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ORIGINAL ARTICLE

Assessment of Bacterial Spectrum in Chronic Suppurative Otitis Media

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ABSTRACT:

Background and Aim: Chronic otitis media (COM) is a common middle ear condition, especially in developing countries, characterized by chronic inflammation and persistent ear discharge. The disease is frequently associated with polymicrobial infections, and the emergence of antibiotic resistance has made its management increasingly challenging. This study aimed to identify the bacterial flora isolated from ear discharge in COM patients and assess their antibiotic susceptibility patterns. **Material and Methods:** A descriptive cross-sectional study was conducted at a tertiary care hospital in India, including 150 patients aged 10–60 years diagnosed with COM. Sterile swabs of ear discharge were collected from patients attending the ENT outpatient department. Samples were processed under aseptic conditions using standard microbiological protocols, including culture on blood agar and MacConkey agar. Bacterial isolates were identified by colony morphology, Gram staining, and biochemical tests. Antibiotic susceptibility testing was performed using the Kirby-Bauer disk diffusion method according to CLSI 2018 guidelines. **Results:** The most common bacterial isolate was *Pseudomonas aeruginosa* (36%), followed by *Proteus mirabilis* (23.3%), methicillin-sensitive *Staphylococcus aureus* (6%), methicillin-resistant *S. aureus* (6%), and *Klebsiella pneumoniae* (5.3%). Less frequent isolates included *E. coli*, *Pseudomonas fluorescens*, *Staphylococcus epidermidis*, *Streptococcus pyogenes*, and *Citrobacter freundii*. Antibiotic susceptibility testing showed polymyxin B and amikacin to be the most effective agents across most isolates, while widespread resistance was observed with cefotaxime and cefoxitin. **Conclusion:** This study highlights *Pseudomonas aeruginosa* and *Proteus mirabilis* as the leading pathogens in COM, with notable presence of methicillin-resistant strains. The findings emphasize the need for routine microbial surveillance and culture-guided antibiotic therapy to improve treatment outcomes and reduce antimicrobial resistance.

Keywords: Chronic otitis media, bacterial isolates, antibiotic susceptibility, *Pseudomonas aeruginosa*, multidrug resistance

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INTRODUCTION

Chronic otitis media (COM) is a long-standing inflammatory disease of the middle ear and mastoid cavity, characterized by recurrent or persistent ear discharge through a perforated tympanic membrane. It is one of the most common otologic conditions encountered worldwide, especially in developing countries like India, where it contributes significantly to hearing impairment, social disability, and reduced quality of life [1,2]. COM affects both children and adults and is a major cause of preventable hearing loss, particularly in low-resource communities where access to healthcare services and early treatment is limited.

The pathogenesis of COM involves a complex interaction between microbial infection, host immune response, environmental factors, and anatomical variations. Ear discharge in COM is often polymicrobial, with both aerobic and anaerobic organisms playing a role. Among aerobic bacteria, *Pseudomonas aeruginosa* and *Staphylococcus aureus* are the most frequently isolated pathogens, followed by *Proteus* species, *Klebsiella pneumoniae*, and *Escherichia coli*. These organisms are well-adapted to the moist and warm environment of the middle ear and are known for their ability to form biofilms, which protect them from host defenses and antibiotic action, leading to chronicity and treatment failure [3,4].

In recent years, the emergence of multidrug-resistant (MDR) strains has become a global concern, making the management of COM even more challenging. *Pseudomonas aeruginosa*, in particular, has demonstrated resistance to multiple classes of antibiotics, largely due to biofilm formation, efflux pumps, and enzymatic degradation of antibiotics. Similarly, methicillin-resistant *Staphylococcus aureus* (MRSA) has also been increasingly reported in chronic ear infections, underscoring the urgent need for updated antimicrobial surveillance [5,6].

The management of COM traditionally involves a combination of aural toilet, topical and systemic antibiotics, and surgical intervention when needed. However, empirical antibiotic therapy without culture and sensitivity testing may lead to prolonged disease, recurrent infections, and increasing antimicrobial resistance. Hence, it is imperative to study the microbial flora and their antimicrobial susceptibility patterns in COM to guide clinicians in selecting appropriate therapy, optimize treatment outcomes, and prevent complications such as mastoiditis, facial nerve palsy, and intracranial infections [7,8].

