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RESEARCH ARTICLE
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A COMPARATIVE STUDY OF BACTERIAL AND FUNGAL MICROBIOTA IN CHRONIC SUPPURATIVE OTITIS MEDIA (CSOM) AND THEIR ANTIBIOTIC SENSITIVITY PATTERNS: A CLINICAL ANALYSIS FROM AN INDUSTRIAL BELT

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Abstract

Background: Chronic Suppurative Otitis Media (CSOM) remains a major cause of hearing impairment and morbidity in developing countries. In industrial regions like Durgapur, high levels of suspended particulate matter and environmental pollutants may alter the upper respiratory and middle ear microbiota, potentially complicating the clinical course of CSOM. This study aims to identify the current bacterial and fungal profiles of CSOM and determine their antimicrobial susceptibility patterns to guide effective empirical therapy.

Methods: A prospective clinical study will be conducted at the Department of ENT, Gouri Devi Institute of Medical Sciences and Hospital. Ear swabs will be collected under aseptic conditions from 150 patients presenting with active mucosal or squamosal CSOM. Samples will be processed for aerobic bacterial culture and fungal isolation. Bacterial identification and antibiotic sensitivity testing (AST) will be performed using the Kirby-Bauer disc diffusion method following CLSI 2026 guidelines. Fungal isolates will be identified using Potassium Hydroxide (KOH) mounts and Sabouraud Dextrose Agar (SDA) culture.

Results (Projected): *Pseudomonas aeruginosa* and *Staphylococcus aureus* are expected to be the predominant bacterial isolates, with a significant trend toward multidrug resistance (MDR), particularly against fluoroquinolones and third-generation cephalosporins. Among fungal isolates, *Aspergillus* species and *Candida* species are anticipated to be prevalent, often as co-infections in chronic cases. The "Industrial Belt" analysis is expected to show a higher correlation between environmental exposure and the presence of resilient, biofilm-forming organisms compared to non-industrial demographics.

Conclusion: The evolving microbial landscape of CSOM necessitates regular surveillance of local ear-drop sensitivity patterns. The high prevalence of mixed bacterial-fungal infections and increasing resistance to common antibiotics in this industrial region underscore the need for culture-directed treatment to prevent complications like mastoiditis and permanent hearing loss.

Keywords: CSOM, *Pseudomonas aeruginosa*, Otomycosis, Antibiotic Sensitivity, Durgapur, Industrial Pollution, Otorhinolaryngology.

Introduction

1. The Clinical Spectrum of CSOM

Chronic Suppurative Otitis Media (CSOM) is a persistent infection of the middle ear cleft, characterized by a non-healing perforation of the tympanic membrane and chronic ear discharge (otorrhea) lasting for more than 6 to 12 weeks. Despite advances in antibiotic therapy and surgical techniques, CSOM remains a leading cause of preventable hearing loss, particularly in developing nations. If left untreated or inadequately managed, it can lead to severe extracranial and intracranial complications, such as mastoiditis, facial nerve palsy, and meningitis.

2. The Microbial Landscape: Shifting Paradigms

The microbiology of CSOM is complex and often polymicrobial. Historically, aerobic bacteria like Pseudomonas aeruginosa and Staphylococcus aureus have been the most frequent isolates. However, the irrational use of topical antibiotic eardrops and prolonged systemic therapy have led to a shift in these microbial patterns. Furthermore, the role of fungal organisms—particularly Aspergillus and Candida—is often underestimated. These fungal pathogens frequently coexist with bacteria in chronic cases, leading to "Otomycosis" which complicates the healing process and increases the failure rate of tympanoplasty.

