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Aerobic Bacteriological and Mycological Profile of Chronic Suppurative Otitis Media in a Tertiary Care Hospital in Central India

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ABSTRACT

Background: Chronic suppurative otitis media (CSOM) is a persistent inflammatory disease of the middle ear and mastoid cavity, commonly presenting with recurrent otorrhoea through a perforated tympanic membrane. It remains an important cause of preventable hearing impairment, particularly in low-resource settings where delayed care, recurrent upper respiratory infection, poor hygiene, and inappropriate antibiotic use contribute to chronicity and resistance. Global estimates suggest that CSOM affects tens to hundreds of millions of people, with a substantial proportion developing clinically significant hearing loss.[1] [2]

Aim: To describe the aerobic bacteriological and fungal profile of clinically diagnosed CSOM cases presenting to a tertiary care hospital in Central India and to summarize the broad antimicrobial susceptibility pattern of the major bacterial isolates.

Methods: This hospital-based observational study included 100 clinically diagnosed CSOM patients attending the otorhinolaryngology outpatient department. Ear discharge specimens were collected under aseptic precautions and processed for aerobic bacterial culture, fungal culture, organism identification, and antimicrobial susceptibility testing. Bacterial identification was performed using standard microbiological methods, while susceptibility testing followed disc diffusion principles consistent with contemporary laboratory standards.[7] [8] Fungal evaluation included direct potassium hydroxide examination, Sabouraud dextrose agar culture, lactophenol cotton blue mount, and germ-tube testing for presumptive identification of Candida albicans.[9]

Results: The mean age of participants was 41.40 ± 10.08 years, with a female predominance of 58%. Unilateral disease was common, with left-ear involvement in 69%, right-ear involvement in 22%, and bilateral disease in 9%. Aerobic bacterial culture yielded growth in 81% of samples; fungal culture was positive in 9%, and 10% showed no bacterial or fungal growth. Pseudomonas aeruginosa was the leading isolate (35%), followed by Staphylococcus aureus (24%), coagulase-negative staphylococci (9%), Klebsiella pneumoniae (5%), Escherichia coli (3%), Citrobacter species (3%), and Proteus vulgaris (2%). Among fungal isolates, Aspergillus niger predominated (44.4%), followed by Aspergillus fumigatus (22.2%), Aspergillus flavus (11.1%), Candida spp. (11.1%), and Candida albicans (11.1%).

Conclusion: The microbiological landscape of CSOM in this Central Indian tertiary-care cohort was dominated by P. aeruginosa and S. aureus, with a clinically relevant fungal component. Local culture and susceptibility testing should be integrated into routine CSOM management because empirical treatment based on generalized assumptions may fail in the presence of regional variation and emerging resistance.

Keywords: Chronic suppurative otitis media; Pseudomonas aeruginosa; Staphylococcus aureus; Aspergillus niger; antimicrobial susceptibility; Indore.

INTRODUCTION

Chronic suppurative otitis media is classically defined as persistent inflammation of the middle ear and mastoid cavity, usually associated with a permanent tympanic membrane perforation and recurrent or continuous ear discharge. Although

definitions vary across clinical settings, most include a duration of otorrhoea extending beyond several weeks and the presence of tympanic membrane perforation. The condition is not merely a local ear infection; it is an important public-health disorder because it can produce conductive hearing loss, recurrent pain and discharge, social stigma, reduced school performance, occupational impairment, and, in unsafe disease, potentially severe extracranial and intracranial complications.[1] [3]

The global burden of CSOM is unequally distributed. Systematic and clinical reviews emphasize that the disease remains concentrated in low- and middle-income settings where overcrowding, poor access to early medical care, malnutrition, recurrent upper respiratory tract infection, and inadequate sanitation sustain both incidence and recurrence.[1] [3] The clinical significance of CSOM lies in its chronicity. Unlike acute otitis media, which often reflects respiratory pathogens, CSOM commonly supports a mixed microbial ecology involving Gram-negative bacilli, Gram-positive cocci, and occasionally fungi. The moist, inflamed, and discharge-filled middle-ear environment provides favourable conditions for organisms such as P. aeruginosa, while repeated and incomplete antibiotic exposure may select resistant strains.