Globally, the prevalence of bacterial isolates and their antibiotic resistance patterns varies depending on

geographic region, patient population, and prior antibiotic exposure. Studies from various regions of India have reported wide variability in the predominant organisms and their sensitivity profiles, reflecting regional differences in microbial ecology and healthcare practices [9]. Despite the high burden of COM in India, comprehensive and up-to-date data on microbial flora and drug sensitivity from many tertiary care centers is limited, making local surveillance studies essential.

The present descriptive study aims to analyze the microbial flora isolated from ear discharge in patients with chronic otitis media attending a tertiary care hospital in India and assess the antibiotic susceptibility patterns of the isolates. By identifying the prevailing pathogens and their resistance profiles, this study seeks to support rational antibiotic prescribing, reduce treatment failures, limit complications, and contribute to antimicrobial stewardship in the management of COM [10].

MATERIAL AND METHODS

This descriptive cross-sectional study was conducted in the Department of ENT at a tertiary care hospital in India over a period of 12 months. A total of 150 patients diagnosed with chronic otitis media (COM) and attending the ENT outpatient department were included.

Institutional ethics committee approval was obtained prior to the study. Written informed consent was obtained from all participants.

Inclusion criteria

- Patients aged 10 to 60 years presenting with ear discharge and clinically diagnosed with COM.
- Patients who provided informed consent to participate in the study.

Exclusion criteria

- Patients with comorbidities such as diabetes mellitus or hypertension.
- Patients already receiving systemic antibiotics or topical antibiotic ear drops for COM.
- Patients with superadded otomycosis, otitis externa, myringitis, COM occurring post-surgery, traumatic ear discharge, or who refused consent.

Eligible patients attending the ENT outpatient department with ear discharge were evaluated after obtaining informed consent. Aural cleaning was performed using a Bull's eye lamp and sterile suction under aseptic precautions. After cleaning the external auditory canal, a sterile aural speculum was introduced to create a sterile field, and middle ear discharge was collected using sterile cotton swabs. Samples were transported to the microbiology laboratory within 30 minutes for bacteriological culture and sensitivity testing.

All samples were handled under strict aseptic conditions and processed immediately according to standard microbiological protocols. The samples were inoculated onto blood agar and MacConkey agar plates, and special media were used when required. The plates were incubated aerobically at 37°C for 24 hours, and bacterial growth was examined for colony characteristics, hemolysis, and pigmentation.

Isolation and identification of organisms

Gram staining was performed on all isolates, followed by biochemical tests for definitive identification of bacterial species. Identification relied on colony morphology, Gram reaction, catalase, coagulase, oxidase tests, and other relevant biochemical reactions according to standard protocols.

The Kirby-Bauer disc diffusion method was used to assess antibiotic susceptibility of all isolates, following the Clinical and Laboratory Standards Institute (CLSI) 2018 guidelines. Muller-Hinton agar was freshly prepared and poured into 9 cm Petri plates to a depth of 4 mm. Sterility of the media was confirmed prior to use.

Bacterial colonies were subcultured one day before the test. A 0.5 McFarland turbidity standard was used to prepare bacterial suspensions in peptone water. Using a sterile swab, the inoculum was evenly spread over the Muller-Hinton agar plates to form a lawn culture.

Commercially available antibiotic discs (Himedia) were brought to room temperature before use to prevent moisture condensation. Up to six antibiotic discs were placed on each plate, ensuring a 24 mm center-to-center distance between discs.

The plates were incubated aerobically at 37°C for 18–24 hours. After incubation, plates were checked to ensure a confluent lawn of growth. The diameter of the inhibition zones was measured in millimeters, and results were interpreted as sensitive, intermediate, or resistant according to CLSI 2018 guidelines.

The collected data were compiled using Microsoft Excel and analyzed with the help of SPSS software version 25.0 (IBM, Chicago, USA). Descriptive statistics were used to summarize patient demographics, microbial isolates, and antibiotic susceptibility patterns. Categorical variables such as age groups, sex distribution, type of organisms, and resistance profiles were expressed as frequencies and percentages.

Chi-square test (χ^2 test) was applied to compare the distribution of microbial isolates across different age groups and sex, as well as to assess the association between clinical and microbiological parameters. A p-value of <0.05 was considered statistically significant. All results were presented in the form of tables.

