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Original Research Article

A Study on Bacteriological Profile of Chronic Otitis Media and its Antibiotic Susceptibility Patterns in a Tertiary Care Centre

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Abstract

Background & Objectives: Chronic otitis media (COM) is a persistent inflammation of the middle ear cleft, serving as a primary cause of preventable hearing impairment in developing countries. Continuous surveillance of its bacteriological profile and antimicrobial resistance patterns is crucial for guiding effective empiric and targeted treatment. This study aimed to identify the aerobic bacterial isolates in patients presenting with COM and to evaluate their antibiotic susceptibility patterns in a tertiary care setting.

Methods: A hospital-based cross-sectional study was conducted over an 18-month period (June 2023 to November 2024) at the Department of Otorhinolaryngology, Hassan Institute of Medical Sciences. A total of 100 patients with a history of middle ear discharge lasting >3 months were enrolled. Aural swabs were collected under strict aseptic precautions and processed for aerobic bacterial identification and standard antimicrobial susceptibility testing using the Kirby-Bauer disc diffusion method.

Results: The mean age of the study population was 38.4 ± 14.26 years, with a slight male predominance (51% males, 49% females). Mucosal COM was present in 79% of subjects, while 21% had squamosal COM. Culture positivity yielded specific bacterial pathogens, with *Staphylococcus aureus* being the most prevalent isolate (34%), followed by *Pseudomonas aeruginosa* (16%), *Klebsiella pneumoniae* (13%), *Proteus mirabilis* (11%), *Acinetobacter baumannii* (8%), and *Klebsiella aerogenes* (7%). Culture negativity was observed in 6% of cases. Antimicrobial sensitivity testing revealed high susceptibility of *S. aureus* to Linezolid (20.4%), Clindamycin (12.8%), and Cotrimoxazole (12.8%), while displaying high resistance to Ciprofloxacin (15.4%) and Penicillin G (12.8%). *Pseudomonas aeruginosa* exhibited maximum sensitivity to Meropenem (15.9%), Piperacillin-tazobactam (13.6%), and Ceftazidime-clavulanic acid (13.6%), with notable resistance to Amikacin (12.9%). *Acinetobacter baumannii* displayed significant multidrug resistance, retaining maximum sensitivity to Piperacillin-tazobactam (13.5%).

Conclusion: *Staphylococcus aureus* and *Pseudomonas aeruginosa* remain the primary causative pathogens in chronic otitis media. The emerging resistance against routinely used first-line antimicrobials underscores the critical necessity for regular microbiological monitoring and formulation of institution-specific antibiotic policies.

Keywords: Chronic Otitis Media, Bacteriological Profile, Antibiotic Resistance, Staphylococcus aureus, Pseudomonas aeruginosa, Multidrug Resistance.

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Introduction

The ear is a vital sensory organ, and inflammatory middle ear disorders remain a major cause of global morbidity. Ear discharge (otorrhea) originates either from the external auditory canal (otitis externa) or the middle ear cavity (otitis media). Otitis media represents an inflammation of the middle ear mucosa caused by bacterial, viral, or fungal pathogens. Chronic otitis media (COM) is defined as a persistent stage of ear disease characterized by continuous or recurrent ear discharge through a permanent tympanic membrane

Objectives

1. To determine the aerobic bacteriological profile of ear discharge in patients presenting with chronic otitis media.
2. To evaluate the in vitro antibiotic susceptibility patterns of the isolated bacterial strains.

Materials and Methods

Study Design & Setting: This hospital-based cross-sectional study was conducted in the Department of Otorhinolaryngology in collaboration with the Department of Microbiology at Hassan Institute of Medical Sciences, Hassan, Karnataka, from June 2023 to November 2024 (18 months duration).

