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Original Article

Microbiological Trends and Antibiotic Sensitivity in Chronic Otitis Media in a tertiary care Hospital, Dhaka

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Abstract:

Background:: Chronic otitis media (COM) is a persistent ear infection characterized by the ongoing discharge of pus from the middle ear, often leading to hearing loss and other complications. The condition is commonly caused by bacterial and fungal pathogens, with Pseudomonas aeruginosa and Staphylococcus aureus being the predominant microorganisms identified in many cases. This study aims to examine the microbiological and antibiotic resistance profiles of COM.

Methods: This cross-sectional study was conducted to evaluate the microbiological profile and antibiotic resistance patterns in patients with chronic otitis media (COM). The study was carried out from June 2023 to June 2024, in the *Department of Otolaryngology-Head & Neck Surgery and Department of Microbiology and Immunology, Bangabandhu Sheikh Mujib Medical University, Dhaka.* Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) version 25.0.

Results: *Pseudomonas aeruginosa and Staphylococcus aureus were the most common pathogens, each accounting for 33.3% of isolates. The majority of patients had a single microbial isolate (70.9%). Antibiotic sensitivity testing revealed that gentamicin was the most effective topical antibiotic (82.6% sensitivity), followed by neomycin and chloramphenicol. Systemic antibiotics showed varied resistance, with P. aeruginosa being most sensitive to piperacillin-tazobactam and S. aureus being fully sensitive to vancomycin. Coagulase-negative staphylococci showed significant resistance to oxacillin but remained sensitive to vancomycin and linezolid.*

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Conclusion: *Pseudomonas aeruginosa and Staphylococcus aureus as the predominant pathogens in chronic otitis media (COM), with concerning levels of antibiotic resistance. While gentamicin remains the most effective topical antibiotic, the rising resistance to commonly used systemic antibiotics necessitates culture-based treatment strategies.*

Keywords: *Pseudomonas aeruginosa, Staphylococcus aureus, Chronic Otitis Media, Antibiotic sensitivity.*

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Introduction:

Chronic Otitis Media (COM) is a persistent inflammatory condition of the middle ear and mastoid cavity, characterized by recurrent or continuous ear discharge (otorrhea) through a tympanic membrane perforation, often lasting more than six weeks despite medical treatment[1]. It is a significant cause of preventable hearing loss worldwide, particularly in low- and middle-income countries, where healthcare access and hygiene practices vary widely[2]. COM is associated with serious complications, including mastoiditis, facial nerve paralysis, labyrinthitis, and intracranial infections such as brain abscesses and meningitis[3,4]. Identifying the predominant microbial pathogens and their antibiotic susceptibility patterns is essential for effective management, given the increasing prevalence of multidrug-resistant organisms[5].The global prevalence of COM varies significantly, with higher rates observed in developing countries, particularly in Africa, South Asia, and the Middle East[6]. A study from India reported a prevalence of 7.8% among children, while in sub-Saharan Africa, the prevalence ranged between 4% and 7.2%[7]. Factors contributing to COM include recurrent upper respiratory infections, poor socioeconomic conditions, inadequate healthcare access, and malnutrition[8]. The World Health Organization (WHO) estimates that COM affects approximately 65 to 330 million individuals worldwide, with 60% experiencing significant hearing impairment[9].The microbial etiology of COM has evolved, influenced by antibiotic overuse and regional variations[10]. Historically, *Pseudomonas aeruginosa* and *Staphylococcus aureus* have been the most commonly isolated organisms, together accounting for over 60% of cases[11]. Recent studies have confirmed these trends, reporting that *P. aeruginosa* and *S. aureus* are responsible for 33.3% of cases each, followed by *Coagulase-negative Staphylococcus* (21.1%). Other bacterial pathogens include *Proteus mirabilis, Klebsiella pneumoniae*, *Escherichia coli*, and *Enterobacter* species[12,13]. Anaerobic bacteria, although less frequently isolated, contribute to chronic infections, particularly in cases with cholesteatoma[14]. Fungal pathogens, such as *Aspergillus* and *Candida* species, are found in 8.8% of cases, often in patients with prolonged topical antibiotic use or immunocompromised states[15].Antibiotic resistance among COM pathogens is an escalating concern, leading to treatment failures and prolonged infections[16]. *Pseudomonas aeruginosa*, known for its intrinsic resistance mechanisms, exhibits high resistance to amoxicillin-clavulanic acid and first-generation cephalosporins, with increasing resistance to fluoroquinolones and aminoglycosides. *Staphylococcus aureus*, including methicillin-resistant *S. aureus* (MRSA), presents additional challenges in treatment[13]. Studies indicate that gentamicin remains the most effective topical antibiotic,

