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Study of Bacteriological Profile and Antimicrobial Resistance Pattern in Chronic Suppurative Otitis Media

Dr. P. Himabindu
Department of ENT, Mamata Medical College, Khammam, India

ABSTRACT
Chronic Suppurative Otitis Media (CSOM) is a common chronic infection of the middle ear associated with persistent ear discharge, hearing impairment, and significant morbidity. The changing bacteriological profile and increasing antimicrobial resistance among causative organisms make periodic evaluation of bacterial isolates and their antibiotic sensitivity patterns essential for effective management. Aim was to study the bacteriological profile and antibiotic sensitivity pattern among patients with Chronic Suppurative Otitis Media attending a tertiary care hospital. A prospective observational study was conducted in the Department of ENT, Mamata Medical College, Khammam, among 100 patients clinically diagnosed with CSOM. Sterile aural swabs were collected and subjected to culture and antibiotic sensitivity testing using standard microbiological methods and Kirby–Bauer disc diffusion technique. Data were analyzed using descriptive and inferential statistics. The majority of patients belonged to the age group of 11–20 years, with male predominance (58%). Hearing loss was the most common associated symptom (72%). *Pseudomonas aeruginosa* (38%) was the predominant bacterial isolate followed by *Staphylococcus aureus* (26%). *Pseudomonas aeruginosa* showed maximum sensitivity to Imipenem (94.7%) and Piperacillin-Tazobactam (92.1%), while *Staphylococcus aureus* showed highest sensitivity to Vancomycin (100%) and Linezolid (96.2%). Increased resistance was observed against Amoxicillin and Cotrimoxazole. *Pseudomonas aeruginosa* and *Staphylococcus aureus* were the predominant pathogens in CSOM. Regular bacteriological surveillance and antibiotic sensitivity testing are essential for rational antimicrobial therapy and prevention of complications.

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Key Words
Chronic suppurative otitis media, bacteriological profile, antibiotic sensitivity, *pseudomonas aeruginosa*, *staphylococcus aureus*, antimicrobial resistance

Corresponding Author
Dr. P. Himabindu,
Department of ENT, Mamata Medical College, Khammam, India

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INTRODUCTION

Chronic Suppurative Otitis Media (CSOM) is a persistent inflammatory disease of the middle ear cleft characterized by recurrent or persistent ear discharge through a perforated tympanic membrane for a duration exceeding six weeks. It remains one of the most common otological disorders encountered in developing countries and continues to be a major public health concern because of its association with preventable hearing impairment and serious extracranial and intracranial complications[1]. The disease affects individuals of all age groups but is particularly prevalent among children and people belonging to lower socioeconomic groups where overcrowding, poor hygiene, malnutrition, and inadequate healthcare access contribute significantly to its occurrence[2].

CSOM is a multifactorial disease involving complex interactions between microbial pathogens, host immunity, environmental factors, and Eustachian tube dysfunction. Persistent infection within the middle ear cavity results in chronic inflammation and destruction of the middle ear mucosa, leading to continuous otorrhea, hearing loss, and occasionally life-threatening complications such as mastoiditis, facial nerve palsy, meningitis, and brain abscess[3]. Hearing impairment resulting from CSOM adversely affects speech development, educational performance, communication skills, and overall quality of life, especially in children and young adults[4].

The bacteriological spectrum of CSOM varies considerably according to geographical location, socioeconomic conditions, climate, and antibiotic prescribing practices. Traditionally, aerobic organisms such as *Pseudomonas aeruginosa*, *Staphylococcus aureus, Proteus mirabilis, Klebsiella pneumoniae*, and *Escherichia coli* have been identified as the predominant causative pathogens[5]. Among these, *Pseudomonas aeruginosa* is considered the most frequently isolated organism due to its ability to survive in moist environments, produce biofilms, and develop resistance to multiple antimicrobial agents. *Staphylococcus aureus* also plays a significant role because of its virulence factors and increasing prevalence of methicillin-resistant strains[6].

Appropriate antimicrobial therapy remains the cornerstone of CSOM management. However, the indiscriminate use of topical and systemic antibiotics has resulted in the emergence of resistant bacterial strains worldwide. The changing bacteriological profile and evolving antimicrobial susceptibility patterns pose a major challenge to clinicians in selecting effective empirical therapy[7]. Increasing resistance to commonly prescribed antibiotics such as ampicillin, amoxicillin, cotrimoxazole, and certain fluoroquinolones has been reported from various regions. Consequently, periodic monitoring of local bacterial isolates and their antibiotic sensitivity patterns has become essential for evidence-based treatment and prevention of complications[8].

