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ORIGINAL ARTICLE

Chronic Suppurative Otitis Media: Optimizing Initial Antibiotic Therapy in a Tertiary Care Setup

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Abstract A prospective study was done to determine the clinico-microbiological profile and the antibiogram of patients with chronic suppurative otitis media. Ninety-four patients presenting with tympanic perforation and ear discharge of more than 3 months were studied. Middle ear swabs obtained aseptically were processed for culture and the isolates identified by standard procedures. Antimicrobial susceptibility testing of the aerobic bacterial isolates was performed by disc diffusion method according to clinical laboratory standards institute guidelines. Patients in the age group of 21–30 years were more commonly affected (22.3%). Male:Female ratio was 2:1.4. Of the 94 patients, 64 (68.1%) had tubo-tympanic disease and rest 30 (31.9%) presented with attico-antral disease. Monomicrobial flora was seen in 55 (58.5%) samples, 28 (29.8%) yielded polymicrobial growth and 11 (11.7%) samples were sterile. A total of 115 microbial isolates (86 aerobic bacteria, 18 anaerobic bacteria and 11 fungi) were obtained. *Pseudomonas aeruginosa* (32.2%) was the most common isolate followed by *Staphylococcus aureus* (17.4%). Amongst anaerobes, gram positive cocci were more commonly isolated (38.9%). *Aspergillus spp.* (72.7%) were the most common fungus isolated. Most of the *Pseudomonas aeruginosa* isolates (25, 67.6%) were susceptible to all the antibiotics. Among the commonly used topical agents in the treatment of CSOM, tobramycin was the most effective (83.8%), followed by gentamicin (78.1%), ciprofloxacin (75.6%) and neomycin (3.5%). Periodic monitoring of the microbiological profile along with their sensitivity pattern is essential for formulating an effective antibiotic policy for CSOM.

Keywords Aminoglycosides · Anaerobes · Chronic otitis media · Pseudomonas aeruginosa

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Introduction

Chronic suppurative otitis media (CSOM) is a commonly encountered infection of the middle ear. It can cause extra cranial and intracranial complications and involves considerable morbidity [1, 2]. It is defined as chronic or intermittent otorrhea through a persistent non-intact tympanic membrane [3]. CSOM, whether attico-antral or tubo-tympanic disease, is associated with mixed bacterial flora. With improved isolation techniques, a significant number of isolates (20–50%) are likely to be anaerobic. Fungi are also thought to play a role in CSOM, especially in hot and humid regions and involve mainly *Candida spp.* and *Aspergillus spp*. [4]. Topical preparations containing antibiotics and steroids, to reduce otorrhea and to provide local anti-inflammatory effect are the mainstays of medical management of chronic otitis media [3, 5]. Knowledge of

the local microbiological flora in CSOM is essential for initiating empirical therapy pending culture results. Misuse and overuse of antibiotics along with increasing drug resistance among the common pathogens encountered in CSOM makes it mandatory for periodic surveillance of microbiological and sensitivity profile of CSOM. The objective of this study was to investigate the clinico–microbiological profile of CSOM and to analyze the susceptibility pattern of the aerobic bacterial isolates at our tertiary care centre, so that an antibiotic policy is formulated for CSOM, for better patient management.

Methods

The study was conducted for a period of 6 months from January 2009 to June 2009 at a tertiary care teaching hospital. This study was approved by our Institutional Ethical Committee. The study group included 94 randomly selected patients between 1 and 78 years, who were clinically diagnosed with CSOM. Inclusion criteria included patients presenting with tympanic perforation and ear discharge of more than 3 months. Only those patients who were not on any antibiotics (oral and systemic) in the previous five days were included in the study. Informed consent was obtained at enrollment.

Sample Collection

Before collecting the aural discharge, the external auditory canal was cleared of cerumen, swabbed with boric acid spirit and allowed to dry. The middle ear discharge was then aseptically collected by the oto-rhino-laryngologist from the tympanic cavity with a thin, sterile cotton swab (Himedia, Mumbai, India). Also care was taken not to touch the tympanic membrane or the external auditory canal during sample collection. The specimens so collected were transported immediately to the microbiology laboratory for further processing.