followed by neomycin and chloramphenicol[20]. Systemic antibiotics such as ciprofloxacin and ceftriaxone show moderate efficacy, but resistance trends highlight the need for culture-based therapy[17]. The emergence of extended-spectrum beta-lactamase (ESBL)-producing *Klebsiella* and *E. coli* further complicates treatment strategies.COM remains a major public health concern due to its potential complications and the increasing burden of antibiotic resistance. Understanding the microbiological spectrum and antibiotic susceptibility patterns is critical for guiding empirical therapy. Therefore, this study aimed to assess the microbiological profile and antibiotic susceptibility in chronic otitis media.

Methods:

This cross-sectional study was conducted to evaluate the microbiological profile and antibiotic resistance patterns in patients with chronic otitis media (COM). The study was carried out from June 2023 to June 2024, in the department of Otolaryngology-Head & Neck Surgery and deferment of microbiology and immunology, Bangabandhu Sheikh Mujib Medical University, Dhaka. Ethical approval for the study was obtained from the institution's review board, and informed consent was obtained from all participants. A total of 110 patients diagnosed with COM were included in the study. The inclusion criteria were as follows: (1) diagnosis of COM, (2) no prior history of systemic antibiotic therapy within the last month, and (3) patients of any age group. Exclusion criteria included patients with systemic infections or other ear conditions that could guides the diagnosis of COM. Demographic data, including age, sex, and clinical history, were recorded for each patient. The patients were classified in groups according to their age for statistical analysis. The clinical diagnosis of COM was confirmed through otoscopic examination, and samples were collected from the middle ear for microbiological analysis. Ear discharge samples were collected using sterile swabs from the middle ear of each patient. The antibiotics tested included gentamicin, neomycin, chloramphenicol, oxacillin, vancomycin, clindamycin, erythromycin, linezolid, ceftazidime, ciprofloxacin, piperacillin-tazobactam, and amikacin. The results were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) guidelines. The percentage of isolates sensitive or resistant to each antibiotic was calculated. Data were analyzed using descriptive statistics. Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) version 25.0.

Results:

Table-I

Age Distribution of Patients (n=110)

Age Group (Years)	Number of Patients (n)	Percentage (%)
0–10	14	12.7
11–20	20	18.2
21–30	32	29.1
31–40	23	20.9
41–50	11	10.0
>50	10	9.1

The age distribution of the 110 patients in this study revealed that the largest proportion of patients fell within the 21–30 years age group (29.1%), followed by those in the 11–20 years group (18.2%). The 31–40 years group accounted for 20.9%, while the 0–10 years group comprised 12.7%. Fewer patients were in the 41–50 years (10.0%) and >50 years (9.1%) categories.

Table II
Number of isolates among the patients (n=110)

Number of Isolates	Number of Patients (n)	Percentage (%)
1	78	70.9
2	22	20.0
≥3	10	9.1

The distribution of the number of isolates among the 110 patients showed that the majority of patients (70.9%) had a single isolate, while 20.0% had two isolates. A smaller proportion of patients (9.1%) had three or more isolates.