Several studies have investigated the microbiological profile of CSOM and demonstrated considerable regional variation in bacterial isolates and drug susceptibility patterns. Prakash *et al*. reported *Pseudomonas aeruginosa* as the predominant isolate with high sensitivity to aminoglycosides and fluoroquinolones[9]. Similarly, Singh *et al*. observed that *Pseudomonas aeruginosa* and *Staphylococcus aureus* were the major pathogens responsible for chronic ear discharge, although resistance patterns varied among isolates[10]. Other investigators have highlighted an increasing trend of multidrug resistance among CSOM pathogens, emphasizing the need for regular bacteriological surveillance and culture-guided antibiotic therapy[5,8].

Despite numerous studies, there remains a significant research gap regarding the current bacteriological profile and antibiotic sensitivity pattern of CSOM in different geographical regions. The microbial flora associated with CSOM continues to evolve due to changing antibiotic usage practices, self-medication, and emerging resistant strains. Data obtained from previous studies may not accurately reflect the present local bacteriological scenario. Furthermore, differences in demographic characteristics, environmental factors, and healthcare accessibility necessitate periodic regional evaluation of causative organisms and their antimicrobial susceptibility patterns.

Therefore, the present study was undertaken to evaluate the bacteriological profile and antibiotic sensitivity pattern among patients with Chronic Suppurative Otitis Media. Identification of prevalent bacterial pathogens and their susceptibility patterns will help clinicians formulate appropriate empirical treatment protocols, reduce antimicrobial resistance, improve therapeutic outcomes, and minimize disease-related complications in affected patients. This study is expected to contribute valuable local epidemiological data that can aid in rational antibiotic selection and effective management of CSOM.

MATERIALS AND METHODS

Study Design and Setting: The present study was a hospital-based prospective observational study conducted in the Department of ENT in collaboration with Department of Microbiology, Mamata Medical College. The study was carried out among patients clinically diagnosed with

Chronic Suppurative Otitis Media (CSOM) attending the outpatient and inpatient services of the ENT department during the study period. The study aimed to evaluate the bacteriological profile and antibiotic sensitivity pattern in patients with CSOM.

A total of 100 patients diagnosed with Chronic Suppurative Otitis Media were included in the study. Patients presenting with ear discharge through a perforated tympanic membrane persisting for more than six weeks and clinically diagnosed as CSOM were considered for inclusion in the study.

Inclusion Criteria:
- Patients diagnosed clinically with Chronic Suppurative Otitis Media.
- Patients of all age groups and both genders.
- Patients with active ear discharge for more than six weeks.
- Patients willing to participate in the study and provide informed consent.

Exclusion Criteria:
- Patients who received systemic or topical antibiotics within the previous one week.
- Patients with otitis externa or acute otitis media.
- Patients with traumatic perforation of tympanic membrane.
- Patients with fungal ear infections.
- Patients unwilling to participate in the study.

Study Tools: The following tools and materials were used for the study:
- Pre-designed and semi-structured proforma.
- Otoscope and headlight examination.
- Sterile aural swabs for sample collection.
- Culture media for bacterial isolation.
- Antibiotic sensitivity discs for antimicrobial susceptibility testing.
- Laboratory facilities for microbiological analysis.

Data Collection Procedure:
- Detailed history regarding duration of ear discharge, hearing loss, ear pain, fever, and previous treatment history was obtained from all patients.
- Thorough ENT examination was conducted using otoscopic examination.
- Sterile aural swabs were collected from discharging ears under aseptic precautions.
- The collected samples were immediately transported to the microbiology laboratory for culture and sensitivity testing.
- Bacterial isolates were identified by standard microbiological techniques.
- Antibiotic susceptibility testing was performed using Kirby–Bauer disc diffusion method according to standard guidelines.
- The obtained clinical and laboratory data were entered into the study proforma for analysis.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software. Descriptive statistics such as mean, standard deviation, frequency, and percentage were used for data presentation. Categorical variables were expressed in proportions and percentages. Results were presented in the form of tables and graphs wherever necessary. A p-value of less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

Table 1 depicts the demographic characteristics of patients with Chronic Suppurative Otitis Media included in the study. The majority of patients belonged to the age group of 11-20 years (32%), followed by 21-30 years (26%), indicating higher disease prevalence among adolescents and young adults. Male predominance was observed with 58% cases, while females constituted 42% of the study population. Most patients were from rural areas (68%), reflecting the influence of poor socioeconomic conditions, overcrowding, inadequate hygiene, and limited healthcare access on disease occurrence. The association between demographic variables and CSOM occurrence was found to be statistically significant ($p < 0.05$).

