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BACTERIOLOGICAL PROFILE AND ANTIBIOTIC GUIDELINES FOR CHRONIC OTITIS MEDIA – A RURAL TERTIARY TEACHING HOSPITAL-BASED STUDY

ENT

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ABSTRACT

Introduction: Chronic otitis media (COM) is a persistent middle ear infection causing recurrent ear discharge and hearing loss, particularly in rural, low-income communities. This study evaluates the bacteriological profile, antibiotic susceptibility patterns, and evidence-based treatment guidelines for COM in a rural tertiary care setting. **Materials And Methods:** A cross-sectional study of 114 COM patients at a rural tertiary care hospital involved microbiological analysis of ear swabs to identify pathogens and their antibiotic susceptibility. **Results:** Gram-negative bacteria predominated (64.91%), with Pseudomonas aeruginosa (58.82%) and Methicillin-Resistant Staphylococcus aureus (MRSA) (25.44%) being most common. Gentamicin showed the highest susceptibility (61.90% for P. aeruginosa, 55.55% for MRSA). **Conclusion:** P. aeruginosa and MRSA are the primary COM pathogens, with increasing resistance to higher antibiotics. We recommend a 7–10-day course of tobramycin-based ear drops as first-line treatment, with culture-guided therapy for non-responsive cases. Regular bacteriological studies are essential to optimize treatment and mitigate resistance.

KEYWORDS

Chronic otitis media, antibiotic susceptibility, bacteriological profile, rural health

INTRODUCTION

Chronic otitis media (COM) is a long-standing inflammation of the middle ear and mastoid cavity, persisting for over 12 weeks, characterized by recurrent ear discharge (otorrhea) and conductive hearing loss. It is a major public health concern, particularly in infants and children from rural, low socioeconomic communities, where prevalence in India exceeds 4%, placing it among the highest globally [1]. COM contributes to speech and language delays in children and poses risks of serious complications if untreated [2].

COM is classified into two types: mucosal (tubo-tympanic or safe) and squamous (attico-antral or unsafe). Mucosal COM involves a central perforation of the pars tensa with low complication risk, while squamous COM, associated with cholesteatoma, carries a higher risk of intra-temporal (e.g., mastoiditis, facial paralysis, labyrinthitis) and intracranial complications (e.g., meningitis, brain abscess) [3,4, 5]. The microbial flora of COM varies by geography and socioeconomic status. Aerobic bacteria such as Pseudomonas aeruginosa, Staphylococcus aureus, Proteus spp., Klebsiella spp., and Escherichia coli are commonly isolated, alongside anaerobic bacteria like Peptococcus niger and Fusobacterium spp., and fungi such as Aspergillus niger and Candida spp. [6-9].

Antibiotic resistance is an emerging challenge in COM management, driven by indiscriminate use of broad-spectrum antibiotics and inadequate treatment regimens [10]. Rural populations face unique risk factors, including malnutrition, poor hygiene, overcrowding, and limited healthcare access, which exacerbate infection rates and resistance [11]. Knowledge of local microbial profiles and susceptibility patterns is essential for developing effective treatment protocols. This study aims to characterize the bacteriological diversity in ear discharge, determine antibiotic susceptibility, and propose evidence-based antibiotic guidelines for COM in a rural tertiary care hospital.

Objectives

1. Characterize the bacteriological diversity in ear discharge of COM patients at a rural tertiary care hospital.
2. Evaluate antibiotic susceptibility patterns of COM pathogens.
3. Formulate evidence-based antibiotic treatment guidelines for COM.

Methodology

This observational, cross-sectional study enrolled 114 patients with chronic otitis media (COM) attending the ENT outpatient department of a rural tertiary care hospital in Faridabad, Haryana, over a six month period. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants.

Inclusion Criteria:

- Patients with mucosal or squamous COM presenting with active ear discharge.

Exclusion Criteria:

- Use of local or systemic antibiotics within 7 days prior to enrolment.
- Current febrile illness, recent ear or mastoid surgery, presence of in-situ grommets or tympanostomy tubes, or congenital ear/hearing abnormalities.