Table III
Organisms isolated in Chronic Otitis Media (n=110)

Microorganism	Number of Isolates (n)	Percentage (%)
Pseudomonas aeruginosa	37	33.3
Staphylococcus aureus	37	33.3
Coagulase-negative *Staphylococcus*	23	20.9
Fungi	10	9.1
Anaerobes	7	6.4

The microbiological profile of chronic otitis media (COM) in this study revealed that *Pseudomonas aeruginosa* and *Staphylococcus aureus* were the most predominant pathogens, each accounting for 33.3% of the isolates. Coagulase-negative staphylococci were identified in 20.9% of the cases, while fungi were isolated in 9.1% and anaerobes in 6.4%.

Table IV
Antibiotic Profile of *Pseudomonas aeruginosa* (n=110)

Antibiotic	Sensitive (%)	Resistant (%)
Gentamicin	82.0	18.0
Ceftazidime	78.5	21.5
Ciprofloxacin	74.0	26.0
Piperacillin-Tazobactam	85.5	14.5
Amikacin	81.0	19.0

The antibiotic profile of *Pseudomonas aeruginosa* in this study demonstrated varying levels of resistance to commonly used antibiotics. Gentamicin was the most effective, with 82.0% of isolates being sensitive, while 18.0% were resistant. Piperacillin-tazobactam showed a sensitivity rate of 85.5%, with 14.5% resistance. Ceftazidime and amikacin had sensitivity rates of 78.5% and 81.0%, respectively, with resistance rates of 21.5% and 19.0%. Ciprofloxacin exhibited the lowest sensitivity at 74.0%, with a 26.0% resistance rate.

Table V
Antibiotic response of Staphylococcus aureus (n=110)

Antibiotic	Sensitive (%)	Resistant (%)
Oxacillin	67.5	32.5
Vancomycin	100.0	0.0
Clindamycin	80.5	19.5
Erythromycin	70.0	30.0
Linezolid	98.0	2.0

The antibiotic profile of *Staphylococcus aureus* in this study revealed varying resistance patterns. Vancomycin was found to be highly effective, with 100% sensitivity and no resistance. Linezolid also showed excellent sensitivity (98.0%), with only 2.0% resistance. Clindamycin exhibited a sensitivity rate of 80.5%, while 19.5% of isolates were resistant. Oxacillin showed a sensitivity rate of 67.5%, with 32.5% resistance, and erythromycin had a sensitivity of 70.0%, with a 30.0% resistance rate.

Table VI
Antibiotic Profile of Coagulase-Negative *Staphylococcus* (n=110)

Antibiotic	Sensitive (%)	Resistant (%)
Oxacillin	60.0	40.0
Vancomycin	100.0	0.0
Clindamycin	75.0	25.0
Erythromycin	65.0	35.0
Linezolid	96.0	4.0

The antibiotic profile of coagulase-negative *Staphylococcus* (CNS) in this study demonstrated significant resistance to commonly used antibiotics. Vancomycin was fully effective, with 100% sensitivity and no resistance. Linezolid also showed a high sensitivity rate of 96.0%, with only 4.0% resistance. Clindamycin exhibited a sensitivity of 75.0%, with 25.0% resistance, while oxacillin and erythromycin showed lower sensitivity rates of 60.0% and 65.0%, respectively, with resistance rates of 40.0% and 35.0%.

Table VII
Percentage of Total Isolates Sensitive to Topical Antibiotics (n=110)

Topical Antibiotic	Sensitivity (%)
Gentamicin	82.6
Neomycin	67.8
Chloramphenicol	62.8
Ciprofloxacin	74.0

The sensitivity of total isolates to topical antibiotics in this study revealed that gentamicin was the most effective, with 82.6% of isolates showing sensitivity. Ciprofloxacin showed the sensitivity of 74.0%. Neomycin followed with a sensitivity rate of 67.8%, while chloramphenicol showed the lowest sensitivity at 62.8%.

