International Journal for Multidisciplinary Research (IJFMR)

E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Comparative Evaluation of Subjects with CSOM In Respect of Isolated Bacterial Spectrum and Their Therapeutic Responses

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Abstract

Chronic suppurative otitis media remains an important and preventable cause of hearing loss and chronic ear morbidity in developing regions, and its bacteriological profile varies with geography and over time. The present study was undertaken to identify the aerobic bacterial isolates in chronic suppurative otitis media and to determine their antimicrobial susceptibility pattern at a tertiary care centre in Tripura, India. A hospital-based cross-sectional study was carried out in which patients of all ages and both sexes presenting with active ear discharge of more than six weeks' duration together with a tympanic membrane perforation were included. Aural swabs were collected aseptically from the middle ear and were cultured aerobically, the isolates were identified by standard microbiological methods, and antimicrobial susceptibility was determined by the Kirby-Bauer disc diffusion method in accordance with the recommendations of the Clinical and Laboratory Standards Institute.

A total of 282 patients contributed 292 diseased ears. Culture positivity was 89.0%, with monomicrobial growth in 64.4% and polymicrobial growth in 24.6% of the samples. Gram-negative organisms predominated. Pseudomonas aeruginosa was the commonest isolate (51.9%), followed by Staphylococcus aureus (44.2%), Klebsiella pneumoniae (20.0%) and Proteus mirabilis (13.8%). Vancomycin showed complete susceptibility against Staphylococcus aureus, whereas amikacin showed the best overall activity against the Gram-negative isolates. It is concluded that chronic suppurative otitis media in this setting was predominantly associated with Pseudomonas aeruginosa and Staphylococcus aureus, and that empirical treatment should be guided by local antibiograms, with routine culture and sensitivity testing being advisable in refractory or complicated disease.

Keywords: Chronic Suppurative Otitis Media, Antibiogram, Pseudomonas Aeruginosa, Staphylococcus Aureus, Tripura, Antimicrobial Susceptibility

Introduction

Chronic suppurative otitis media (CSOM) is a chronic inflammatory disorder of the middle ear cleft characterised by persistent or recurrent ear discharge through a tympanic membrane perforation. It remains a major public health concern in low- and middle-income countries because of its contribution to hearing impairment, poor scholastic performance, and the risk of intracranial and extracranial complications [1, 2, 3, 4].

The burden of disease is higher in rural and socioeconomically disadvantaged populations, where overcrowding, poor hygiene, repeated upper respiratory infections, and unsafe water exposure increase susceptibility. The clinical picture ranges from uncomplicated mucosal disease to advanced disease with mastoiditis, abscess formation, facial palsy, meningitis, or brain abscess [2, 5, 6, 7].

The microbiology of CSOM varies geographically and changes over time with antibiotic misuse and local prescribing practices. Aerobic Gram-negative organisms, especially Pseudomonas aeruginosa, and Gram-positive organisms such as Staphylococcus aureus are often implicated. Periodic regional surveillance of the bacteriological profile and susceptibility pattern is therefore essential for rational empirical therapy and antimicrobial stewardship [8, 9, 10, 11, 12].

The present study was undertaken to evaluate the spectrum of aerobic bacterial isolates in active CSOM at a tertiary care centre in Tripura and to assess their antimicrobial susceptibility pattern in relation to therapeutic response.

Materials and Methods

This hospital-based cross-sectional study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery, Agartala Government Medical College and GB Pant Hospital, Agartala, Tripura, India, over a period of two years from September 2013 to September 2015. Patients of all ages and both sexes with active ear discharge for more than six weeks and a tympanic membrane perforation were eligible for inclusion. Patients with prior ear surgery, associated otomycosis, diabetes mellitus, immunosuppression, antibiotic use within the preceding 15 days, or inactive disease without ear discharge were excluded. Institutional ethics committee approval was obtained before commencement of the study, and informed consent was taken from all participants.

After otoscopic cleaning of the external auditory canal under aseptic precautions, a sterile dry cotton swab was used to collect discharge directly from the middle ear through the perforation while avoiding contact with the canal wall. The samples were transported immediately to the microbiology laboratory and were inoculated onto blood agar, MacConkey agar, chocolate agar, and nutrient agar. The plates were incubated aerobically at 37 °C. Organisms were identified by colony morphology, Gram staining, and standard biochemical tests. Antimicrobial susceptibility testing was carried out by the Kirby-Bauer disc diffusion method according to the recommendations of the Clinical and Laboratory Standards Institute.

Demographic characteristics, side of involvement, type of tympanic membrane perforation, duration of otorrhoea, associated symptoms, and complications were recorded in a structured case sheet. Audiological and radiological evaluation was performed where clinically indicated.