Specimen Processing

The swabs were inoculated onto sheep blood agar, chocolate agar and MacConkey agar for aerobic culture and the inoculated plates were incubated at 37°C for 24–48 h with 5% carbon dioxide enrichment for blood agar and chocolate agar plates. Inoculation onto two slopes of sabouraud's dextrose agar (Incubation at 25 and 37°C) was done for isolation of fungus. The aerobic bacterial and fungal isolates were identified according to standard bacteriological techniques [6]. For isolation of anaerobes, swabs were placed soon after collection in Robertson's cooked meat (RCM) medium, incubated at 37°C for 48 h. Subcultures from the RCM broth was done on to solid media—neomycin blood agar and the plates were incubated anaerobically at 37°C in Dyanox anaerobic jar (Dynamicro labs, Mumbai, India) for 72 h. Identification of anaerobes was done according to standard methods [7].

Susceptibility Testing

Antimicrobial susceptibility testing for aerobic bacterial isolates was done by Kirby-Bauer disc diffusion method following the Clinical Laboratory Standards Institute (CLSI) guidelines [8]. Methicillin resistance among *Staphylococcus aureus* strains was detected by cefoxitin disc test [8]. Extended spectrum beta lactamase (ESBL) detection among the enterobacteriaecae strains were performed by double disc synergy test [9].

Results

Of the 94 patients enrolled for the study, 64 (68.1%) had tubo-tympanic disease and rest 30 (31.9%) presented with attico-antral disease. CSOM was more common among males (M:F-2:1.4). Majority of the patients (22.3%) were in the age group of 21–30 years (Table 1). Other than recurrent ear discharge and tympanic perforation, they also had a history of hearing loss (64%), ear pain (23%), giddiness (15%) and tinnitus (14%). Forty-one patients (43%) had a long standing history since childhood.

A total of 115 organisms (1.2 isolates per specimen), including 86 (74.8%) aerobic and facultative anaerobic bacteria, 18 (15.6%) anaerobic bacteria and 11 (9.6%) fungi were recovered. Monomicrobial growth was detected

Table 1 Shows the distribution of middle ear disease in different age groups in the study population

Age groups	Type of CSOM		Total	
	Tubo-tympanic disease	Attico-antral disease	No.	%
0–10	07	04	11	11.7
11–20	13	05	18	19.1
21–30	15	06	21	22.3
31–40	09	05	14	14.9
41–50	07	04	11	11.7
51–60	05	04	9	9.6
61–70	05	02	7	7.4
71–80	03	00	3	3.2
Total	64	30	94	100

Table 2 Shows different types of organisms isolated from CSOM patients

Types of organisms	Number of isolates	Percentage
Aerobic bacteria (86, 74.8%)		
Pseudomonas aeruginosa	37	32.2
Staphylococcus aureus	20	17.4
Coagulase negative *Staphylococcus spp.*	10	8.7
Klebsiella pneumoniae	8	6.9
Proteus mirabilis	3	2.6
Proteus vulgaris	1	0.9
Escherichia coli	2	1.7
Streptococcus pneumoniae	2	1.7
Acinetobacter baumanii	2	1.7
Enterobacter aerogenes	1	0.9
Anaerobic bacteria (18, 15.6%)		
Anaerobic gram positive cocci	7	6.1
Bacteroides fragilis	5	4.3
Clostridium spp.	4	3.5
Prevotella spp.	2	1.7
Fungi (11, 9.6%)		
Aspergillus niger	4	3.5
Aspergillus flavus	4	3.5
Candida glabrata	2	1.7
Candida albicans	1	0.9
Total	115	100

from 55 (58.5%) samples, whereas 28 (29.8%) samples yielded polymicrobial growth; 11 (11.7%) samples were sterile. The most common isolate was *Pseudomonas aeruginosa* (37, 32.2%) followed by *Staphylococcus aureus* (20, 17.4%), Coagulase negative *Staphylococcus spp.* (10, 8.7%) and *Klebsiella pneumoniae* (8, 6.9%). Anaerobic gram positive cocci (7, 38.9%) were the most commonly isolated anaerobes. Among fungus, *Aspergillus spp.* (8, 72.7%) were more commonly seen (Table 2).