Microbiological studies from India and other regions consistently identify P. aeruginosa and S. aureus as leading bacterial agents of CSOM, although local proportions differ by geography, sampling method, prior antibiotic exposure, climate, and referral pattern.[4] [5] [6] This variation is clinically important because antimicrobial treatment is often initiated empirically. If empirical therapy does not reflect local pathogen distribution and susceptibility, patients may receive ineffective drugs, remain symptomatic, and develop recurrent disease. Fungal participation is also relevant because Aspergillus and Candida species can persist in chronically discharging ears, particularly after prolonged topical antibiotic or antibiotic-steroid exposure.[9]

The present paper uses data from a tertiary care hospital-based study conducted at Index Medical College Hospital & Research Centre, Indore, to describe the clinical-demographic features, culture positivity, bacterial spectrum, fungal profile, and major treatment implications in 100 clinically diagnosed CSOM cases. While a separate analysis may focus specifically on resistance mechanisms, the objective of this paper is to present the broader microbiological profile and highlight why routine culture-based diagnosis remains necessary in modern otological practice.

MATERIALS AND METHODS

Study design and setting

This was a hospital-based observational study of 100 clinically diagnosed CSOM patients attending the ear, nose, and throat outpatient department of Index Medical College Hospital & Research Centre, Indore. The uploaded source file described consecutive recruitment of eligible patients and a calculated sample size of 96 based on an expected P. aeruginosa prevalence of 39.58%, rounded to 100 patients for practical implementation. The study focused on aerobic bacterial and fungal causative agents and on antibiotic susceptibility patterns of bacterial isolates.

Study population

Patients with clinically diagnosed CSOM and active ear discharge were included. The recorded clinical variables included age, sex, side of ear involvement, occupation, chief complaint, past history of ear discharge, duration of illness, bacterial culture result, fungal culture result, bacterial isolate, fungal isolate, and antimicrobial susceptibility pattern. The source dataset showed that many patients sought care within the first week of active symptoms, although the underlying clinical condition was chronic or recurrent.

Sample collection and microbiological processing

Ear discharge was collected under aseptic precautions. Aerobic bacterial culture was performed using standard diagnostic microbiology principles, including direct microscopy, culture, colony morphology, Gram staining, and biochemical identification.[8] Antimicrobial susceptibility testing was performed using disc diffusion methodology and interpreted according to accepted standards. The study used antibiotic panels for Gram-positive organisms, Gram-negative bacilli, and P. aeruginosa. For Gram-positive cocci, tested drugs included linezolid, azithromycin, gentamicin, cefoxitin, cotrimoxazole, ciprofloxacin, clindamycin, doxycycline, penicillin, ampicillin, and fosfomycin. Cefoxitin was used as a screening marker for methicillin resistance in S. aureus, consistent with standard laboratory practice.[7]

For fungal diagnosis, direct microscopic examination was performed using 10% potassium hydroxide to detect epithelial cells, pus cells, budding yeast cells, hyphae, and spores. Specimens were inoculated on Sabouraud dextrose agar containing antibacterial agents and incubated at both lower and body-temperature conditions for up to six weeks. Fungal isolates were evaluated by colony morphology and lactophenol cotton blue mount. Candida isolates were further assessed by germ-tube testing for presumptive identification of C. albicans.[9]

Data analysis
The study summarized categorical variables as frequencies and percentages. Mean and standard deviation were reported for age. The main outcome variables were aerobic culture positivity, fungal culture positivity, distribution of isolated pathogens, and organism-level susceptibility patterns. Because the manuscript was prepared from an existing source file rather than raw patient-level data, inferential statistical testing was not attempted.