A detailed clinical history was collected, including age, sex, socioeconomic status, duration and onset of ear discharge, associated symptoms (e.g., hearing loss, pain), and prior antibiotic use. Otoscopic examination was performed to assess tympanic membrane status and document findings.

Sample Collection And Microbiological Analysis: Ear swabs were collected aseptically from the affected ear(s), with bilateral sampling for patients with bilateral discharge. Swabs were transported to the Microbiology Department for immediate processing. Each swab underwent direct Gram staining and aerobic culture. Samples were inoculated onto MacConkey agar, Blood agar, and Chocolate agar plates and incubated at 37°C for 24 hours. Bacterial isolates were identified based on colony morphology, Gram staining characteristics, and standard biochemical tests, including catalase, coagulase, oxidase, and indole tests, following established protocols [9, 12, 13].

Antibiotic Susceptibility Testing: Susceptibility was assessed using the Kirby-Bauer disc diffusion method on Mueller-Hinton agar, with results interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines [14]. Antibiotics tested included ampicillin, ampicillin-sulbactam, piperacillin-tazobactam, cefotaxime, ceftazidime, ceftazidime-clavulanic acid, aztreonam, amikacin, gentamicin, ciprofloxacin, levofloxacin, and tetracycline.

Statistical Analysis: Data were analyzed using SPSS version 20 [13]. Prevalence of pathogens was calculated as percentages, and differences in susceptibility patterns were compared using the Chi-Square test, with a p-value <0.05 considered significant.

OBSERVATIONS AND RESULTS

The study included 114 patients with clinically diagnosed COM. The majority were aged 0–20 years (68.41%), with the highest incidence in the 0–10 age group (36.84%) (**Table 1**). Males comprised 57.89% (n=66), and females 42.10% (n=48). Unilateral infections were observed in 85.96% (n=98), with bilateral infections in 14.03% (n=16). Rural patients accounted for 87.71% (n=100), and 78.94% (n=90) were from low socioeconomic backgrounds.

Table 1: Age Distribution Of Patients

Age Group (Years)	No. of Patients	Percentage
0-10	42	36.84
11-20	36	31.57
21-30	20	17.54
31-40	8	7.01
41-50	2	1.75
51-60	6	5.26

Bacterial growth was absent in 10.52% (n=12) of swabs, possibly due to anaerobic, fungal, or viral etiologies. Among 102 isolates, gram-negative bacteria predominated (64.91%, n=74) over gram-positive bacteria (24.56%, n=28). Pseudomonas aeruginosa was the most prevalent pathogen (58.82%, n=60), followed by Methicillin-Resistant Staphylococcus aureus(MRSA) (25.44%, n=26). Other isolates included Klebsiella species (7.84%, n=8), Proteus species (5.88%, n=6), and Staphylococcus aureus (1.96%, n=2) (**Table 3**).

Table 2: Growth Results In The Swab

Type of growth	Number	Percentage
Gram Negative Bacteria	74	64.91%
Gram Positive Bacteria	28	24.56%
No Growth	12	10.52%
Total Swabs	114	

Table 3: Bacterial Isolates From Swab Culture

Isolates	Number	Percentage
Pseudomonas aeruginosa	60	58.82%
Staphylococcus Aureus	2	1.96%
Methicillin Resistant Staphylococcus Aureus (MRSA)	26	25.44%
Klebsiella species	8	7.84%
Proteus species	6	5.88%
Total	102	

Antibiotic susceptibility patterns revealed gentamicin as the most effective antibiotic, with 61.90% susceptibility against P. aeruginosa and 55.55% against MRSA. Other antibiotics showed variable efficacy: amikacin (57.14% for P. aeruginosa, 33.33% for MRSA), ciprofloxacin (57.14% for P. aeruginosa, 11.11% for MRSA), and piperacillin-tazobactam (47.61% for P. aeruginosa, 0% for MRSA). High resistance was observed for cefotaxime, ceftazidime, and aztreonam, often exceeding 80% (Table 4). Klebsiella species showed 100% susceptibility to gentamicin, while Proteusspecies had 50% susceptibility to most antibiotics tested.

