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MICROBIOLOGICAL PROFILE AND ANTIBIOTIC SENSITIVITY PATTERN IN ACTIVE TUBOTYMPANIC (MUCOSAL) TYPE OF CHRONIC SUPPURATIVE OTITIS MEDIA

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ABSTRACT **Background And Rational:** Chronic Suppurative Otitis Media (CSOM) is a common infectious disease of the middle ear cleft, defined by persistent discharge through a tympanic membrane perforation lasting over three months [1]. Because microbiological profiles vary by geography and irrational antibiotic use drives resistance, identifying local pathogen patterns is essential for effective empirical treatment. This study focused specifically on the active tubotympanic (mucosal) type of CSOM. **Methods:** This descriptive cross-sectional study assessed 85 patients with clinically diagnosed active tubotympanic CSOM who had not utilized systemic or topical antibiotics for at least 15 days. Aseptic ear discharge specimens were analyzed via aerobic and fungal cultures, and Antimicrobial Susceptibility Testing (AST) was conducted using the Kirby-Bauer disc diffusion method, interpreted according to CLSI guidelines [2]. **Results:** Cultures were positive in 97.65% of cases, with monomicrobial infections being the most common (70.59%). The predominant pathogens were Pseudomonas aeruginosa (44.71%) and Staphylococcus aureus (42.35%). The study noted a male predominance (62.35%) and a higher prevalence among the lower socio-economic class (52.94%). Clinically, 55.29% of patients experienced symptoms for over 12 months, and audiological evaluations revealed that sensorineural hearing loss (44.71%) slightly exceeded conductive hearing loss (40%). **Conclusion:** Antibiotic sensitivity testing indicated that isolates were highly sensitive to Colistin (94%), Meropenem (92%), and Vancomycin (91%). However, significant resistance was observed against common antibiotics like Ampicillin (59%), Erythromycin (53%), and Azithromycin (51%), highlighting the need for targeted therapy based on local antibiograms.

KEYWORDS : Chronic Suppurative Otitis Media (CSOM), Tubotympanic, Pseudomonas aeruginosa, Staphylococcus aureus, Antimicrobial Resistance.

Introduction To Chronic Suppurative Otitis Media (CSOM)

Chronic Suppurative Otitis Media (CSOM) is a prevalent infectious disease in otorhinolaryngology practice, characterized by a longstanding infection of the mucoperiosteal lining of the middle ear cleft. It is defined by continuous or intermittent discharge through a persistent tympanic membrane perforation lasting for more than three months[1]. The disease affects all age groups but is particularly common in children and populations in underdeveloped areas, with an estimated global incidence of over 20 million people.

CSOM is clinically classified into two distinct types:

Tubotympanic (Safe/Benign) Type: This type primarily affects the anteroinferior region of the middle ear cleft and is associated with a central perforation. While associated with discharge and hearing loss, it carries a lower risk of severe complications.

Atticoantral (Unsafe/Dangerous) Type: This involves the posterosuperior regions and is associated with marginal perforations. It is termed "dangerous" because it is prone to cholesteatoma formation and bone erosion, leading to serious complications.

The development of CSOM is multifactorial, involving genetic, environmental, and social risk factors. Key risk determinants include frequent acute otitis media (AOM), upper respiratory tract infections (URTI), tympanic membrane trauma, poor nutrition, and overcrowding.

Anatomical And Physiological Context

The Middle Ear Cleft The middle ear cleft is a system of air-filled spaces within the temporal bone, comprising the Eustachian tube, tympanic cavity (middle ear), mastoid antrum, and mastoid air cells. These components function together to maintain pressure equilibrium and facilitate sound transmission.

Eustachian Tube: Connecting the middle ear to the nasopharynx, this tube equalizes pressure and drains secretions. In children, the tube is shorter, wider, and more horizontal, making them more susceptible to retrograde infection from the nasopharynx.

Tympanic Membrane: This trilaminar structure separates the external ear from the middle ear. Perforations in the membrane, which can be central or marginal, disrupt the "gas cushion" of the middle ear, leading to the reflux of nasopharyngeal secretions and pathogen entry.

Mastoid Air Cells: These are air-filled spaces connecting to the middle ear via the antrum. They act as a buffer system for pressure and insulation. Infection here can lead to mastoiditis.