Selection Criteria: A total of 100 patients presenting to the outpatient department or admitted to the ENT wards with a history of middle ear discharge lasting >3 months, irrespective of age and gender, were recruited after obtaining written informed consent/assent. Exclusion criteria comprised non-COM ear discharge (e.g., otitis externa, (12%), and 1 year (11%). Mucosal COM was diagnosed in 79% of patients, while 21% presented with Squamosal COM.

Bacteriological Distribution: Among 100 samples, 94 showed positive bacterial growth while 6 (6%) showed no aerobic growth. Staphylococcus aureus was the predominant isolate (34%), followed by Pseudomonas aeruginosa (16%), Klebsiella pneumoniae (13%), Proteus mirabilis (11%), Acinetobacter baumannii (8%), Klebsiella aerogenes (7%), Enterococcus (2%), and non-aeruginosa Pseudomonas (2%).

Antimicrobial Susceptibility Profile

Staphylococcus aureus: Exhibited highest sensitivity to Linezolid (20.4%), Clindamycin (12.8%), Cotrimoxazole (12.8%), Chloramphenicol (10.9%), and Doxycycline (9.5%). High resistance was recorded against Ciprofloxacin (15.4%), Penicillin G (12.8%), Tetracycline (12.8%), Ofloxacin (6.7%), and Gentamicin (6.7%).

Pseudomonas aeruginosa & Pseudomonas spp.: High susceptibility was observed for Meropenem (15.9%), Piperacillin-tazobactam (13.6%), Ceftazidime-clavulanic acid (13.6%), and Aztreonam (12.5%). Significant resistance was observed against Amikacin (12.9%), Ceftazidime-clavulanic acid (9.7%), Levofloxacin (9.7%), Tobramycin (9.7%), and Ceftazidime (8.1%).

Klebsiella Species: Showed highest sensitivity to Ceftazidime-clavulanic acid (13.4%), Piperacillin-tazobactam (11.6%), Tobramycin (9.8%), and Gentamicin (8.0%). Prominent resistance was found against Amoxicillin-clavulanic acid (17.4%), Imipenem (11.6%), Ampicillin (10.1%), and Aztreonam (10.1%).

Proteus mirabilis: Displayed maximum sensitivity to Meropenem (10.6%), Piperacillin-tazobactam (10.6%), Ceftazidime (10.6%), Doxycycline (9.4%), and Gentamicin (9.4%). Primary resistance was observed against Ampicillin (28.2%) and Cefixime (15.4%).

Acinetobacter baumannii: Exhibited peak sensitivity to Piperacillin-tazobactam (13.5%), Ceftriaxone (10.8%), and Doxycycline (10.8%). Highest resistance was noted against Tobramycin (19.2%), Amoxicillin-clavulanic acid (11.5%), and Ceftazidime (11.5%).

Enterococcus: Sensitive to Linezolid (25%), Penicillin G (25%), and Tetracycline (25%), with observed resistance to Doxycycline, Gentamicin, and Levofloxacin. otomycosis) and patients who had received topical or systemic antibiotics within the preceding week.

Sample Collection & Processing: Under sterile operating conditions and direct visualization via a sterile aural speculum, excess canal discharge was mopped up, and the canal was disinfected with 70% alcohol. Ear swabs were collected carefully using sterile cotton-tipped swabs without touching the external canal walls. Swabs were transported immediately to the microbiology laboratory.

Specimens were inoculated onto Blood Agar, Chocolate Agar, and MacConkey Agar plates and incubated aerobically at ***37°C for*** 18–24 hours.

Isolated organisms were identified through standard biochemical tests. Antimicrobial susceptibility testing was performed on Mueller-Hinton agar using the Kirby-Bauer disc diffusion method in alignment with CLSI guidelines.

Sample Size Calculation: Sample size was calculated using Cochran's formula $N = (Z\alpha^2 P(1-P))/d^2$

$Z\alpha^2$ = Std normal variate 1.96

P =Expected proportion from population

d = Absolute error

Based on an estimated COM prevalence (**P**) of 5.2% in India and an absolute error (**d**) of 5%, a minimum sample size of 73 was required. A total of 100 cases were analyzed to enhance statistical power.