Table 2 shows the clinical presentation of patients with CSOM. Ear discharge was present in all patients as it is the hallmark symptom of the disease. Hearing loss was the most common associated symptom observed in 72% of patients, followed by ear pain in 28% and tinnitus in 22%. Fever and vertigo were less frequently observed. Unilateral disease was more common than bilateral involvement. The findings are consistent with previous studies showing that persistent otorrhea and conductive hearing loss are the predominant manifestations of CSOM. Statistical analysis demonstrated significant association among presenting clinical features ($p < 0.05$).

Table 3 illustrates the bacteriological profile of CSOM patients. Pseudomonas aeruginosa was the predominant organism isolated in 38% of cases, followed by *Staphylococcus aureus* in 26%. Other isolates included Proteus, Klebsiella, and *Escherichia coli*. Mixed bacterial growth and sterile cultures were observed in a small proportion of patients. The predominance of *Pseudomonas aeruginosa* may be attributed to its affinity for moist environments and biofilm formation. The bacteriological distribution was statistically highly significant (p<0.001), emphasizing the importance of culture-based diagnosis in CSOM management.

Table 4 demonstrates the antibiotic sensitivity pattern of *Pseudomonas aeruginosa*, the most commonly isolated organism in the study. Maximum sensitivity was observed with Imipenem (94.7%) and Piperacillin-Tazobactam (92.1%), followed by Amikacin (89.5%). Moderate sensitivity was noted with Ciprofloxacin and Gentamicin, whereas relatively higher resistance was seen with Ceftazidime. These findings indicate increasing antimicrobial resistance among Gram-negative organisms due to indiscriminate antibiotic use. The difference in antibiotic sensitivity patterns was statistically significant (p<0.05), highlighting the importance of susceptibility-guided therapy.

Table 5 shows the antimicrobial susceptibility pattern of Staphylococcus aureus isolates. Vancomycin demonstrated 100% sensitivity, followed by Linezolid with 96.2% sensitivity. Gentamicin and Ciprofloxacin also showed good efficacy against the isolates. However, higher resistance rates were observed with Erythromycin and Amoxicillin-Clavulanic acid. The results indicate the growing resistance among Gram-positive organisms to commonly prescribed antibiotics. Statistical analysis revealed significant differences in antibiotic susceptibility patterns (p<0.01), supporting the need for culture-directed treatment.

Table 6 summarizes the overall antibiotic sensitivity pattern among bacterial isolates obtained from CSOM patients. Amikacin showed the highest overall sensitivity (88%), followed by Gentamicin (82%) and Ciprofloxacin (78%). Ceftriaxone demonstrated moderate effectiveness, whereas Cotrimoxazole and Amoxicillin exhibited comparatively higher resistance rates. The increasing resistance to routinely used antibiotics indicates irrational antibiotic usage and self-medication practices among patients. The observed differences in antibiotic sensitivity were statistically highly significant (p <0.001), emphasizing the necessity for periodic bacteriological surveillance and rational antibiotic prescribing practices in CSOM management.

Table 1: Demographic Distribution of Study Population (n = 100)

Variable	Number of Patients (n)	Percentage (%)
Age Group (Years)		
≤10 years	18	18.0
11-20 years	32	32.0
21-30 years	26	26.0
31–40 years	14	14.0
>40 years	10	10.0
Gender		
Male	58	58.0
Female	42	42.0
Residence		
Rural	68	68.0
Urban	32	32.0

Chi-square value = 8.42, p-value = 0.038

Table 2: Clinical Profile of Patients with Chronic Suppurative Otitis Media (n = 100)

Clinical Parameter	Number of Patients (n)	Percentage (%)
Ear Discharge	100	100.0
Hearing Loss	72	72.0
Ear Pain	28	28.0
Fever	14	14.0
Tinnitus	22	22.0
Vertigo	10	10.0
Laterality		
Unilateral	74	74.0
Bilateral	26	26.0

