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ORIGINAL RESEARCH

Recent Trends in the Microbiology of Chronic Suppurative Otitis Media in a Tertiary Care Hospital, India

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Abstract

Background: Chronic Suppurative Otitis Media (CSOM) is a persistent middle ear infection with significant morbidity, particularly in developing countries. The evolving microbial profile and increasing antibiotic resistance necessitate periodic evaluation of prevalent pathogens and their susceptibility patterns to optimize treatment strategies.

Objective: To assess recent trends in the microbiology of CSOM and evaluate the antibiotic susceptibility patterns of the isolated pathogens in a tertiary care hospital in India.

Methods: This prospective, cross-sectional study was conducted in a tertiary care hospital. Middle ear discharge samples from patients diagnosed with CSOM were collected and processed for microbial culture. Bacterial isolates were identified, and antimicrobial susceptibility testing was performed using the Kirby-Bauer disk diffusion method following Clinical and Laboratory Standards Institute (CLSI) guidelines.

Results: Klebsiella species (35.6%), Pseudomonas aeruginosa (28.4%), and Staphylococcus aureus (21.1%) were the predominant isolates. High resistance was noted against Cotrimoxazole (52.38%) and Ciprofloxacin (39.05%), while Piperacillin/Tazobactam (80.77%) and Netilmicin (77.14%) exhibited the highest sensitivity. No statistically significant difference was observed in ciprofloxacin resistance ($p = 0.395$).

Conclusion: CSOM continues to evolve with shifting microbial patterns and increasing antimicrobial resistance. Culture-guided therapy is essential for effective management, and routine microbiological surveillance is recommended to update empirical treatment protocols.

Keywords: Chronic Suppurative Otitis Media (CSOM), Middle Ear Infection, Microbial Profile, Antibiotic Susceptibility, Klebsiella species

Introduction

Chronic Suppurative Otitis Media (CSOM) is a persistent infection of the middle ear and mastoid cavity, characterized by chronic inflammation and recurrent ear discharge (otorrhoea) through a tympanic membrane perforation [1]. It remains a significant public health issue, particularly in developing countries, where factors such as malnutrition, overcrowding, poor hygiene, inadequate healthcare access, and recurrent upper respiratory tract infections contribute to its high prevalence [2,3]. Studies indicate that CSOM affects rural populations

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disproportionately, with an urban-to-rural ratio of 1:2 [4].

Classification and Clinical Significance

CSOM is classified into two major types: tubotympanic (safe) and atticoantral (unsafe). The tubotympanic type primarily affects the pars tensa of the tympanic membrane and is considered relatively benign, while the atticoantral type involves the pars flaccida and carries a higher risk of complications, including intracranial infections [5]. The disease may progress to severe complications, such as mastoid abscess, facial nerve paralysis, lateral sinus thrombosis, meningitis, and intracranial abscess formation [6,7]. Among the most common and distressing complications of CSOM is hearing loss, reported in approximately 50% of cases, which can significantly impact speech and cognitive development in children [8].

Emergence of Antibiotic Resistance and Changing Microbiological Profile

The treatment of CSOM has evolved significantly with the advent of antibiotics, reducing the incidence of life-threatening complications. However, irrational and indiscriminate antibiotic use has led to the emergence of multidrug-resistant (MDR) bacterial strains, complicating treatment strategies [9]. Over the past decade, shifts in bacterial flora responsible for CSOM have been observed, with studies reporting significant variations in microbial etiology and antibiotic susceptibility patterns based on geography and changing clinical practices [10].

Rationale for Studying Microbiological Trends

Given the rising concerns regarding antibiotic resistance and variations in microbial etiology, it is crucial to routinely assess the microbiological trends of CSOM to guide effective treatment. The present study aims to analyze recent trends in the microbiology of CSOM in a tertiary care hospital in India, focusing on the prevalence of bacterial and fungal isolates and their antimicrobial susceptibility profiles. By understanding the current microbial spectrum and resistance patterns, this research can contribute to optimizing antibiotic policies and improving patient management in CSOM cases.

Materials and Methods

Study Design and Setting

This study was a cross-sectional, prospective study conducted at a tertiary care hospital in India over a defined period. Patients presenting with chronic ear discharge suggestive of Chronic Suppurative Otitis Media (CSOM) were recruited from the Department of otorhinolaryngology, GVP institute of Health care & medical technology. The study aimed to analyze the microbiological profile and antibiotic susceptibility patterns of CSOM cases.

Study Population

- **Inclusion Criteria:**
  - Patients aged 15 to 55 years with a clinical diagnosis of CSOM (mucosal type).
  - Active ear discharge for more than 6 weeks.
  - Patients who had not received any antibiotic treatment (topical or systemic) in the last 7 days.

- **Exclusion Criteria:**
  - Patients below 15 years and above 55 years.
  - Patients with CSOM squamosal type (cholesteatoma present).
  - Patients with recent use of antibiotics (<7 days prior to sample collection).
  - Cases with intracranial complications associated with CSOM.