Statistical Analysis: Data were compiled using Microsoft Excel and analyzed via SPSS version 21. Continuous variables are expressed as Mean ± SD and Median, while categorical data are presented as frequencies and percentages.

Results

A total of 100 subjects with chronic middle ear discharge were evaluated. The mean age was 38.4 \pm 14.26 years (range: 12 to 76 years), with 32% falling in the 26–35 age group, followed by 22% in the 36–45 age group. Gender distribution showed 51% males and 49% females. Socioeconomic status (SES) evaluation revealed that 61% belonged to the Upper Lower (UL) class, 34% to Lower Middle (LM), and 5% to Lower (L) class. Discharge duration varied from 4 months to 15 years, with the highest proportion of patients experiencing discharge for 2 years (19%), 3 years perforation lasting for more than three months, with otorrhea persisting for at least six weeks.

Anatomically and clinically, COM is broadly classified into two major types:

1. **Tubotympanic (Mucosal/Safe):** Involves the pars tensa, characterized by a central perforation, and carries a low risk of grave intracranial complications.
2. **Attico-antral (Squamosal/Unsafe):** Involves the pars flaccida or posterior margin, often associated with cholesteatoma and bone erosion, posing life-threatening temporal and intracranial complications.

The burden of COM is substantially elevated in developing nations such as India, particularly in low-to-middle socioeconomic groups (urban-to-rural ratio 1:2), driven by overcrowded living conditions, poor personal hygiene, malnutrition, and limited health awareness. The global prevalence ranges between 65 and 330 million individuals, of whom 60% suffer from clinically significant hearing loss. In India, the prevalence exceeds 6%, necessitating urgent clinical attention.

Although anaerobic bacteria, viruses, and fungi contribute to middle ear infections, aerobic bacteria remain the primary pathogens. The most common isolates include *Staphylococcus aureus* and *Pseudomonas aeruginosa*, followed by *Proteus* spp., *Klebsiella* spp., and *E. coli*. Indiscriminate and empirical antibiotic usage has led to significant shifts in microbial flora and alarming increases in multidrug-resistant (MDR) strains over time.

Therefore, continuous updating of local bacteriological profiles and antibiograms is essential for effective patient management and stewardship.

Table 1: Demographic and Clinical Characteristics of Study Participants (N = 100)

Variable	Subcategory	Number Of Subjects (%)
Age Group (Years)	<15	1 (1%)
	16–25	15 (15%)
	26–35	32 (32%)
	36–45 / >45	22 (22%) / 30 (30%)
Gender	Male / Female	51 (51%) / 49 (49%)
Socioeconomic Status	Upper Lower (UL) / Lower Middle (LM) / Lower (L)	61 (61%) / 34 (34%) / 5 (5%)
COM Type	Mucosal / Squamosal	79 (79%) / 21 (21%)

Table 2: Distribution of Isolated Aerobic Microorganisms in Ear Swabs

Organism Isolated	Frequency (N)	Percentage (%)
Staphylococcus aureus	34	34%
Pseudomonas aeruginosa	16	16%
Klebsiella pneumoniae	13	13%
Proteus mirabilis	11	11%
Acinetobacter baumannii	8	8%
Klebsiella aerogenes	7	7%
Enterococcus spp.	2	2%
Pseudomonas spp. (Non-aeruginosa)	2	2%
Klebsiella spp.	1	1%
No Growth	6	6%
Total	100	100%