Among the commonly used topical agents in the treatment of CSOM, tobramycin was the most effective (sensitive against 83.8% of the *P. aeruginosa* isolates), followed by gentamicin (78.1%) and ciprofloxacin (75.6%) against both gram-positive and gram-negative aerobic bacteria. Neomycin was the least effective with only 3.5% of all isolates sensitive to this antibiotic. Other aminoglycosides like amikacin and netilmicin were active against 93.9 and 81.4% of the isolates, respectively.

A large number of the *P. aeruginosa* isolates (25, 67.6%) obtained in the present study were susceptible to all the antibiotics tested. Four isolates (10.8%) were multi drug resistant. Piperacillin (97.3%), followed by ceftazidime (91.2%), tobramycin (83.8%) and ciprofloxacin (83.8%) were the most effective antibiotics against *P. aeruginosa.* Cephalosporins (100%), doxycycline (100%) and amoxicillin-clavulanic acid (100%) were the most effective antibiotics against *S. aureus*. Methicillin resistance was not observed. Gentamicin was effective against 85% of strains of *S. aureus*. ESBL was detected in all the *Escherichia coli* isolates; however the other bacterial isolates were mostly sensitive to the antibiotics tested (Tables 3, 4).

Discussion

In CSOM, bacteria gain access to the middle ear either from the nasopharynx through the eustachian tube or from the external auditory canal through a non-intact tympanic membrane [2]. Infection of the middle ear mucosa subsequently results in ear discharge [1]. Results of the present study showed *P. aeruginosa* and *S. aureus* as the most common isolates from active CSOM infections. This is in tandem with the observations made by many other authors [1, 10, 11, 12]. Coagulase negative *Staphyloccoccus spp.* were the third most frequently isolated organisms. These may be a part of normal skin flora and may not be true pathogens.

Anaerobic bacteria formed 15.6% of all isolates, which is in agreement with previous observations of 20–50% of all CSOM infections attributed to anaerobes [4]. Some of the previous studies have not found significant association of anaerobes with CSOM [1, 4, 12]. Even though anaerobes are thought to play a pathogenic role in CSOM, the large variability in their isolation rates among different studies may be due to differences in sampling and processing techniques, prior use of antibiotics and differences in the timing of sampling during the course of the disease.

In the present analysis, fungi formed 9.6% of all isolates, with *Aspergillus spp.* being the predominant isolate. Even though fungi are routinely regarded as colonizers, they can be pathogenic in an already inflamed ear. Fungi have been isolated in previous studies in up to 50% of cases of CSOM [2]. Treatment targeting fungi should be administered in cases of positive cultures especially in hot and humid regions.

The cardinal symptoms of CSOM include purulent otorrhoea and progressive conductive deafness. Medical management of CSOM involves eliminating infection and controlling otorrhea. Ototopical agents are a highly effective and powerful tool for clinicians and are used as first-line agents for otorrhea [3]. Topical agents used in the treatment of chronic middle ear disease are a combination of antibiotics, antifungals, antiseptics, solvents and steroids. The common topical antibiotics used in the management are the aminoglycosides including gentamicin, framycetin and neomycin. Neomycin, the most commonly

Table 3 Shows the susceptibility pattern of gram positive aerobic bacterial isolates to various antibiotics

Organisms (no.)	Antibiotics (% sensitive)											
	Ap	Ac	Cf	Cr	Fr	Ci	Ct	Er	Cm	Gm	Ne	Do
S. aureus (20)	55	100	100	100	NT	45	95	75	90	85	5	100
CONS (10)	90	90	90	90	NT	100	100	100	100	100	0	100
S. pneumoniae (2)	100	100	100	100	100	100	100	0	100	NT	0	100
Total	68.8	96.9	96.9	96.9	100	62.5	96.9	78.1	93.8	90	3.1	100

