | 6%                  |
| Posterior                | 5%                  |
| Attic                    | 5%                  |
| Total perforation        | 3%                  |
| Total                    | 100%                |

**Table 4:**Type of hearing loss

| Type of hearing loss | No. of patients (%) |
|----------------------|---------------------|
| Conductive           | 687(87%)            |
| Sensorineural        | 71 (9%)             |
| Mixed                | 31 (4%)             |

**Table 5:** Pure tone audiometry in CSOM

| Type                                | Percentage |
|-------------------------------------|------------|
| Mild hearing loss<br>26 - 40 dB     | 53%        |
| Moderate hearing loss<br>41 – 55 dB | 29%        |
| Moderately severe<br>56-70 dB       | 7%         |
| Severe<br>71-90 dB                  | 2%         |
| Couldn't assess                     | 9%         |

## Discussion

CSOM is a condition of the middle ear that is characterized by persistent or recurrent discharge through a chronic perforation of tympanic membrane. Due to perforation of tympanic membrane, microorganism gain entry to the middle ear via the external ear.<sup>11</sup> The sex

**Table 6:**Percentile of bacterial isolates (No. of isolates = 640)

| Bacterial isolates               | Percentage (%) |
|----------------------------------|----------------|
| <b>Gramm negative bacteria</b>   | <b>61%</b>     |
| Pseudomonas aeruginosa           | 40%            |
| Klebsiella species               | 10%            |
| Escherichia coli                 | 7%             |
| Proteus species                  | 4%             |
| <b>Gram positive bacteria</b>    | <b>39%</b>     |
| Staphylococcus aureus            | 33%            |
| Coagulase negative staphylococci | 6%             |

wise distribution in the present study showed 54.49 % of total cases of CSOM were males and 45.50 % were females. Similar results of male preponderance were reported by previous studies,<sup>12-14</sup> whereas a study by Mansoor et al reported higher female preponderance.<sup>15</sup>

In the present study, highest prevalence 62.73% was reported in the pediatric age group. This finding was in congruence with previous authors.<sup>2,16</sup> The incidence of CSOM in pediatric age group is because of increased risk of respiratory infections, short and straight eustachian tube in infant and young children allows ready access of bacteria to middle ear. Hot and humid climate is one of the risk factor along with ear picking with different objects, putting oil drops in ear and swimming. Otorrhoea was a commonest clinical presentation in our study followed by diminution of hearing. Similar finding have been observed in the study done by Mugliston et al.<sup>17</sup>

It is observed from our study that 640 patients with CSOM were tested by pure tone audiometry, degree of hearing loss in decibels had mild 53%, moderate 29%, moderately severe 7% and severe hearing loss is 2%. Our findings were similar to Handi et al.<sup>18</sup> and Deviana et al.<sup>19</sup>. Hearing loss depends on the size of the perforation which results in increase hearing loss. We found mild to moderate hearing loss in 82% of the patients. Only 9% had moderately severe to severe hearing loss. This is similar to the observations by Priyadarshani et al.<sup>20</sup> In our study, 87% of patients had conductive type hearing loss and 9% sensorineural and 4 % mixed hearing loss which is similar to other study done by Alabbasi et al.<sup>21</sup>

Knowledge of the local microorganism pattern

**Table 7:** Antibiogram of bacterial isolates in CSOM (inpercentages)

| Isolates               | E  | AMP | AMC | GEN | AMK | CIP | CTX | CFX | PIP |
|------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|
| Pseudomonas aeruginosa | -  | -   | -   | 80  | 100 | 90  | 81  | 90  | 89  |
| Staph.aureus           | 75 | 74  | 80  | 65  | 98  | 85  | 78  | 72  | 50  |
| Klebsiella             | -  | 83  | 60  | 100 | 50  | 70  | 76  | 70  | 40  |
| E.coli                 | -  | 82  | 65  | 80  | 65  | 65  | 80  | 75  | 50  |
| CoNS                   | 60 | 82  | 60  | 60  | 80  | 50  | 80  | 74  | 50  |
| Proteus                | -  | 60  | 50  | 100 | 60  | 80  | 70  | 60  | 65  |

[E-Erythromycin, AMP-Ampicillin, AMC- Amoxicillin Clavulanic acid, GEN- Gentamicin  
AMK- Amikacin, CIP- Ciprofloxacin, CTX- Ceftriaxone, CFX- Cefuroxime,  
PIP- Piperacillin]

and their antibiotic sensitivity is essential to allow effective and cost saving treatment.<sup>5</sup> In the present study, *Pseudomonas aeruginosa* (40%) was the predominant organism followed by *Staphylococcus aureus* (33%). It is observed that both Gram negative and Gram positive organisms were responsible for CSOM. Gram negative bacilli were more as compared to gram positive cocci. These findings were consistent to the finding of other studies.<sup>22,23</sup> In contrast, some of the studies reported *Staphylococcus aureus* as predominant organisms followed by *Pseudomonas aeruginosa*.<sup>11,24</sup>

In the present study, Coliforms including *Klebsiella* and *E. coli* were isolated from 10% and 7% cases respectively, these findings were similar to the studies by Mansoor et al.<sup>15</sup> who reported the same to be 8% and 4% respectively. More frequent isolation of fecal bacteria like *E. coli*, *Klebsiella* and water bacteria like *Pseudomonas* indicates that individual are at high risk of infection due to poor hygiene conditions.

Among the various antibiotics tested Amikacin, Ciprofloxacin, Cefuroxime, Piperacillin were found to be most effective. Gentamicin and Ciprofloxacin commonly used topical agents showed good activity against most of the isolates. In the present study both *Pseudomonas aeruginosa* and *Staphylococcus aureus* showed good sensitivity to Amikacin and Gentamicin and the finding is supported by previous study.<sup>25</sup> Although very few cases are documented, but risk of ototoxicity due to aminoglycoside overuse should also be kept in mind.<sup>26</sup> The present study showed that 80% of all isolates sensitive to ciprofloxacin indicating that it is very effective drug. Thus knowing the etiological agents of CSOM and their antimicrobial susceptibility is of essential

importance for an efficient treatment, prevention of both complications and development of antibiotic resistance and finally, the reduction of the treatment cost, changes in the microbial flora, introduction of more sophisticated antibiotics and the changing AST pattern increases the relevance of culture and sensitivity which serves as an important tool for the clinician to plan the treatment of a chronically discharging ear.

### Conclusion

From this study it can be concluded that the site and size of tympanic membrane perforation affect hearing loss. To limit hearing loss due to CSOM, proper diagnosis and treatment must be started as early as possible. So awareness should be developed among the general population about CSOM and its sequelae. With the development and widespread use of antibiotics, the type of pathogenic microorganism and their resistance to antibiotics have changed. Continuous and periodic evaluation of microbiological patterns and antibiotic sensitivity of isolates is necessary to decrease the potential risk of complications by early institutions of appropriate treatment.

**Conflict of interest:** None declared.

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**Ethical Approval:** The study was approved by the REB of Indian Institute of Medical Science & Research Jalna (IIMSR Jalna), Maharashtra, India.

**Author's Contribution:** The author is solely responsible for design of the study, patient selection, data collection, analysis, manuscript preparation, revision and finalization.

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