Table 3: Sensitivity and Resistance Patterns of Major Isolates

Organism	Highly Sensitive Antibiotics (% Share)	Resistant Antibiotics (% Share)
S. aureus	Linezolid (20.4%), Clindamycin (12.8%), Cotrimoxazole (12.8%)	Ciprofloxacin (15.4%), Penicillin G (12.8%), Tetracycline (12.8%)
P. aeruginosa	Meropenem (15.9%), Piperacillin-tazobactam (13.6%), Aztreonam (12.5%)	Amikacin (12.9%), Tobramycin (9.7%), Levofloxacin (9.7%)
Klebsiella spp.	Ceftazidime-clavulanate (13.4%), Piperacillin-tazobactam (11.6%)	Amoxicillin-clavulanic acid (17.4%), Imipenem (11.6%), Ampicillin (10.1%)
P. mirabilis	Meropenem (10.6%), Piperacillin-tazobactam (10.6%), Ceftazidime (10.6%)	Ampicillin (28.2%), Cefixime (15.4%), Cefoxitin (12.8%)
A. baumannii	Piperacillin-tazobactam (13.5%), Ceftriaxone (10.8%), Doxycycline (10.8%)	Tobramycin (19.2%), Amoxicillin-clavulanic acid (11.5%), Ceftazidime (11.5%)

Discussion

Chronic otitis media remains a dominant public health burden in developing nations. The chronic nature of otorrhea and middle ear destruction often leads to permanent conductive or sensorineural hearing loss. Knowledge of local microbiological profiles is mandatory for initiating rational empirical antibiotic treatment.

In our study, *Staphylococcus aureus* (34%) was the most predominant isolate, closely followed by Gram-negative bacilli led by *Pseudomonas aeruginosa* (16%), *Klebsiella pneumoniae* (13%), and *Proteus mirabilis* (11%). These findings align with earlier works by Prakash et al., Gh. Ettehad et al., and Ahmad, who reported *S. aureus* as the chief pathogen. However, other series (Kumar et al., Poorey & Iyer) demonstrated a primary predominance of *Pseudomonas aeruginosa*. Regional variations, environmental conditions, personal hygiene, and prior empirical treatment regimens likely account for these differences.

The high prevalence of *Pseudomonas aeruginosa* in COM is attributed to its opportunistic nature, preference for moist environments, and propensity for biofilm formation within the middle ear mucosa and ossicular chain. Biofilms protect bacteria from host defenses and systemic antibiotics, contributing to persistent otorrhea.

Alarming resistance patterns were observed in this study. *Staphylococcus aureus* exhibited notable resistance to Ciprofloxacin (15.4%) and Penicillin G (12.8%), reflecting widespread over-the-counter misuse of oral fluoroquinolones and penicillins. Conversely, Linezolid, Clindamycin, and Cotrimoxazole demonstrated high sensitivity. Among Gram-negative isolates, beta-lactamase production and efflux pump mechanisms contribute to elevated resistance against ampicillin, amoxicillin-clavulanate, and first-generation cephalosporins. Carbapenems (Meropenem) and combination beta-lactamase inhibitors (Piperacillin-tazobactam) exhibited superior efficacy against *Pseudomonas aeruginosa* and *Proteus mirabilis*. However, the detection of multidrug-resistant strains of *Acinetobacter baumannii* and *Klebsiella* poses significant therapeutic challenges, emphasizing the necessity of strict antibiotic stewardship and routine culture testing.

Study Limitations: This study was conducted at a single tertiary care center and evaluated only aerobic bacterial isolates. Anaerobic bacteria and fungal pathogens were not investigated in this phase. Future multi-centric studies encompassing anaerobic and mycological evaluation are recommended.

Conclusion

Staphylococcus aureus and *Pseudomonas aeruginosa* represent the primary aerobic bacterial pathogens responsible for chronic otitis media. The significant emergence of resistance against commonly prescribed oral antimicrobials highlights the critical need to discontinue routine empirical therapy without microbiological confirmation. Topical therapy (e.g., ciprofloxacin ear drops) coupled with careful aural toilet remains a valuable first-line intervention. Continuous local microbiological surveillance and hospital antibiograms are essential to curb the rise of multidrug-resistant pathogens and prevent otogenic complications.

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