Physiology of Hearing The middle ear acts as an impedance-matching device, amplifying sound energy to overcome the air-fluid barrier of the inner ear. The hydraulic action of the tympanic membrane and the lever action of the ossicles result in an approximate 27 dB gain. CSOM disrupts this mechanism through membrane perforation and ossicular chain erosion, leading to conductive or mixed hearing loss.

Pathogenesis and Microbiology

The transition from acute to chronic otitis media involves complex interactions between host immunity, bacterial virulence, and environmental factors. A significant factor in the persistence of CSOM is the formation of bacterial biofilms, which adhere to damaged mucosa or implants and resist antibiotic treatment.

Microbial Profile The microbiology of CSOM is diverse and varies by geography and patient immunity.

Aerobic Bacteria: *Pseudomonas aeruginosa* and *Staphylococcus aureus* are the most predominant isolates globally. *Pseudomonas* is particularly noted for its ability to form biofilms and develop antibiotic resistance. Other common pathogens include *Proteus* species, *Klebsiella* species, and *Escherichia coli* [4-6].

Anaerobes and Fungi: Anaerobic bacteria like *Peptostreptococcus* and fungi such as *Aspergillus* and *Candida* species are also potential causative agents, particularly in immunocompromised individuals or those with long-term antibiotic use.

Literature Review

Previous studies highlight the shifting landscape of CSOM microbiology:

Draman et al. (2021): Found *Pseudomonas aeruginosa* (32.6%) as the most common isolate, followed by *S. aureus*. They noted high sensitivity to ceftazidime and meropenem but declining sensitivity to other agents.

Sahu and Swain (2019): Identified *S. aureus* (29.17%) as the most prevalent, followed by *P. aeruginosa*. They highlighted a high prevalence of Multidrug-Resistant (MDR) strains.

Geeta et al. (2023): Reported *P. aeruginosa* (39.58%) as the primary pathogen. They observed that gram-negative organisms were sensitive to ciprofloxacin and meropenem, while *S. aureus* remained sensitive to vancomycin.

Xu et al. (2020): In contrast to others, found *S. aureus* (44.9%) to be the most common, with significant Methicillin-Resistant *S. aureus* (MRSA) presence.

Material And Methods Of The Present Study

Study Design This descriptive cross-sectional study was conducted at the Department of ENT, BRLSABVM Medical College, from July 2023 to December 2024.

Study Population

The study included 85 patients clinically diagnosed with active tubotympanic CSOM.

- **Inclusion Criteria:** Patients aged 2 to 80 years with active discharge who had not received antibiotics in the past 15 days.
- **Exclusion Criteria:** Atticoantral disease, inactive CSOM, malignancy, or immunocompromised status.

Sample Size Calculation The sample size was determined using the formula:

$n=d2(Z)2pq$

Based on a prevalence of CSOM in India(p)of 5.2% [5] and allowing for a non-response rate, the final sample size was approximated to 85 patients.

Specimen Collection and Processing Ear discharge was collected using sterile swabs under aseptic conditions. Three swabs were utilized:

1. Bacterial Culture: Inoculated on MacConkey, Blood, and Chocolate agar.
2. Gram Staining: For direct microscopic examination.
3. Fungal Culture: Using Sabouraud Dextrose Agar and KOH wet mount.

Antibiotic Sensitivity Testing Susceptibility was tested using the Kirby-Bauer disc diffusion method on Mueller-Hinton agar, interpreted according to CLSI 2023 guidelines [6].

RESULTS

Demographics

Age: The most affected age group was 31–40 years (21.18%), followed by 21–30 years (18.82%). Children (2–10 years) comprised 9.41% of the study.

Gender: Males were predominantly affected (62.35%) compared to females (37.65%).

Socioeconomic Status (SES): The majority belonged to the lower class (52.94%), followed by the middle class (35.29%).

Residence: A higher prevalence was observed in urban populations (65.88%) compared to rural (34.12%).

Occupation: Farmers (31.76%) and students (24.71%) were the most affected groups.

Clinical Features

Symptoms: Ear discharge was the universal complaint (68.24% listed as chief complaint), followed by earache (42.35%) and tinnitus (9.41%).

Duration: The condition was chronic and long-standing; 55.29% of patients reported symptoms lasting more than 12 months.