CONS Coagulase negative *Staphylococcus spp*., *Ap* ampicillin (10 μg), *Ac* amoxicillin–clavulanic acid (20/10 μg), *Cf* cefazolin (30 μg), *Cr* cefuroxime (30 μg), *Fr* ceftriaxone (30 μg), *Ci* ciprofloxacin (5 μg), *Ct* trimethoprim-sulfamethoxazole (23.75/1.25 μg), *Er* erythromycin (15 μg), *Cm* clindamycin (2 μg), *Gm* gentamicin (10 μg), *Ne* neomycin (30 μg), *Do* doxycycline (30 μg), *NT* not tested

Table 4 Shows the susceptibility pattern of gram negative aerobic bacterial isolates to various antibiotics

Organisms (no.)	Antibiotics (% sensitive)													
	Ap	Ac	Cf	Cr	Fr	Cz	Pc	Ci	Ct	Ak	Gm	Net	To	Ne
P. aeruginosa (37)	NT	NT	NT	NT	NT	91.2	97.3	83.8	NT	78.4	73	73	83.8	2.7
K. pneumoniae (8)	0	100	87.5	87.5	100	NT	NT	75	100	100	100	100	NT	12.5
P. mirabilis (3)	66.7	100	66.7	66.7	100	NT	NT	100	100	100	100	100	NT	0
E. coli (2)	0	0	0	0	0	NT	NT	0	0	100	50	0	NT	0
Acinetobacter spp. (2)	50	100	50	50	100	NT	NT	100	100	100	100	100	NT	0
P. vulgaris (1)	100	100	100	100	100	NT	NT	100	100	100	100	100	NT	0
E. aerogenes (1)	0	100	100	100	100	NT	NT	100	100	100	100	100	NT	0
Total	23.5	88.2	70.6	70.6	88.2	91.2	97.3	81.5	88.2	85.2	79.6	77.8	83.8	3.7

Ap ampicillin (10 μg), *Ac* amoxicillin–clavulanic acid (20/10 μg), *Cf* cefazolin (30 μg), *Cr* cefuroxime (30 μg), *Fr* ceftriaxone (30 μg), *Cz* ceftazidime (30 μg), *Pc* piperacillin (100 μg), *Ci* ciprofloxacin (5 μg), *Ct* trimethoprim-sulfamethoxazole (23.75/1.25 μg), *Ak* amikacin (30 μg), *Gm* gentamicin (10 μg), *Net* netilmicin (30 μg), *To* tobramycin (10 μg), *Ne* neomycin (30 μg), *NT* not tested

prescribed topical agent at our setting was the least efficacious with only 3.5% of all isolates sensitive to this drug. Tobramycin and gentamicin were active against 83.8 and 78.1% of all the isolates tested, respectively. Amikacin was found to be the most effective aminoglycoside; however its unavailability as topical preparation prevents its routine use. The risk of ototoxicity by using aminoglycoside preparations remains a subject of discussion. However, despite the widespread use of aminoglycoside topical preparations worldwide, relatively few cases of ototoxicity seem to have been documented in the literature [13]. Topical quinolones are considered as promising options in the management of CSOM. Our findings showed 75.6% of all isolates were sensitive to ciprofloxacin. However, there is a concern for secondary fungal overgrowth causing otitis externa as a side effect following treatment with topical quinolones [2].

Systemic antibiotics are useful in acute exacerbations of chronically infected ear, in patients with signs of complicated or invasive infections or systemic disease and also in children and adolescents as the choice of ototopical antibiotics is complicated because of potential side effects [3, 5]. Piperacillin or ceftazidime for *P. aeruginosa* and amoxicillin-clavulanic acid or cephalosporins for *S. aureus* were found to be the most effective systemic antibiotics in our study. Trimethoprim-sulfamethoxazole can be used to treat mixed infections with gram-positive and gram-negative bacteria, not involving *P. aeruginosa*. Ciprofloxacin can be used for treating mixed gram-negative bacterial infections, including *P. aeruginosa.* Amikacin was effective (100%) against multi-drug resistant, ESBL producing *E. coli* isolates. Beta lactam—beta lactam inhibitor (BL/BLI) combinations including piperacillin/tazobactam or ticarcillin/clavulanic acid would be appropriate for treating infections with ESBL producing bacteria. Although the bactericidal activity of BL/BLI combination with amikacin is greater, the adverse effect of ototoxicity with systemic aminoglycoside use should be considered.