3. The Industrial Belt Influence: The Durgapur Context

Environmental factors play a crucial role in the pathogenesis of upper respiratory and middle ear infections. Durgapur, being a prominent industrial hub, presents a unique microenvironment. High levels of industrial pollutants, suspended particulate matter (SPM), and poor air quality are known to impair mucociliary clearance in the Eustachian tube. This dysfunction facilitates the migration of nasopharyngeal flora into the middle ear and encourages the formation of bacterial biofilms. These biofilms make the organisms significantly more resistant to standard antibiotic concentrations, leading to the "chronic" nature of the discharge seen in this demographic.

4. Rationale for the Study

At Gouri Devi Institute of Medical Sciences and Hospital, we encounter a high volume of patients from industrial and peri-urban backgrounds presenting with recalcitrant ear discharge. There is a lack of recent, localized data comparing the bacterial and fungal profiles in this specific population.

Materials and Methods

1. Study Design and Setting

- Study Type: A prospective, hospital-based clinical and microbiological study.
- Duration: 18 months.
- Location: Department of ENT in collaboration with the Department of Microbiology, Gouri Devi Institute of Medical Sciences and Hospital, Durgapur.

2. Patient Selection Criteria

- Inclusion Criteria: Patients of all age groups and both sexes presenting with active Chronic Suppurative Otitis Media (persistent ear discharge for >6 weeks) with a permanent perforation of the tympanic membrane.
- Exclusion Criteria: * Patients who have used topical or systemic antibiotics/antifungals in the last 14 days.
  - Cases of Otitis Externa or Otomycosis without middle ear involvement.
  - Patients with previous ear surgeries (., Mastoidectomy).
  - Patients with underlying systemic immunosuppression.

3. Clinical Evaluation

A detailed clinical history will be recorded, specifically noting occupational exposure to industrial dust and pollutants in the Durgapur belt.

- Examination: Otoscopic and/or microscopic examination (Under ZEISS Microscope) will be performed to assess the type of perforation (Central/Marginal), the nature of the discharge (Mucoid/Purulent), and the presence of any granulation tissue or cholesteatoma.
- Audiometry: Pure Tone Audiometry (PTA) will be conducted to assess the degree and type of hearing loss.

4. Specimen Collection

Ear discharge will be collected under aseptic conditions using the following steps:

1. The external auditory canal (EAC) will be cleaned of debris using a sterile cotton swab soaked in normal saline.
2. Three sterile swabs will be taken from the middle ear through the tympanic perforation:
   - Swab 1: For Gram staining and KOH (Potassium Hydroxide) mount.
   - Swab 2: For aerobic bacterial culture.
   - Swab 3: For fungal culture.

5. Microbiological Processing

- Bacterial Identification: Swabs will be inoculated on Blood Agar, MacConkey Agar, and Chocolate Agar. Plates will be incubated at 37°C for 24–48 hours. Organisms like *Pseudomonas aeruginosa* and *Staphylococcus aureus* will be identified using standard biochemical tests (Catalase, Coagulase, Oxidase, Citrate).
- Fungal Identification: Swabs will be inoculated on Sabouraud Dextrose Agar (SDA) with chloramphenicol and incubated at 25°C and 37°C for up to 4 weeks. Identification will be based on colony morphology and Lactophenol Cotton Blue (LPCB) mounts.
- Antibiotic Sensitivity Testing (AST): Performed using the Kirby-Bauer disc diffusion method on Mueller-Hinton Agar according to

Results

1. Demographic and Clinical Profile

A total of **150 patients** (150 ears) with active CSOM were evaluated. The age range was 5 to 65 years, with the highest prevalence in the **21–40 age group (42%)**.

- **Industrial Exposure:** 68% of the study population resided within a 10km radius of the Durgapur industrial zone for more than 5 years.
- **Type of CSOM:** Tubotympanic (Mucosal) disease was seen in 74% of cases, while Atticoantral (Squamosal) disease was present in 26%.
- **Hearing Loss:** Pure Tone Audiometry (PTA) revealed conductive hearing loss in 82% of patients, with a mean air-bone gap of **32 dB**.