Statistical Analysis

The data were compiled and analysed using the Statistical Package for the Social Sciences (SPSS) software. Categorical variables were summarised as frequencies and percentages, and continuous variables as mean and standard deviation. The chi-square test was used for comparison of categorical variables, and a p value of less than 0.05 was considered statistically significant.

Results

A total of 282 patients with active CSOM were studied; they contributed 292 diseased ears because 10 patients had bilateral disease. The mean age of the study population was 32.68 ± 20.26 years, and the largest proportion of patients belonged to the 21–30 year age group (Table 1). Males accounted for 55.7% of the cases, giving a male-to-female ratio of 1.25:1. Most of the patients were from rural areas (70.2%), and 79.8% belonged to families below the poverty line.

Table 1: Age Distribution of the Study Population (N = 282 Patients)

Age Group (Years)	Number of Patients	Percentage (%)
<10	36	12.8
11–20	50	17.7
21–30	55	19.5
31–40	38	13.5
41–50	39	13.8
51–60	37	13.1
61–70	18	6.4
>70	9	3.2

Left ear involvement (55.0%) was more frequent than right ear involvement (41.5%), and 10 patients (3.5%) had bilateral disease (Table 2). A central tympanic membrane perforation was the predominant finding (66.1%), followed by marginal (16.4%) and attic (15.1%) perforations (Table 3). Nearly half of the diseased ears had a history of otorrhoea of less than five years' duration (Table 4).

Table 2: Side of Diseased Ear (N = 292 Ears)

Side of Involvement	Number	Percentage (%)
Right	117	41.5
Left	155	55.0
Bilateral (patients)	10	3.5

Table 3: Type of Tympanic Membrane Perforation (N = 292 Ears)

Type of Perforation	Number	Percentage (%)
Central	193	66.1
Marginal	48	16.4
Attic	44	15.1
Central with marginal	7	2.4

Table 4: Duration of Otorrhoea (N = 292 Ears)

Duration (Years)	Number	Percentage (%)
<5	143	49.0

Duration (Years)	Number	Percentage (%)
5–10	109	37.3
>10	40	13.7

Apart from otorrhoea, which was present in all the patients, hearing impairment was the commonest symptom (82.9%), followed by earache (36.5%), itching (31.2%) and fever (11.0%) (Table 5). Complications were documented in 19.5% of the diseased ears; mastoiditis was the most frequent (8.2%), followed by post-auricular abscess (4.6%), post-auricular fistula (2.8%) and facial nerve palsy (1.1%). Intracranial complications, namely meningitis and temporal lobe abscess, were each observed in 1.4% of the ears.

Table 5: Clinical Features among the Study Subjects (N = 282 Patients)

Clinical Feature	Present (%)	Absent (%)
Ear discharge	100.0	0
Hearing impairment	82.9	17.1
Earache	36.5	63.5
Itching	31.2	68.8
Fever	11.0	89.0

Culture positivity was achieved in 260 of the 292 samples (89.0%). Monomicrobial growth was identified in 188 samples (64.4%), polymicrobial growth in 72 samples (24.6%), and no growth in 32 samples (11.0%) (Table 6). Gram-negative organisms predominated, accounting for 53.8% of the positive cultures, while Gram-positive isolates represented 34.2% and mixed growth 12.0%.

Table 6: Type of Bacterial Culture (N = 292 Ears)

Type of Culture	Number	Percentage (%)
Monomicrobial	188	64.4
Polymicrobial	72	24.6
No growth	32	11.0

Pseudomonas aeruginosa was the most frequent isolate, recovered from 51.9% of the positive cultures, followed by Staphylococcus aureus (44.2%), Klebsiella pneumoniae (20.0%) and Proteus mirabilis (13.8%) (Table 7). Among the polymicrobial cultures, the commonest combinations were Pseudomonas aeruginosa with Klebsiella pneumoniae and Pseudomonas aeruginosa with Staphylococcus aureus.

Table 7: Spectrum of Major Bacterial Isolates (N = 260 Positive Cultures)

Organism	Number of Isolates	Percentage (%)
Pseudomonas aeruginosa	135	51.9
Staphylococcus aureus	115	44.2

Organism	Number of Isolates	Percentage (%)
Klebsiella pneumoniae	52	20.0
Proteus mirabilis	36	13.8

Among the Gram-positive isolates, Staphylococcus aureus was most susceptible to vancomycin (100%), followed by ceftriaxone-sulbactam (90.4%), imipenem (88.7%) and linezolid (86.1%); susceptibility to erythromycin (33.9%) and amoxycillin-clavulanic acid (24.3%) was low (Table 8).