Laterality: The infection was predominantly unilateral (95.29%), with the left ear affected slightly more often (49.41%) than the right (45.88%).

Precipitating Factors: Upper respiratory tract infections were the most common trigger (55.29%), followed by allergic rhinitis (27.06%).

Hearing Loss: Audiological evaluation revealed that sensorineural hearing loss (44.71%) was the most common type, followed by conductive hearing loss (40%). The degree of loss was mostly moderate (28.2%) to moderately severe (23.5%).

Microbiological Profile

- **Culture Outcome:** Bacterial or fungal growth was positive in 97.65% of samples; only 2.35% were negative.
- **Infection Type:** Monomicrobial infections were dominant (70.59%), while polymicrobial infections accounted for 27.06%.

Organisms Isolated:

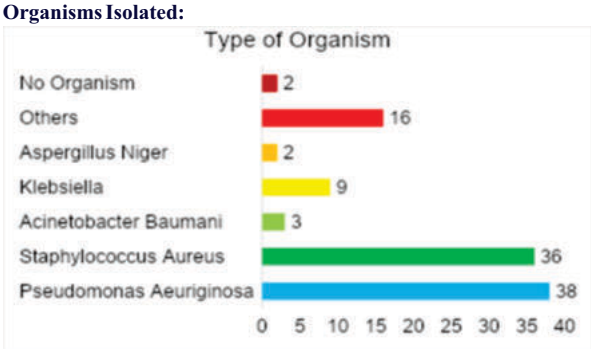

Figure 1: Type of Organism

- *Pseudomonas aeruginosa:* The most frequent isolate (44.71%).
- *Staphylococcus aureus:* The second most frequent isolate (42.35%).
- Other isolates included *Klebsiella* spp. (10.59%), *Acinetobacter baumannii* (3.53%), and *Aspergillus niger* (2.35%).

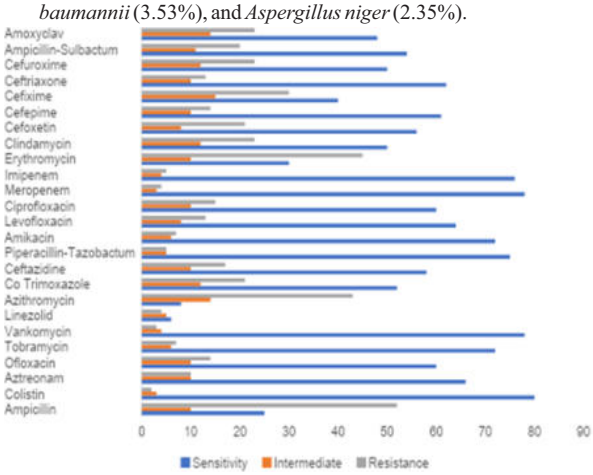

Figure 2: Antibiotic Sensitivity

Antibiotic Sensitivity Patterns The study tested 25 antibiotics. The results indicated distinct patterns of resistance and sensitivity (Table 01 and Figure 02):

Antibiotic	Sensitivity	Intermediate	Resistance
Ampicillin	25 (29%)	10 (12%)	52 (59%)
Colistin	80 (94%)	3 (4%)	2 (2%)
Aztreonam	66 (77%)	10 (12%)	10 (11%)
Ofloxacin	60 (71%)	10 (12%)	14 (17%)
Tobramycin	72 (85%)	6 (7%)	7 (8%)
Vancomycin	78 (91%)	4 (5%)	3 (4
Linezolid	6 (89%)	5 (6%)	4 (5%)
Azithromycin	8 (33%)	14 (16%)	43 (51%)
Co Trimoxazole	52 (61%)	12 (14%)	21 (25%)
Ceftazidime	58 (68%)	10 (12%)	17 (20%)
Piperacillin-Tazobactam	75 (88%)	5 (6%)	5 (6%)
Amikacin	72 (85%)	6 (7%)	7 (8%)
Levofloxacin	64 (75%)	8 (9%)	13 (16%)
Ciprofloxacin	60 (71%)	10 (12%)	15 (17%)
Meropenem	78 (92%)	3 (4%)	4 (4%)
Imipenem	76 (89%)	4 (5%)	5 (6%)
Erythromycin	30 (35%)	10 (12%)	45 (53%)
Clindamycin	50 (59%)	12 (14%)	23 (27%)
Cefoxitin	56 (66%)	8 (9%)	21 (25%)