RESULTS

Table 1 presents the distribution of bacterial isolates from ear discharge samples of 150 patients with chronic otitis media. The most frequently isolated organism was *Pseudomonas aeruginosa*, accounting for 36% of cases (54 isolates), confirming its dominant role in chronic ear infections. *Proteus*

mirabilis followed as the second most common isolate at 23.3% (35 isolates), reflecting its well-known contribution to middle ear infections. Methicillin-sensitive *Staphylococcus aureus* (MSSA) and methicillin-resistant *Staphylococcus aureus* (MRSA) were found in 6% of cases (9 isolates each), underlining the importance of monitoring both sensitive and resistant strains. *Escherichia coli* was present in 3.3% of cases (5 isolates), while *Pseudomonas fluorescens* and *Citrobacter freundii* were less frequent at 2% (3 isolates each). Other notable pathogens included *Klebsiella pneumoniae* at 5.3% (8 isolates), *Staphylococcus epidermidis* at 6% (9 isolates), and *Streptococcus pyogenes* at 5.3% (8 isolates), reflecting a diverse bacterial profile. Interestingly, 6% of samples (9 cases) showed no bacterial growth, possibly due to prior antibiotic use or nonbacterial causes.

Table 2 summarizes the antibiotic susceptibility patterns of these isolates. Ciprofloxacin demonstrated good activity against most organisms except *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, where resistance was observed. Polymyxin B showed uniform sensitivity across all isolates, making it one of the most reliable antibiotics. Ofloxacin was effective against most pathogens, although resistance was noted in MRSA and *Klebsiella pneumoniae*. Gentamycin displayed strong efficacy against *Proteus mirabilis*, MSSA, MRSA, *E. coli*, *Pseudomonas fluorescens*, and *Streptococcus pyogenes*, while resistance was evident in *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. Amikacin was highly effective against *Proteus mirabilis*, *E. coli*, *Pseudomonas fluorescens*, *Klebsiella pneumoniae*, and *Streptococcus pyogenes*, but was less useful for *Pseudomonas aeruginosa* and was not tested on MSSA, MRSA, or *Staphylococcus epidermidis*. Chloramphenicol was effective mainly against *Proteus mirabilis* and *E. coli* but less so for other organisms. Piperacillin-tazobactam (Piptaz) showed good sensitivity across most pathogens, though *Klebsiella pneumoniae* exhibited resistance. Cotrimoxazole worked well against *Proteus mirabilis*, MSSA, MRSA, and *Pseudomonas fluorescens*, but resistance was noted in *Streptococcus pyogenes*. Cefotaxime and cefoxitin showed widespread resistance across nearly all isolates, highlighting their limited utility in this clinical setting. Overall, the antibiotic profile emphasizes the importance of culture-guided treatment, with polymyxin B and amikacin emerging as the most consistently effective antibiotics against the diverse range of pathogens.

Table 1: Percentage of isolates.

Organism	No. of Isolates	Percentage (%)
Pseudomonas aeruginosa	54	36.0
Proteus mirabilis	35	23.3
Methicillin-sensitive Staph. aureus	9	6.0
Methicillin-resistant Staph. aureus	9	6.0
Escherichia coli	5	3.3
Pseudomonas fluorescens	3	2.0
Klebsiella pneumoniae	8	5.3
Staphylococcus epidermidis	9	6.0
Streptococcus pyogenes	8	5.3
Citrobacter freundii	3	2.0
No growth	9	6.0

Table 2: Culture and sensitivity if isolates.

Antibiotic	Proteus mirabilis	Pseudomonas aeruginosa	MSSA	MRSA	E. coli	Pseudomonas fluorescens	Klebsiella pneumoniae	Staphylococcus epidermidis	Streptococcus pyogenes	Citrobacter freundii
Ciprofloxacin	S	R	S	S	S	S	R	S	S	S
Polymyxin B	S	S	S	S	S	S	S	S	S	S
Ofloxacin	S	S	S	R	S	S	R	S	S	S
Gentamycin	S	R	S	S	S	S	R	-	S	S
Amikacin	S	R	-	-	S	S	S	-	S	-
Chloramphenicol	S	-	-	-	S	R	-	-	-	-
Piptaz (Piperacillin-	S	S	-	-	S	S	R	-	S	S

tazobactam)										
Cotrimoxazole	S	-	S	S	-	S	-	-	R	-
Cefotaxime	R	R	R	R	R	R	R	R	R	R
Cefoxitin	R	R	S	R	R	R	R	R	R	R