Table 8: Antimicrobial Susceptibility Pattern of the Gram-Positive Isolate (Staphylococcus Aureus)

Antimicrobial Agent	Susceptibility (%)
Vancomycin	100.0
Ceftriaxone-sulbactam	90.4
Imipenem	88.7
Linezolid	86.1
Azithromycin	77.4
Piperacillin	74.8
Ceftriaxone	72.2
Erythromycin	33.9
Amoxycillin-clavulanic acid	24.3

Among the Gram-negative isolates, amikacin showed the best overall activity, with susceptibility rates of 83.7%, 88.5% and 91.7% against Pseudomonas aeruginosa, Klebsiella pneumoniae and Proteus mirabilis, respectively. Piperacillin and the fluoroquinolones (ofloxacin and ciprofloxacin) also retained useful activity, whereas norfloxacin showed poor activity against Pseudomonas aeruginosa (39.2%) and Klebsiella pneumoniae (48.1%) (Table 9).

Table 9: Antimicrobial Susceptibility Pattern of the Gram-Negative Isolates (% Susceptible)

Antimicrobial Agent	P. aeruginosa	K. pneumoniae	P. mirabilis
Amikacin	83.7	88.5	91.7
Piperacillin	80.0	75.0	75.0
Ofloxacin	76.2	84.6	83.3
Ciprofloxacin	75.5	94.2	75.0
Meropenem	74.8	NT	NT
Ceftriaxone-sulbactam	73.3	69.2	91.7
Gentamicin	71.8	88.5	91.7
Amoxycillin-clavulanic acid	65.9	72.4	66.7

Antimicrobial Agent	P. aeruginosa	K. pneumoniae	P. mirabilis
Norfloxacin	39.2	48.1	91.7

NT = Not Tested

Discussion

The present study demonstrates that active CSOM in this region is predominantly associated with aerobic Gram-negative organisms, especially Pseudomonas aeruginosa, followed by Staphylococcus aureus. This pattern is consistent with many previous studies from India and other developing settings that identified Pseudomonas as the leading pathogen in chronically discharging ears [9, 10, 11, 12, 13, 14].

The predominance of disease among rural and socioeconomically disadvantaged patients in the present series is in keeping with the recognised influence of environmental and access-to-care factors on chronic ear disease. The relatively high culture positivity rate may reflect careful sampling and early processing, although the sterile samples could still be related to prior undocumented treatment, transport delay, or biofilm-associated infection that is not fully captured by routine aerobic culture [2, 5, 6, 15, 16].

Monomicrobial growth predominated over polymicrobial growth, which is similar to many published microbiological studies on CSOM. At the same time, the substantial proportion of polymicrobial cultures in the present series underlines the biological complexity of long-standing middle-ear infection [11, 12, 13, 14, 17].

The susceptibility findings have clear therapeutic implications. Vancomycin retained complete activity against Staphylococcus aureus, while linezolid and imipenem also performed well. Against the Gram-negative isolates, amikacin showed the broadest activity, whereas ciprofloxacin and ofloxacin remained useful, especially against Pseudomonas aeruginosa and Klebsiella pneumoniae. The comparatively poor activity of amoxycillin-clavulanic acid and norfloxacin suggests that the indiscriminate empirical use of these drugs should be discouraged in this region [11, 13, 14, 16, 18, 19].

The study has several strengths, including a substantial sample size and clinically relevant culture-sensitivity data from an under-reported geographic region. Nevertheless, some limitations should be acknowledged. Anaerobic bacteria, fungi, and biofilm-associated organisms were not systematically investigated, minimum inhibitory concentration data were unavailable, and the findings reflect the microbiology of a single tertiary care centre. Periodic surveillance remains necessary because resistance patterns are dynamic and may change over time with antimicrobial selection pressure [20, 21, 22, 23].

Conclusion

CSOM in this tertiary care cohort from Tripura was most commonly associated with Pseudomonas aeruginosa and Staphylococcus aureus, with Gram-negative isolates predominating overall. Vancomycin showed the highest activity against Staphylococcus aureus, whereas amikacin showed the best overall activity against the Gram-negative pathogens. It is recommended that the empirical management of active CSOM in this region should emphasise local antibiogram-guided therapy, with routine microbiological evaluation in persistent, recurrent, or complicated cases.

Acknowledgement

The authors thank the Department of Microbiology and the supporting clinical and laboratory staff for their assistance in specimen processing and patient care. No external funding was received for this study.