It is necessary to provide anaerobic coverage for culture proven cases or in cases with no aerobic growth in presence of purulent discharge and no history of prior antibiotic therapy.

Conclusion

In the era of increasing drug resistance among bacteria, periodic monitoring of the microbiological profile of

CSOM along with clinical correlation is essential as exact choice of antibiotics for empiric therapy depends on the local antibiotic policy, followed by modification in therapy based on the culture and sensitivity results. Before administering antibiotics, either local or systemic, culture of aural discharge should be performed in all CSOM patients. Neomycin, the most commonly prescribed topical agent was found to be the least effective antibiotic. Tobramycin and gentamicin were found to be useful empirical agents in the topical treatment of CSOM at our setting. Local antimicrobial susceptibility data should be utilized for formulating antibiotic policy for every institution.

Conflicts of interest None.

References

1. Loy AHC, Tan AL, Lu PKS (2002) Microbiology of chronic suppurative otitis media in Singapore. Singapore Med J 43:296–299
2. Verhoeff M, van der Veen EL, Rovers MM, Sanders EAM, Schilder AGM (2006) Chronic suppurative otitis media: a review. Int J Pediatr Otorhinolaryngol 70:1–12
3. Youngs R (1998) Chronic suppurative otitis media. In: Ludman H, Wright T (eds) Diseases of the ear, Chapter 27–29, 6th edn. Arnold Publishers, London, pp 374–415
4. Olu Ibekwe A, Shareef ZA, Benayam A (1997) Anaerobes and fungi in chronic suppurative otitis media. Ann Otol Rhinol Laryngol 106:649–652
5. Dhingra PL, Dhingra S (2010) Cholesteatoma and chronic otitis media. In: Diseases of Ear, Nose and Throat, Chapter 11, 5th edn. Elsevier, New Delhi, pp 75–83
6. Collee JG, Miles RS, Watt B (1996) Tests for identification of bacteria. In: Collee JG, Fraser AG, Marmion BP, Simmons A (eds) Mackie and McCartney practical medical microbiology, Chapter 7, 14th edn. Churchill Livingstone, New York, pp 131–149
7. Jousimies-Somer H, Summanen P, Citron DM, Baron EJ, Wexler HM, Finegold SM (2002) Preliminary identification methods. In: Wadsworth-KTL anaerobic bacteriology manual, 6th edn, Chapter 4. Star publishing Company, California, pp 55–74
8. Clinical and Laboratory Standards Institute (2007) Performance standards for antimicrobial susceptibility testing. Seventeenth informational supplement. CLSI document M100–S17. Clinical and Laboratory Standards Institute, Wayne, Pennsylvania
9. Tofteland S, Haldorsen B, Dahl KH, Simonsen GS, Steinbakk M, Walsh TR et al (2007) Effects of phenotype and genotype on methods for detection of extended-spectrum-beta-lactamase-producing clinical isolates of *Escherichia coli* and *Klebsiella pneumoniae* in Norway. J Clin Microbiol 45:199–205
10. Yeo SG, Park DC, Hong SM, Cha CI, Kim MG (2007) Bacteriology of chronic suppurative otitis media—a multicenter study. Acta Otolaryngol 127:1062–1067
11. Maji PK, Chatterjee TK, Chatterje S, Chakrabarthy J, Mukhopadhyaya BB (2007) The investigation of bacteriology of chronic suppurative otitis media in patients attending a tertiary care hospital with special emphasis on seasonal variation. Indian J Otolaryngol Head Neck Surg 59:128–131
12. Indudharan R, Ashraful Haq J, Aiyar S (1999) Antibiotics in chronic suppurative otitis media: a bacteriological study. Ann Otol Rhinol Laryngol 108:440–445
13. Haynes DS, Rutka J, Hawke M, Roland PS (2007) Ototoxicity of ototopical drops—an update. Otolaryngol Clin N Am 40:669–683