DISCUSSION

The present study provides valuable insights into the bacteriological profile and antibiotic susceptibility patterns in patients with chronic otitis media (COM) attending a tertiary care hospital in India. Among the 150 samples analyzed, *Pseudomonas aeruginosa* emerged as the predominant pathogen, consistent with several regional and global studies reporting its dominance in COM due to its ability to adhere to epithelial surfaces, form biofilms, and resist antibiotics [11,12]. *Proteus mirabilis* was the second most frequent isolate, a well-known gram-negative organism capable of producing enzymes like urease and proteases that contribute to tissue damage and chronic inflammation [13]. Methicillin-sensitive *Staphylococcus aureus* (MSSA) and methicillin-resistant *Staphylococcus aureus* (MRSA) were also isolated in considerable numbers, underscoring the rising concern of resistant gram-positive organisms in chronic ear infections, as highlighted by earlier studies [11,14].

Other gram-negative organisms, including *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas fluorescens*, and *Citrobacter freundii*, reflect the polymicrobial nature of COM. These organisms often colonize the middle ear following eustachian tube dysfunction, prior upper respiratory infections, or trauma, contributing to the chronicity of infection [12,15]. Additionally, gram-positive isolates such as *Staphylococcus epidermidis* and *Streptococcus pyogenes* indicate that both skin flora and respiratory pathogens play important roles in middle ear disease, adding complexity to the microbial landscape and making empiric therapy more challenging [13,16].

The antibiotic susceptibility patterns revealed in this study are clinically important. Polymyxin B and amikacin showed the highest efficacy across most isolates, aligning with previous findings where aminoglycosides and polymyxins remained reliable against multidrug-resistant gram-negative bacteria [11,14]. Fluoroquinolones like ciprofloxacin and ofloxacin, often used as first-line agents, demonstrated good activity but showed reduced effectiveness against *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, consistent with reports of increasing fluoroquinolone resistance due to efflux pumps and target-site mutations [12,15]. Gentamycin displayed robust activity against many gram-negative and gram-positive isolates, but its resistance in *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* raises concerns about indiscriminate use and emerging resistance patterns.

Amikacin's excellent activity across most isolates, especially *Pseudomonas* and *Proteus* species, highlights its continued relevance in treating COM, particularly in cases with suspected resistant organisms. Chloramphenicol, although effective in some isolates, showed limited overall activity, reflecting its declining clinical utility. Piperacillin-tazobactam (Piptaz) maintained good sensitivity against most pathogens except *Klebsiella pneumoniae*, where extended-spectrum beta-lactamase (ESBL) production may explain resistance. The near-universal resistance to cefotaxime and cefoxitin across isolates underscores the limitations of cephalosporins in the current antimicrobial landscape and emphasizes the need for culture-guided therapy.

The clinical implications of these findings are substantial. Empirical antibiotic use without microbial confirmation risks treatment failure, prolonged infection, complications such as mastoiditis or facial nerve palsy, and contributes to antimicrobial resistance. Studies from other Indian regions and globally have consistently emphasized the need for routine culture and sensitivity testing in COM management, allowing tailored antibiotic regimens and improved patient outcomes [11–13]. The emergence of resistant strains like MRSA and multidrug-resistant *Pseudomonas* further amplifies the urgency of local antimicrobial surveillance, rational prescribing practices, and implementation of hospital antibiotic stewardship programs [14,15].

Additionally, attention should be paid to the potential coexistence of fungal infections, particularly in patients with long-term antibiotic use or those with repeated ear manipulations, as recent studies highlight an increasing role of fungal pathogens in recalcitrant cases [15]. Public health measures aimed at improving early detection, patient education, and adherence to treatment can significantly reduce the burden of COM and its complications. Importantly, strengthening the collaboration between ENT specialists, microbiologists, and infectious disease teams can help develop standardized treatment protocols and update institutional guidelines regularly [16].

CONCLUSION

This study demonstrates that *Pseudomonas aeruginosa* and *Proteus mirabilis* are the most common bacterial isolates in chronic otitis media, with a considerable presence of both methicillin-sensitive and methicillin-resistant *Staphylococcus*

aureus. Polymyxin B and amikacin emerged as the most consistently effective antibiotics, while significant resistance was seen with cefotaxime and cefoxitin. These findings underscore the need for culture-guided antibiotic therapy to ensure optimal patient outcomes, prevent complications, and curb the rise of antimicrobial resistance. Regular surveillance, strict adherence to antibiotic guidelines, and patient education are crucial components in the long-term management of COM.

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