Table 4: Antibiotic sensitivity and resistance pattern of bacterial isolates

Antibiotic Agent	Pseudomonas aeruginosa (n=60)		Methicillin resistant staphylococcus aureus (MRSA) (n=26)		Klebsiella species (n=8)		Proteus species (n=6)		Staphylococcus aures (n=2)	
	%S	%R	%S	%R	%S	%R	%S	%R	%S	%R
Ampicillin	47.61%	52.39%	0	100%	33.33%	66.67%	50%	50%	100%	0
Ampicillin-Sulbactam	47.61%	52.39%	0	100%	33.33%	66.67%	50%	50%	100%	0
Piperacillin-Tazobactam	47.61%	52.39%	0	100%	33.33%	66.67%	50%	50%	0	100%
Cefuroxime(2^{nd})	-	-	-	-	-	-	-	-	-	-
Cefotaxime(3^{rd})	0	100%	11.11%	88.89%	0	100%	50%	50%	100%	0
Ceftazidime(3^{th})	0	100%	0	100%	0	100%	0	100%	0	100%
Cefepime(4^{th})	-	-	-	-	-	-	-	-	-	-
Ceftazidime-Clavulanic acid	0	100%	0	100%	0	100%	0	100%	0	100%
Aztreonam	19.04%	80.96%	0	100%	0	100%	0	100%	0	100%
Meropenem	-	-	-	-	-	-	-	-	-	-
Amikacin	57.14%	42.86%	33.33%	66.67%	66.66%	33.34%	50%	50%	0	100%
Gentamicin	61.90%	38.1%	55.55%	44.45%	100%	0	50%	50%	100%	0
Ciprofloxacin	57.14%	42.86%	11.11%	88.89%	33.33%	66.67%	50%	50%	0	100%
Levofloxacin	38.09%	61.91%	11.11%	88.89%	0	100%	50%	50%	0	100%
Tetracycline	0	100%	11.11%	88.89%	33.33%	66.67%	0	100%	0	100%
Trimethoprim-Sulfamethoxazole	-	-	-	-	-	-	-	-	-	-
Polymyxin B	-	-	-	-	-	-	-	-	-	-

Compared to prior studies, P. aeruginosa in this study showed reduced susceptibility to amikacin (57.14% vs. 80.14–93.6%), ciprofloxacin (57.14% vs. 47.26–91.4%), and piperacillin-tazobactam (47.61% vs. 100% in Parmar et al.) (**Table 5**)

Table 5: Comparison of Sensitivity Pattern of Pseudomonas Aeruginosa

Antimicrobial agent	Present study	Harshika et al., 2015	Twinkle Kumar Kantilal Parmar et al., 2017	Ramesh Agarwal et al., 2017
Ampicillin	47.61%	-	-	-
Ampicillin-Sulbactam	47.61%	-	-	-
Piperacillin-Tazobactam	47.61	-	100%	-
Aztreonam	19.04%	51%	99.32%	52.8%
Amikacin	57.14%	93.6%	80.14%	83.1%
Gentamicin	61.90%	89.3%	50.68%	-
Ciprofloxacin	57.14%	91.4%	47.26%	73.3%
Levofloxacin	38.09%	-	49.32%	-

DISCUSSION

Microbial Profile

Chronic otitis media (COM) remains a significant health burden, particularly in rural India, where pediatric populations are disproportionately affected [14,15]. The high incidence in children aged 0–10 years (36.84%) is likely due to frequent upper respiratory infections, shorter and straighter Eustachian tubes, and environmental exposures such as contaminated water used for bathing or swimming [9]. Males showed a higher prevalence (57.89%) than females (42.10%), consistent with Agarwal et al. (male-to-female ratio 1.38:1) [16], possibly due to increased outdoor activities and risk exposure.