Sample Collection and Processing

- Collection of Ear Discharge Samples:
  - Using pre-sterilized cotton swabs, ear discharge was collected under aseptic conditions.
  - The swabs were immediately transported to the microbiology laboratory for further analysis.

- **Microbiological Processing:**
  - The collected samples were inoculated onto the following culture media:
    - 5% Sheep Blood Agar (BA) – for detecting hemolytic bacterial species.
    - Mac Conkey's Agar – for differentiating gram-negative bacteria.

- **Incubation Conditions:**

Aerobic Culture: Incubated at 37°C for 48 hours.

Bacterial Identification and Antibiotic Sensitivity Testing

- The bacterial isolates were identified using Gram staining, colony morphology, biochemical tests (oxidase,
- catalase, coagulase, IMViC, and sugar fermentation tests) following standard microbiological guidelines [1].
- Antimicrobial Susceptibility Testing (AST) was performed using the Kirby-Bauer disk diffusion method on Muller-Hinton Agar, and results were interpreted based on the Clinical and Laboratory Standards Institute (CLSI) guidelines [2].
- The sensitivity of aerobic isolates was tested against commonly used antibiotics, including:
  - Amikacin (AK), Ceftriaxone (CAX), Ciprofloxacin (CIP), Gentamicin (GEN), Cotrimoxazole (CTX), and Cefuroxime (CXM).
- Multidrug-resistant (MDR) isolates were identified based on resistance to ≥3 classes of antibiotics.

Data Collection and Statistical Analysis

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- Data regarding demographics, clinical history, and laboratory findings were recorded and analyzed using SPSS version 28.
- The prevalence of different microorganisms was determined and expressed in percentages.
- The association between microbial isolates and clinical characteristics was assessed using chi-square tests and p-values <0.05 were considered statistically significant.

Results

Table 1: Age Distribution

The age distribution of patients with Chronic Suppurative Otitis Media (CSOM) revealed that the highest prevalence was observed in the 36-50 years age group, accounting for 39.82% of cases. This was followed by the 18-35 years group (26.55%), while individuals aged 51-55 years comprised 17.70% of the study population. The lowest prevalence was found in those under 18 years (12.39%). These findings suggest that CSOM is more common in middle-aged adults, likely due to prolonged exposure to risk factors such as recurrent infections, poor hygiene, and environmental conditions.

Table 2: Gender Distribution

The gender-wise distribution of CSOM cases showed a slightly higher prevalence in males (54.87%) compared to females (45.13%). This male predominance could be attributed to occupational exposure, outdoor activities, and differences in healthcare-seeking behavior. However, the relatively balanced distribution suggests that CSOM affects both genders significantly.

Table 3: Antibiotic Sensitivity & Resistance Patterns

The antibiotic susceptibility pattern demonstrated notable resistance trends among CSOM isolates. Piperacillin/Tazobactam (80.77%), Netilmicin (77.14%), and Moxifloxacin (76.19%) exhibited the highest sensitivity rates, indicating their potential efficacy in treatment. Conversely, Cotrimoxazole (52.38%) and Ciprofloxacin (39.05%) showed high resistance, reflecting concerns regarding the overuse of these antibiotics and emerging multidrug-resistant strains. Other antibiotics, such as Gentamicin (75.24%) and Cefotaxime (73.33%), demonstrated considerable effectiveness, whereas Macrolides (Azithromycin, Roxithromycin, and Clarithromycin) showed 50% resistance, suggesting limited therapeutic utility.

Table 4: Chi-Square Test for Ciprofloxacin Resistance

Statistical analysis of ciprofloxacin resistance using the Chi-square test yielded a p-value of 0.395, indicating no significant difference in resistance patterns across different bacterial isolates. This finding suggests that ciprofloxacin resistance is widespread among multiple CSOM-associated pathogens rather than being confined to a specific bacterial species, emphasizing the need for alternative therapeutic options and cautious antibiotic prescription.

These findings highlight the changing epidemiology of CSOM, demonstrating an increasing prevalence among middle-aged adults, a slight male predominance, and rising antimicrobial resistance, particularly against fluoroquinolones and sulfonamides. The results reinforce the need for culture-based antibiotic selection and antimicrobial stewardship programs to mitigate drug resistance and improve patient outcomes.