Cefepime	61 (72%)	10 (12%)	14 (16%)
Cefixime	40 (47%)	15 (18%)	30 (35%)
Ceftriaxone	62 (73%)	10 (12%)	13 (15%)
Cefuroxime	50 (59%)	12 (14%)	23 (27%)
Ampicillin-Sulbactam	54 (63%)	11 (13%)	20 (24%)
Amoxiclav	48 (56%)	14 (16%)	23 (27%)

Highly Effective Antibiotics:
- **Colistin:** 94% sensitivity (Best overall).
- **Meropenem:** 92% sensitivity.
- **Vancomycin:** 91% sensitivity.
- **Imipenem:** 89% sensitivity.
- **Linezolid:** 89% sensitivity.
- **Piperacillin-Tazobactam:** 88% sensitivity.
- **Amikacin:** 85% sensitivity.

Moderately Effective Antibiotics:
- **Ciprofloxacin & Ofloxacin:** 71% sensitivity. These fluoroquinolones showed resistance rates of roughly 17%, indicating growing resistance.
- **Ceftriaxone:** 73% sensitivity.

High Resistance (Less Effective):
- **Ampicillin:** Highest resistance at 59% (only 29% sensitive).
- **Erythromycin:** 53% resistance.
- **Azithromycin:** 51% resistance.
- **Cefixime:** 35% resistance.

DISCUSSION

The study reaffirms that CSOM is a significant health burden, particularly among young adults and those of lower socioeconomic status. The preponderance of males and urban residents may reflect occupational exposures and environmental hygiene factors.

The microbiological findings align with global trends identifying *Pseudomonas aeruginosa* and *Staphylococcus aureus* as the primary pathogens. The high prevalence of *Pseudomonas* suggests that empirical treatment must cover gram-negative organisms.

Crucially, the antibiotic sensitivity profile highlights a worrying trend of resistance to commonly used first-line antibiotics like Ampicillin and Macrolides. While fluoroquinolones (Ciprofloxacin) are often the standard topical treatment, the study revealed a resistance rate of 17%, suggesting their efficacy may be diminishing due to widespread use. Conversely, drugs like Colistin, Meropenem, and Vancomycin remain highly effective but are typically reserved for severe or resistant cases.

The high rate of sensorineural hearing loss (44.71%) observed in this study is notable, as CSOM is traditionally associated with conductive loss. This suggests that chronic inflammation and potential cochlear toxicity from the infection or treatment may have long-term consequences on inner ear function.

Limitations

The study was limited by its single-center design, which may not reflect regional variations in microbial flora. The exclusion of anaerobic bacteria and viral pathogens due to technical constraints limits the complete understanding of the polymicrobial nature of CSOM. Additionally, the sample size (n=85) resulted in a low number of isolates for certain organisms (e.g., *Proteus*), making statistical analysis for those specific pathogens less robust.

RECOMMENDATIONS AND CONCLUSION

Conclusion Active tubotympanic CSOM in this study population is characterized by chronic discharge, unilateral involvement, and significant hearing impairment. The infection is predominantly bacterial, driven by *Pseudomonas aeruginosa* and *Staphylococcus aureus*. There is a clear shift in antibiotic susceptibility, with significant resistance observed against older beta-lactams and macrolides.

Recommendations

a) Routine Culture: Empirical therapy often fails due to resistance; therefore, routine microbiological culturing of ear discharge is recommended prior to treatment.

b) Rational Antibiotic Use: To combat the rising resistance against fluoroquinolones and cephalosporins, strict antibiotic stewardship programs are necessary.

c) Updated Antibiograms: Hospitals should maintain local antibiograms to guide empirical decisions when culture facilities are unavailable.

d) Public Awareness: Educating at-risk populations (farmers, low Socioeconomic Status groups) about ear hygiene and early treatment of URTIs is vital for prevention.

e) Audiological Screening: Routine hearing assessments are essential for early detection and rehabilitation of hearing loss associated with CSOM.

By adhering to culture-guided therapies and improving hygiene and living conditions, the burden of CSOM and its complications can be significantly reduced.

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