Pseudomonas aeruginosa (58.82%) and MRSA (25.44%) were the dominant pathogens, corroborating previous studies [17-19]. Klebsiella species (7.84%), Proteus species (5.88%), and Staphylococcus aureus (1.96%) were less common, suggesting a primarily monomicrobial etiology, as supported by Haider et al. (80.7% monomicrobial growth) [20]. Negative cultures (10.52%) may indicate anaerobic bacteria, fungi (Aspergillus or Candida spp.), or viral agents (e.g., respiratory syncytial virus), or unreported prior antibiotic use, which is common in rural settings due to self-medication and low health literacy. This also underlines the immense role to be played by the first contact points in rural areas.

Antibiotic Susceptibility

Gentamicin was the most effective antibiotic, with 61.90% susceptibility against P. aeruginosa and 55.55% against MRSA, aligning with Harshika et al. [**10**]. However, P. aeruginosa showed reduced susceptibility to amikacin (57.14% vs. 80.14–93.6%) and ciprofloxacin (57.14% vs. 47.26–91.4%) compared to prior studies [8,14,15]. Notably, piperacillin-tazobactam, reported as 100% effective by Parmar and Pattani [**16**], was susceptible in only 47.61% of P. aeruginosa isolates in our study, highlighting emerging resistance in rural India. MRSA exhibited high resistance to ampicillin, piperacillin-tazobactam, and aztreonam (100%), underscoring the challenge of treating resistant strains.

Risk Factors In Rural Settings

Rural populations face unique challenges, including malnutrition, overcrowding, poor hygiene, and recurrent upper respiratory infections, which exacerbate COM prevalence and resistance [9]. Low public awareness about appropriate antibiotic use and the risks of self-medication further aggravate the problem. Early reporting and initiation of targeted treatment are critical to preventing complications and reducing healthcare burdens in these communities.

Treatment Recommendations

A Cochrane review found topical antibiotics more effective than systemic antibiotics for resolving otorrhea and eradicating middle ear bacteria, with no added benefit from combined oral-topical therapy [**21**]. The choice between quinolones (e.g., ciprofloxacin) and aminoglycosides (e.g., gentamicin, tobramycin) is critical. Ciprofloxacin was effective against only 11.11% of MRSA isolates, while gentamicin achieved 55.55% susceptibility, making it a better empirical choice for COM, given its efficacy against both P. aeruginosa (61.90%) and MRSA.

Both, Committee on Safety of Medicine (UK) and AAOHNS recommend against the use of topical aminoglycosides for patients with a perforated ear drum due to possible ototoxicity **[22, 23]**. Concerns about aminoglycoside ototoxicity, particularly with perforated eardrums, stem from animal studies and case reports [**24-29**]. However, clinical trials by Gyde [**30**] and Browning et al. [**31**] found no significant hearing loss with topical gentamicin in COM patients. Still, topical aminoglycosides are not widely accepted in many countries. Among aminoglycosides, tobramycin is potentially less ototoxic than gentamicin [**32**]. Therefore, we recommend a 7–10-day course of aminoglycoside (tobramycin) based ear drops as first-line empirical treatment. Culture-guided therapy should be reserved for non-responsive cases, particularly in high-volume centres. Regular bacteriological studies are crucial to monitor resistance trends and refine treatment protocols.

CONCLUSION

Chronic otitis media (COM) is a prevalent condition in rural India, primarily affecting children and driven by Pseudomonas aeruginosa and MRSA. The increasing prevalence of MRSA and reduced susceptibility to antibiotics like piperacillin-tazobactam and ciprofloxacin highlight the growing challenge of resistance. Rural risk factors, including poor hygiene and self-medication, exacerbate the problem, emphasizing the need for public health interventions. We recommend a 7–10-day course of tobramycin-based ear drops as first-line treatment for active COM, with culture-guided therapy for non-responsive cases. Frequent bacteriological studies are essential to develop effective treatment protocols, minimize resistance, and reduce the public health burden of COM in rural communities.

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