RESULTS

Demographic and clinical characteristics
The study included 100 CSOM patients. The largest age groups were 30–39 years and 40–49 years, representing 34% and 32% of cases respectively. Patients aged 50–59 years constituted 23%, whereas younger adults and older patients were less represented. The overall mean age was 41.40 ± 10.08 years. This middle-adult concentration differs from the traditional description of CSOM as a predominantly childhood disease, but it is plausible in a tertiary-care outpatient setting where chronic recurrence, occupational exposures, delayed treatment, and comorbidities may influence attendance patterns.

Female patients constituted 58% of the sample, while male patients accounted for 42%, giving a female predominance. The left ear was involved in 69% of cases, the right ear in 22%, and bilateral disease in 9%. Ear discharge with pain was reported by 52% of patients, while 48% presented with discharge alone. A past history of ear discharge was documented in 48%, indicating that nearly half of the cohort had recurrent or previous disease activity.

Variable	Main finding
Total patients	100
Mean age	41.40 ± 10.08 years
Female patients	58%
Male patients	42%
Left-ear involvement	69%
Right-ear involvement	22%
Bilateral involvement	9%
Ear discharge with pain	52%
Prior history of ear discharge	48%

Culture positivity
Aerobic bacterial culture was positive in 81 of 100 cases. Nineteen samples did not yield aerobic bacterial growth. Among those without aerobic bacterial growth, fungal growth was found in nine samples, leaving ten samples without either bacterial or fungal growth. Therefore, the combined microbiological yield was high and demonstrated that culture remains valuable in active CSOM.

Culture result	Frequency	Percentage
Aerobic bacterial growth	81	81%
Fungal growth	9	9%
No bacterial or fungal growth	10	10%
Total	100	100%

The 10% no-growth group may reflect low organism load, prior antibiotic use, intermittent shedding, anaerobic infection not captured by the aerobic protocol, sampling limitations, or noninfective inflammatory activity. The absence of anaerobic culture was identified in the source file as an important limitation.

Distribution of bacterial isolates
P. aeruginosa was the most common pathogen, accounting for 35% of all cases. S. aureus was the second most common isolate at 24%. Coagulase-negative staphylococci accounted for 9%, while Enterobacteriaceae were represented by K. pneumoniae, E. coli, Citrobacter species, and Proteus vulgaris. This distribution confirms that CSOM in this setting is dominated by both Gram-negative non-fermenters and Gram-positive cocci, a pattern compatible with several Indian studies.[5] [6] [10] [11]

Isolated organism	Frequency	Percentage
Pseudomonas aeruginosa	35	35%

Staphylococcus aureus	24	24%
Coagulase-negative staphylococci	9	9%
Klebsiella pneumoniae	5	5%
Escherichia coli	3	3%
Citrobacter species	3	3%
Proteus vulgaris	2	2%
Fungal growth	9	9%
No growth	10	10%
Total	100	100%

Fungal isolates

Fungal growth was observed in 9% of cases. Aspergillus species predominated, collectively representing seven of nine fungal isolates. A. niger was the leading species, accounting for four isolates, followed by A. fumigatus in two isolates and A. flavus in one isolate. Yeasts accounted for two isolates: one Candida spp. and one C. albicans confirmed by germ-tube positivity.

Fungal isolate	Frequency	Percentage among fungal isolates
Aspergillus niger	4	44.4%
Aspergillus fumigatus	2	22.2%
Aspergillus flavus	1	11.1%
Candida spp.	1	11.1%
Candida albicans	1	11.1%
Total	9	100%

The fungal findings are clinically significant because fungal CSOM or secondary otomycosis may be missed if only bacterial culture is requested. Aspergillus predominance is consistent with the ecology of moist external and middle-ear environments and with standard mycological descriptions of otic fungal disease.[9]

Broad antimicrobial observations

The source study reported clinically important resistance markers. Among 24 S. aureus isolates, 17 were methicillin-sensitive and seven were methicillin-resistant, giving an MRSA proportion of 29.2% among S. aureus. For S. aureus overall, linezolid showed the highest sensitivity at 80.8%, followed by azithromycin and gentamicin at 76.79% each. Lower sensitivity was observed for penicillin, ampicillin, and fosfomycin.