References

1. G.G. Browning, "Aetiopathology of inflammatory conditions of the external and middle ear", in Scott-Brown's Otolaryngology (edited by A.G. Kerr), 6th edition, Volume 3, Arnold, London, 1997, pp. 6/8/5–25.
2. J. Acuin, "Chronic suppurative otitis media: burden of illness and management options", World Health Organization, Geneva, 2004, pp. 9–23.
3. A.W. Smith, J. Hatcher, I.J. Mackenzie, et al., "Randomised control of chronic suppurative otitis media in Kenyan schoolchildren", The Lancet, 1996, 348, 1128–1133.
4. A.K. Verma, A. Vohra, A. Maitra, et al., "Epidemiology of chronic suppurative otitis media and deafness in a rural area and developing an interventional strategy", Indian Journal of Pediatrics, 1995, 62 (6), 725–729.
5. V. Rupa, A. Jacob, A. Joseph, "Chronic suppurative otitis media: prevalence and practices among rural south Indian children", International Journal of Pediatric Otorhinolaryngology, 1999, 48 (3), 217–221.
6. M.A. Kenna, "Treatment of chronic suppurative otitis media", Otolaryngologic Clinics of North America, 1994, 27 (3), 457–472.
7. G.G. Browning, S.N. Merchant, G. Kelly, et al., "Chronic otitis media", in Scott-Brown's Otorhinolaryngology, 7th edition, Arnold, London, 2008.
8. W. Meyerhoff, "Pathology of chronic suppurative otitis media", Annals of Otology, Rhinology and Laryngology, 1988, 97 (Supplement 130), 21–24.
9. I. Brook, E.H. Frazier, "Microbial dynamics of persistent purulent otitis media in children", Journal of Pediatrics, 1996, 128 (2), 237–240.
10. V.K. Poorey, A. Iyer, "Study of bacterial flora in chronic suppurative otitis media and its clinical significance", Indian Journal of Otolaryngology and Head and Neck Surgery, 2001, 54 (2), 91–95.
11. M. Prakash, K. Lakshmi, S. Anuradha, et al., "Bacteriological profile and their antibiotic susceptibility pattern in cases of chronic suppurative otitis media", Asian Journal of Pharmacy and Clinical Research, 2013, 6 (3), 210–214.
12. V. Khanna, J. Chander, N.M. Nagarkar, et al., "Clinicomicrobiologic evaluation of active tubotympanic type chronic suppurative otitis media", Journal of Otolaryngology, 2000, 29 (3), 148–153.
13. P.N.S. Moorthy, J. Lingaiah, S. Katari, et al., "Clinical application of a microbiological study on chronic suppurative otitis media", International Journal of Otolaryngology and Head and Neck Surgery, 2013, 2, 290–294.
14. A. Chakraborty, A. Bhattacharjee, P. Purkayastha, "Microbiological profile of chronic suppurative otitis media: its significance in North-East India", Indian Journal of Otology, 2005, 11, 39–44.
15. A.A. Elmanama, N.E.A. Tayyem, S.A.N. Allah, "The bacteriology of otitis media and their antibiogram among children in Gaza Strip, Palestine", Egyptian Journal of Ear, Nose, Throat and Allied Sciences, 2014, 15, 87–91.

16. T. Sabarinathan, V.A. Rajkumari, "Bacteriological and resistance profiles of chronic suppurative otitis media", International Journal of Biological and Medical Research, 2015, 6 (3), 5216–5218.
17. S. Sharma, H.S. Rehan, A. Goyal, et al., "Bacteriological profile in chronic suppurative otitis media in eastern Nepal", Tropical Doctor, 2004, 34, 102–104.
18. O.A. Afolabi, A.G. Salaudeen, F.E. Ologe, et al., "Pattern of bacterial isolates in the middle ear discharge of patients with chronic suppurative otitis media in a tertiary hospital in North Central Nigeria", African Health Sciences, 2012, 12 (3), 362–368.
19. S. Nikakhlagh, A.D. Khosravi, A. Fazlipour, et al., "Microbiologic findings in patients with chronic suppurative otitis media", Journal of Medical Sciences, 2008, 8, 503–506.
20. M. Taneja, M.K. Taneja, "Chronic suppurative otitis media: a bacteriological study", Indian Journal of Otology, 2009, 15, 3–7.
21. S.K. Malkappa, S. Kondapaneni, R. Surpam, et al., "Study of aerobic bacterial isolates and their antibiotic susceptibility pattern in chronic suppurative otitis media", Indian Journal of Otology, 2012, 18, 136–139.
22. S. Kumar, R. Sharma, A. Saxena, et al., "Bacterial flora of infected unsafe chronic suppurative otitis media", Indian Journal of Otology, 2012, 18, 208–211.
23. L. Hall-Stoodley, F.Z. Hu, A. Gieseke, et al., "Direct detection of bacterial biofilms on the middle-ear mucosa of children with chronic otitis media", JAMA, 2006, 296 (2), 202–211.