Chi-square value = 10.16, p-value = 0.017

Table 3: Bacteriological Isolates among CSOM Patients (n = 100)

Organism Isolated	Number of Isolates (n)	Percentage (%)
Pseudomonas aeruginosa	38	38.0
Staphylococcus aureus	26	26.0
Proteus species	12	12.0
Klebsiella species	8 8.0	
Escherichia coli	6 6.0	
Mixed Growth	5 5.0	
No Growth	5 5.0	

Chi-square value = 24.38, p-value < 0.001

Table 4: Antibiotic Sensitivity Pattern of Pseudomonas aeruginosa (n = 38)

Antibiotic	Sensitive n (%)	Resistant n (%)
Ciprofloxacin	32 (84.2%)	6 (15.8%)
Gentamicin	30 (78.9%)	8 (21.1%)
Amikacin	34 (89.5%)	4 (10.5%)
Ceftazidime	28 (73.7%)	10 (26.3%)
Piperacillin-Tazobactam	35 (92.1%)	3 (7.9%)
Imipenem	36 (94.7%)	2 (5.3%)

Chi-square value = 16.54, p-value = 0.005

Table 5: Antibiotic Sensitivity Pattern of Staphylococcus aureus (n = 26)

Antibiotic	Sensitive n (%)	Resistant n (%)
Amoxicillin-Clavulanic Acid	18 (69.2%)	8 (30.8%)
Ciprofloxacin	20 (76.9%)	6 (23.1%)
Gentamicin	22 (84.6%)	4 (15.4%)
Linezolid	25 (96.2%)	1 (3.8%)
Vancomycin	26 (100%)	0
Erythromycin	16 (61.5%)	10 (38.5%)

Chi-square value = 18.92, p-value = 0.002

Table 6: Overall Antibiotic Sensitivity Pattern among Bacterial Isolates (n = 100)

Antibiotic	Sensitivity (%)	Resistance (%)
Ciprofloxacin	78.0	22.0
Gentamicin	82.0	18.0
Amikacin	88.0	12.0
Ceftriaxone	66.0	34.0
Cotrimoxazole	54.0	46.0
Amoxicillin	48.0	52.0

Chi-square value = 21.67, p-value < 0.001

Chronic Suppurative Otitis Media (CSOM) remains one of the most common chronic infections encountered in otorhinolaryngology practice and continues to be a major cause of preventable hearing loss, particularly in developing countries. The present study was conducted to evaluate the bacteriological profile and antibiotic sensitivity pattern among patients with CSOM attending the Department of ENT, Mamata Medical College, Khammam. Identification of the predominant bacterial pathogens and their antimicrobial susceptibility patterns is essential for appropriate treatment and prevention of complications.

In the present study, the majority of patients belonged to the age group of 11-20 years (32%), followed by 21-30 years (26%). Similar findings were reported by Poorey and Iyer[11], who observed a higher prevalence of CSOM among younger age groups due to recurrent upper respiratory infections, poor hygiene, and Eustachian tube dysfunction. The increased incidence among adolescents and young adults may also be attributed to greater exposure to environmental risk factors and delayed healthcare-seeking behavior.

Male predominance was observed in the present study, with males constituting 58% of the study population. Comparable observations were reported by Nia *et al*.[12], who found a slightly higher incidence among males. The predominance of male patients may be related to greater outdoor exposure, occupational factors, and healthcare utilization patterns. However, several studies have shown only minimal gender differences, suggesting that gender may not be a major determinant in CSOM occurrence.

The present study demonstrated that 68% of patients belonged to rural areas. Similar observations were reported by Kumar and Seth[13], who found a higher prevalence of CSOM among rural populations. Poor socioeconomic status, overcrowding, malnutrition, inadequate sanitation, and limited access to healthcare services are recognized risk factors contributing to the increased burden of CSOM in rural communities. These findings highlight the importance of public health interventions aimed at improving hygiene and early treatment of ear infections.

Ear discharge was present in all patients included in the study, while hearing loss was observed in 72% of cases. Ear pain was present in 28%, tinnitus in 22%, and vertigo in 10% of patients. Similar findings were reported by Shyamala and Reddy[14], who observed persistent otorrhea and hearing impairment as the predominant clinical manifestations of CSOM. Hearing loss remains the most significant morbidity associated with CSOM and may adversely affect educational performance, speech development, and quality of life.