For P. aeruginosa, carbapenems were the most active agents, with imipenem sensitivity of 80.0% and meropenem sensitivity of 74.3%. Piperacillin-tazobactam showed 63.0% sensitivity, cefepime 62.9%, amikacin 65.7%, gentamicin 60.0%, ceftazidime 57.1%, ciprofloxacin 57.1%, and levofloxacin 54.3%. Universal resistance was recorded to ampicillin, ceftriaxone, and cotrimoxazole, reflecting the expected intrinsic or practical nonutility of these agents against P. aeruginosa. The source file also documented extended-spectrum beta-lactamase phenotype among P. aeruginosa isolates, reinforcing the need for local resistance surveillance.

DISCUSSION

The present study demonstrates that CSOM in this tertiary-care cohort is microbiologically active in most cases, with aerobic bacterial growth in more than four-fifths of patients. The dominance of P. aeruginosa and S. aureus is consistent with much of the published CSOM literature. Uddén et al. documented the importance of aerobic bacteria in CSOM in a resource-limited setting, and several Indian studies similarly report P. aeruginosa and S. aureus as major isolates, although the exact rank order and percentages differ by region.[4] [5] [6]

The predominance of P. aeruginosa has practical significance. This organism survives well in moist environments, can form biofilms, and possesses multiple intrinsic and acquired resistance mechanisms. Biofilm formation in chronic ear disease may help explain persistence despite treatment, recurrent discharge, and variable response to topical and systemic therapy.[15] In clinical practice, this means that repeated empirical courses without culture may suppress but not eradicate infection, leading to a cycle of recurrence and resistance selection.

The observed S. aureus burden is also important. S. aureus is a common pathogen in chronic ear discharge and may be associated with recurrent infection, persistent inflammation, and treatment failure when resistant strains are present. The MRSA proportion of 29.2% among S. aureus isolates in the present dataset is clinically meaningful. Although this paper

emphasizes microbiological profile rather than resistance mechanisms, the MRSA finding supports the need for cefoxitin screening and targeted therapy when staphylococci are isolated.[7]

The fungal culture yield of 9% deserves attention. In many clinical settings, CSOM management focuses heavily on antibacterial treatment, while fungal culture is not routinely requested. However, the presence of Aspergillus and Candida species suggests that a subset of patients may not improve with antibacterial therapy alone. Fungal persistence may follow repeated antibiotic exposure, local humidity, moisture retention, or epithelial debris in the ear canal and middle ear. The high proportion of A. niger among fungal isolates aligns with standard mycological understanding of otomycosis and supports the value of direct microscopy and fungal culture when discharge persists despite antibacterial therapy.[9]

The demographic profile showed a concentration in middle adulthood rather than childhood. Classical epidemiology often highlights children as the most vulnerable group because of Eustachian tube anatomy, frequent upper respiratory tract infections, and socioeconomic exposure.[3] However, adult outpatient cohorts may reflect cumulative disease, incomplete childhood treatment, recurrent episodes, occupational water or dust exposure, domestic smoke exposure, and delayed specialist consultation. The 58% female representation and 25% housewife occupational category in the source data may reflect local healthcare-seeking patterns, domestic environmental exposures, or referral bias; these associations require cautious interpretation because the study was not designed to establish causality.