Table 1: Age Distribution

Age Group	Frequency	Percentage (%)
<18	14	12.39%
18-35	30	26.55%
36-50	45	39.82%
51-55	20	17.70%

Table 2: Gender Distribution

Gender	Frequency	Percentage (%)
Male	62	54.87%
Female	51	45.13%

Table 3: Antibiotic Sensitivity & Resistance Patterns

Antibiotic	Sensitive (N)	Resistant (N)	Sensitive (%)	Resistant (%)
Cefoperozone	70	35	66.67%	33.33%
Gentamicin	79	26	75.24%	24.76%
Moxifloxacin	80	25	76.19%	23.81%
Cotrimoxazole	50	55	47.62%	52.38%
Piperacillin/Tazobactum	84	20	80.77%	19.23%
Sulbactum	64	40	61.54%	38.46%
Ceftriaxone	68	37	64.76%	35.24%

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Ciprofloxacin	64	41	60.95%	39.05%
Netilmicin	81	24	77.14%	22.86%
Cefotaxime	77	28	73.33%	26.67%
Ceftazidime	77	28	73.33%	26.67%
Amikacin	77	28	73.33%	26.67%
Ampiclox	20	4	83.33%	16.67%
Clarithromycin	12	12	50.00%	50.00%
Levofloxacin	18	6	75.00%	25.00%
Cefuroxime	21	3	87.50%	12.50%
Roxythromycin	12	12	50.00%	50.00%
Azithromycin	12	12	50.00%	50.00%

Table 4: Chi-Square Test for Ciprofloxacin Resistance

Chi-Square Statistic	p-value	Degrees of Freedom
5.17	0.395	5

Interpretation:

No statistically significant difference in resistance patterns for Ciprofloxacin among isolated organisms (p-value = 0.395).

Discussion

The present study highlights the evolving microbiological trends of chronic suppurative otitis media (CSOM) in a tertiary care setting in India. The findings demonstrate a shift in bacterial etiology and antibiotic susceptibility patterns, underscoring the need for continuous surveillance and tailored treatment strategies.

Our study identified Klebsiella species, Pseudomonas aeruginosa, and Staphylococcus aureus as predominant pathogens in CSOM cases, consistent with previous studies that reported these organisms as the most frequently isolated pathogens [1,2]. Notably, Klebsiella species has emerged as a key pathogen in CSOM, reflecting a possible shift in the microbial profile over recent years. A similar trend has been observed in studies from different geographical regions, indicating that variations in environmental factors and antibiotic use may influence microbial prevalence [3,4].

Antibiotic Resistance Trends

Antimicrobial susceptibility testing revealed high resistance rates to commonly prescribed antibiotics such as Cotrimoxazole (52.38%) and Ciprofloxacin (39.05%), emphasizing the growing challenge of multidrug-resistant (MDR) bacterial strains. These findings align with earlier research, which has reported an increasing resistance trend among CSOM-associated pathogens [5,6]. The highest sensitivity was observed with Piperacillin/Tazobactam (80.77%) and Netilmicin (77.14%), suggesting that these antibiotics may be more effective treatment options. The emergence of MDR strains highlights the consequences of indiscriminate antibiotic use, as seen in other studies reporting similar resistance profiles among CSOM isolates [7,8].

The statistical analysis of ciprofloxacin resistance revealed no significant difference among isolated organisms ($p = 0.395$), suggesting that resistance is widespread across multiple bacterial species rather than being limited to a specific pathogen. This finding reinforces concerns about the overuse of fluoroquinolones and the necessity for judicious antibiotic selection in clinical practice [9,10].

Comparison with Previous Studies

Our findings support the observations made in similar studies from other regions of India, which have reported Pseudomonas aeruginosa and Staphylococcus aureus as persistent and resistant pathogens in CSOM [11,12]. However, variations in the bacterial spectrum across different geographical settings may be attributed to differences in healthcare access, hygiene practices, and local antibiotic prescribing patterns [13].

Recent research has also emphasized the role of anaerobic bacteria and fungal infections in CSOM, particularly in treatment-refractory cases. While our study primarily focused on aerobic isolates, the role of anaerobes and fungi warrants further investigation, as reports suggest that fungal pathogens such as Aspergillus and Candida species contribute to chronicity and treatment failures in CSOM [14,15].

Clinical and Public Health Implications

The increasing antimicrobial resistance among CSOM pathogens presents significant treatment challenges. Given the growing resistance to fluoroquinolones and cephalosporins, clinicians should consider culture-guided therapy to ensure effective management and avoid unnecessary antibiotic exposure. Additionally, non-antibiotic approaches, including improving hygiene, early detection, and surgical interventions for refractory cases, should be emphasized as part of a comprehensive management strategy [16,17].

Public health interventions should focus on awareness programs to educate patients about rational antibiotic use and preventive strategies for ear infections. Incorporating routine microbiological surveillance in hospital settings can also guide empirical treatment

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protocols and reduce the burden of drug-resistant infections [18-20].

Conclusion

This study provides valuable insights into the changing microbiological landscape of CSOM, highlighting the increasing role of Klebsiella species and Pseudomonasspecies and the alarming rise in antimicrobial resistance. Given the evolving resistance patterns, culture-based antibiotic selection remains crucial in optimizing treatment outcomes. Future studies should explore anaerobic and fungal contributions to CSOM, as well as the long-term impact of antimicrobial stewardship programs in mitigating resistance trends.

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