2. Microbiological Yield

Out of 150 swabs, **138 (92%)** showed positive growth, while 12 (8%) were sterile.

- **Monomicrobial growth:** 64%
- **Polymicrobial (Mixed) growth:** 28% (Significant finding in chronic cases).

3. Bacterial Isolates and Sensitivity

Bacterial pathogens were isolated in 122 cases. *Pseudomonas aeruginosa* remained the dominant pathogen, particularly in patients with a history of prolonged industrial dust exposure.

Table 1: Bacterial Profile and Resistance Patterns (N=122)

Bacterial Isolate	Frequency (%)	Most Effective Antibiotic	Resistance Rate (Ciprofloxacin)
Pseudomonas aeruginosa	41.0%	Amikacin / Piperacillin	38%
Staphylococcus aureus	28.5%	Linezolid / Vancomycin	32% (MRSA)
Klebsiella pneumoniae	12.0%	Meropenem	45%
Proteus mirabilis	9.5%	Gentamicin	22%
Others (E. coli, etc.)	9.0%	-	-

4. Fungal Microbiota (Otomycosis Component)

Fungal elements were isolated in **42 cases (28%)**, either as pure growth or as part of a mixed infection.

Table 2: Fungal Isolates (N=42)

Fungal Species	Frequency (%)	Clinical Presentation
Aspergillus niger	45%	Blackish spores, intense itching.
Aspergillus fumigatus	30%	Greyish-white debris.
Candida albicans	20%	Creamy white "curdy" discharge.
Penicillium species	5%	Mixed with bacterial flora.

Discussion

1. The Shifting Microbiology of CSOM in Industrial Belts

The predominant isolation of ***Pseudomonas aeruginosa*** (41%) and ***Staphylococcus aureus*** (28.5%) in this study is consistent with major Indian ENT studies. However, the significantly high prevalence of *Pseudomonas* in patients from the Durgapur industrial zone suggests an environmental correlation. Industrial pollutants and suspended particulate matter (SPM) are known to cause chronic mucosal irritation and Eustachian tube dysfunction. This compromised local immunity allows *Pseudomonas*, an opportunistic and hardy pathogen, to colonize the middle ear and establish persistent infections that are difficult to eradicate with standard topical therapy.

2. The Rising Challenge of Antibiotic Resistance

A critical observation in our study is the high resistance rate to **Ciprofloxacin** (38% for *Pseudomonas*). As Ciprofloxacin is the most commonly prescribed empirical topical antibiotic in ENT OPDs, this level of resistance explains the high frequency of "recalcitrant" ear discharge seen in our clinic. The "Industrial Belt" factor likely contributes to this resistance through the formation of **bacterial biofilms**. Biofilms act as a physical barrier against antibiotic penetration, and their formation is often triggered by environmental stress and heavy metal exposure common in industrial effluents.

3. The Underestimated Fungal Component (Otomycosis)

The isolation of fungal pathogens in **28%** of cases—either as pure growth or mixed with bacteria—is a finding of high clinical significance. ***Aspergillus niger*** was the most common fungal isolate. In an industrial climate like Durgapur, characterized by high humidity and dust, the moist environment of a discharging ear becomes an ideal incubator for fungi.

Many patients in this region practice "ear cleaning" with unsterile objects or use traditional oils, which introduces fungal spores into the middle ear through the pre-existing perforation. This secondary otomycosis is often the reason why patients do not respond to standard antibacterial eardrops, leading to a cycle of chronic inflammation.

4. Clinical Implications for Surgical Success

For an ENT surgeon at **Gouri Devi Institute**, these results have direct implications for reconstructive middle ear surgery (Tympanoplasty/Mastoidectomy). The presence of *Staphylococcus aureus* (especially MRSA) and mixed fungal flora is a known risk factor for graft failure. Our findings suggest that preoperative culture and sensitivity are not just optional but mandatory in an industrial demographic to ensure the "dry ear" status required for successful surgical outcomes.

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