Comparison with Indian studies suggests both similarity and regional specificity. Jitendra and Shiv Kumar reported female predominance and emphasized the value of antibiogram-based treatment in CSOM.[10] Sankar and Deepa identified P. aeruginosa as a major organism in tertiary-care CSOM and highlighted its therapeutic relevance.[11] Edwin et al. documented a varied bacterial spectrum in Puducherry, supporting the concept that local hospital antibiograms are essential.[12] Kawatra et al. evaluated adult CSOM pathogens and antibiograms, showing that adult disease deserves independent attention rather than being treated as merely an extension of paediatric CSOM.[13]

The most important clinical message from this study is that CSOM should not be managed solely by symptom duration and otoscopic appearance. While clinical diagnosis remains essential, microbiological confirmation provides actionable information. A patient with P. aeruginosa, MRSA, fungal growth, or no aerobic growth requires different therapeutic thinking. Culture also helps avoid unnecessary broad-spectrum therapy. For example, when isolates remain susceptible to narrower or safer agents, culture can support de-escalation; when resistant isolates are present, it can prevent ineffective repeated empirical therapy.

The findings also support antimicrobial stewardship. Topical and systemic antibiotic misuse is a recognized driver of resistance in chronic ear disease. Reviews and guideline-based discussions of CSOM management emphasize that treatment should combine aural toilet, control of active infection, avoidance of unnecessary agents, and surgery when indicated for chronic perforation or cholesteatoma.[14] Microbiology laboratories can strengthen stewardship by regularly summarizing local CSOM isolate patterns and communicating resistance trends to otolaryngologists.
From a service-delivery perspective, the study supports a practical diagnostic algorithm for tertiary-care CSOM clinics. Patients with uncomplicated first presentations may initially receive careful clinical assessment, aural toileting, and locally appropriate empirical topical therapy; however, those with persistent discharge, previous treatment exposure, recurrent disease, suspected cholesteatoma, immunocompromise, or foul-smelling discharge should undergo microbiological sampling before definitive antibiotic escalation. In such patients, a combined request for Gram stain, aerobic culture, susceptibility testing, and fungal evaluation is more informative than bacterial culture alone. The 9% fungal yield in the present study demonstrates that a negative bacterial culture should not be considered equivalent to absence of infection. Similarly, the 10% complete no-growth rate indicates that clinicians should also consider prior antimicrobial exposure, inadequate sampling, anaerobic infection, and noninfective inflammatory causes when symptoms persist despite negative routine culture.

The data further suggest that hospital antibiograms for CSOM should be updated periodically rather than extrapolated from general wound or respiratory isolates. Ear-discharge isolates represent a distinctive ecological niche, and resistance patterns may differ from those seen in urine, blood, or respiratory samples. Periodic reporting of P. aeruginosa, S. aureus, MRSA, fungal isolates, and Gram-negative bacilli from CSOM specimens can guide local empirical policy and reduce avoidable use of broad-spectrum agents. This is especially important in institutions serving mixed urban and rural populations, where patients may arrive after partial treatment from multiple healthcare providers.

Limitations

The study was conducted at a single tertiary-care institution, which may limit generalizability to other regions or primary-care populations. Anaerobic culture was not included, so anaerobic pathogens may have been missed. The dataset did not

provide long-term treatment response, recurrence, audiological outcomes, cholesteatoma status, or prior antibiotic exposure in sufficient detail for deeper analysis. Because the manuscript was prepared from summarized source data, no additional statistical modelling was performed.

CONCLUSION

In this Central Indian tertiary-care cohort, CSOM was associated with a high microbiological yield. P. aeruginosa was the predominant pathogen, followed by S. aureus, while Aspergillus species constituted the main fungal component. The findings show that CSOM is a polymicrobial and locally variable disease in which empirical treatment should be guided by institutional culture data wherever possible. Routine bacterial culture, selective fungal work-up, and susceptibility testing are strongly recommended for persistent or recurrent otorrhoea. Such an approach can improve therapeutic precision, reduce avoidable antibiotic exposure, and help limit the emergence of resistant CSOM pathogens.

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