The bacteriological analysis in the present study revealed that *Pseudomonas aeruginosa* was the most common isolate (38%), followed by *Staphylococcus aureus* (26%), *Proteus species* (12%), *Klebsiella species* (8%), and *Escherichia coli* (6%). These findings are in accordance with the study conducted by Sharma *et al*.[15], who reported Pseudomonas aeruginosa as the predominant organism isolated from CSOM patients. The predominance of Pseudomonas may be attributed to its ability to survive in moist environments, produce biofilms, and resist host defense mechanisms. Similar bacteriological patterns have also been reported by Vishwanath *et al*.[16], emphasizing the continued importance of *Pseudomonas aeruginosa* as the principal pathogen in CSOM.

In the present study, *Staphylococcus aureus* was the second most common isolate. Similar observations were reported by Prakash *et al*.[5], who documented significant isolation rates of *Staphylococcus aureus* among CSOM patients. The organism possesses multiple virulence factors and has increasingly demonstrated resistance to commonly used antibiotics. The emergence of resistant strains, particularly methicillin-resistant *Staphylococcus aureus* (MRSA), has become a growing concern in otological infections.

Antibiotic sensitivity testing revealed that *Pseudomonas aeruginosa* showed maximum sensitivity to Imipenem (94.7%), Piperacillin-Tazobactam (92.1%), and Amikacin (89.5%). Similar findings were reported by Rout *et al*.[17], who observed high susceptibility of Pseudomonas isolates to carbapenems and aminoglycosides. Ciprofloxacin and Gentamicin also demonstrated good efficacy in the present study, whereas resistance was relatively higher against Ceftazidime. The increasing resistance among Gram-negative organisms may be attributed to indiscriminate antibiotic usage and incomplete treatment courses.

The antibiotic susceptibility pattern of *Staphylococcus aureus* in the present study showed highest sensitivity to Vancomycin (100%) and Linezolid (96.2%), followed by Gentamicin and Ciprofloxacin. Similar findings were reported by Kumar *et al*.[18], who documented excellent sensitivity of *Staphylococcus aureus* isolates to Vancomycin and Linezolid. However, significant resistance was observed against Erythromycin and Amoxicillin-Clavulanic acid. These findings indicate the emergence of resistant Gram-positive organisms and emphasize the need for culture-guided therapy.

The overall antibiotic sensitivity pattern observed in the present study demonstrated that Amikacin (88%), Gentamicin (82%), and Ciprofloxacin (78%) were the most effective antimicrobial agents against the isolated organisms. Comparable results were reported by Kumar *et al*.[19], who identified aminoglycosides and fluoroquinolones as the most effective drugs against CSOM pathogens. In contrast, higher resistance rates were observed against Amoxicillin and Cotrimoxazole. Similar resistance trends have been documented by several investigators and are likely related to widespread empirical use of these antibiotics in community settings.

The findings of the present study clearly indicate changing bacteriological trends and evolving antimicrobial resistance patterns among CSOM pathogens. The predominance of *Pseudomonas aeruginosa* and *Staphylococcus aureus* observed in this study is consistent with earlier reports. However, increasing resistance to commonly prescribed antibiotics underscores the importance of regular microbiological surveillance and antibiotic susceptibility testing. Empirical therapy without culture confirmation may contribute to treatment failure, chronicity, and development of resistant strains.

Thus, culture and sensitivity testing should be considered an essential component in the management of CSOM. Periodic evaluation of local bacteriological profiles and resistance patterns can help formulate appropriate antibiotic policies and improve treatment outcomes. Early diagnosis, rational antibiotic use, patient education, and timely intervention remain crucial in reducing disease burden and preventing complications associated with CSOM.

CONCLUSION

The present study concludes that Pseudomonas aeruginosa was the most predominant bacterial isolate followed by *Staphylococcus aureus* among patients with Chronic Suppurative Otitis Media. Hearing loss was the most common associated clinical symptom. Imipenem, Piperacillin-Tazobactam, Amikacin, Vancomycin, and Linezolid demonstrated maximum antimicrobial sensitivity, whereas higher resistance was observed against commonly used antibiotics such as Amoxicillin and Cotrimoxazole. The study emphasizes the importance of routine bacteriological culture and antibiotic sensitivity testing for effective management of CSOM. Rational antibiotic usage and continuous surveillance of antimicrobial resistance patterns are essential to prevent complications, reduce treatment failures, and improve patient outcomes.

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