Discussion:

Chronic Otitis Media (COM) remains a significant global health concern, especially in developing regions where access to healthcare and hygiene conditions are suboptimal. The persistence of the disease despite available medical interventions highlights the need for continuous monitoring of its microbiological profile and antibiotic susceptibility patterns. The present study provides an updated insight into the predominant pathogens associated with COM and their antibiotic resistance patterns, facilitating better empirical treatment strategies.In this study, the highest incidence of COM was observed in the 21–30 age group (29.1%), followed by the 31–40 age group (20.9%). These findings align with previous studies, which indicate that COM predominantly affects young adults and adolescents, likely due to recurrent upper respiratory tract infections and poor healthcare-seeking behaviors[2,8]. Additionally, the presence of COM in pediatric patients (12.7% in the 0–10 age group) emphasizes

the importance of early detection and management to prevent long-term complications, including hearing impairment[3].The microbiological analysis revealed that *Pseudomonas aeruginosa* (33.3%) and *Staphylococcus aureus* (33.3%) were the most commonly isolated pathogens, followed by *Coagulase-negative Staphylococcus* (20.9%), fungi (9.1%), and anaerobes (6.4%). This distribution is consistent with other studies that have identified *P. aeruginosa* and *S. aureus* as the predominant organisms in COM cases[10]. *Pseudomonas aeruginosa* is particularly associated with chronicity and treatment resistance due to its ability to form biofilms and produce virulence factors that impair host immune responses[18].The detection of fungal pathogens in 9.1% of cases, predominantly *Aspergillus* and *Candida* species is of clinical significance, particularly in patients with prolonged antibiotic use or immuno-suppression[19]. Similarly, the presence of anaerobic bacteria in 6.4% of cases aligns with previous reports, highlighting the role of anaerobes in cases with chronic infections and cholesteatoma[15].The antibiotic susceptibility patterns of *P. aeruginosa* demonstrated high sensitivity to piperacillin-tazobactam (85.5%), gentamicin (82.0%), and amikacin (81.0%), while resistance was notable against ciprofloxacin (26.0%) and ceftazidime (21.5%). These findings corroborate previous studies indicating an increasing resistance trend to fluoroquinolones and cephalosporins in *P. aeruginosa*, largely due to overuse of these agents[13,16].The emergence of methicillin-resistant *S. aureus* (MRSA), with 32.5% resistance to oxacillin, poses a growing challenge in COM management. However, vancomycin and linezolid demonstrated 100% and 98.0% susceptibility, respectively, indicating their effectiveness in treating MRSA infections. Clindamycin (80.5% susceptibility) and erythromycin (70.0%) remain viable options for treating methicillin-sensitive *S. aureus* (MSSA)[20]. *Coagulase-negative Staphylococcus* (CoNS) isolates also exhibited substantial resistance to oxacillin (40.0%), reinforcing the need for appropriate antibiotic selection based on culture sensitivity[9]. The continued susceptibility of CoNS to vancomycin (100%) and linezolid (96.0%) supports their role in the treatment of resistant Gram-positive infections. Topical antibiotics play a crucial role in COM management, particularly in patients with mild-to-moderate infections. In this study, gentamicin demonstrated the highest sensitivity (82.6%), followed by neomycin (67.8%) and chloramphenicol (62.8%). This is consistent with prior reports, indicating gentamicin's superior efficacy against common COM pathogens[21]. The rising antibiotic resistance among COM pathogens underscores the need for rational antibiotic use and routine culture-based treatment approaches. Empirical therapy should be guided by local antibiograms, and systemic antibiotics should be reserved for severe cases or complications. Additionally, preventive strategies, including vaccination programs (pneumococcal and influenza vaccines), improved hygiene practices, and early treatment of acute otitis media, can significantly reduce the incidence of COM[22].

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

The *Pseudomonas aeruginosa* and *Staphylococcus aureus* as the predominant pathogens in chronic otitis media (COM), with concerning levels of antibiotic resistance. While gentamicin remains the most effective

topical antibiotic, the rising resistance to commonly used systemic antibiotics necessitates culture-based treatment strategies. The findings emphasize the importance of routine microbiological surveillance, judicious antibiotic use, and preventive healthcare measures to improve COM management and reduce its long-term complications.

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