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Original Research Article

Study of bacterial pathogens causing chronic suppurative otitis media and the antibiotic susceptibility pattern of the isolates at a tertiary care centre in Kochi

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ABSTRACT

Background: Chronic suppurative otitis media (CSOM) is defined as chronic inflammation of middle ear and mastoid cavity presenting with recurrent ear discharges through a tympanic membrane perforation. Complications of CSOM were frequent in pre-antibiotic era. Injudicious use of antibiotics led to the emergence of multi-drug resistant strains and complications in return. To isolate the organisms associated with CSOM in a tertiary care centre and to detect their antibiogram.
Methods: In this clinical, prospective, cross sectional study, a total of 100 patients clinically diagnosed with CSOM were enrolled from January to December 2019 (1 year).
Results: Of the 100 samples collected, predominant bacteria were isolated in 58 patients (58%). The most common isolate was *Pseudomonas aeruginosa* (29 isolates) followed by *Staphylococcus aureus* (24), *Klebsiella* species (3) and 1 isolate each of *Pneumococci* and *Acinetobacter* species. Among the 29 isolates of *Pseudomonas aeruginosa*, 8 (28%) were multidrug resistant. Sensitivity was 100% to imipenem followed by 97% to meropenem,79% to gentamicin, 76% to amikacin, 66% to ciprofloxacin, 41% to piperacillin tazobactam and 17% to ceftazidime. Of the 24 isolates of *Staphylococcus aureus*, 4 (16%) were methicillin resistant *Staphylococcus aureus* (MRSA).
Conclusions: Pseudomonas aeruginosa was the most common isolate, of which 28% were multi drug resistant. This calls for the judicious use of antibiotics and alternative measures for treatment of drug resistant strains. Formulating an antibiotic policy based on the local antibiogram can help in preventing the emergence and spread of resistant pathogens.

Keywords: CSOM, Middle ear cleft, Multi drug resistant, MRSA

INTRODUCTION

Chronic suppurative otitis media (CSOM) is a highly prevalent disease and commonly encountered in ENT OPD. It is a major health problem and occurs with a high incidence and prevalence in both developed and developing countries.[1,2] It is defined as a disease condition of the middle ear cleft (eustachian tube, tympanic cavity and mastoid air cells) characterized by the presence of persistent perforation of the tympanic membrane with recurrent or persistent mucoid or muco-purulent discharge for at least eight weeks.[3] Incidence of CSOM is higher in developing countries because of poor socioeconomic standards, nutrition and lack of health education. Both sexes and all age groups are affected. The overall prevalence rate in India is 46 and 16 persons per thousand in rural and urban population respectively.

It can also be stated as the single most common cause of hearing impairment in rural population.[3,4]

The disease may begin in childhood or as a complication of untreated or inadequately treated acute suppurative otitis media or may be chronic from onset.[5-7] The bacteria may gain entry to the middle ear through a chronic perforation.[8] Children tend to have higher predisposition to ear infection than adults because anatomy of the eustachian tube in children permits easier access of organism through the nasopharynx.[9] The common causative organism may be aerobic (e.g. *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus pyogenes*, *Proteus mirabilis*, *Klebsiella* species) or anaerobic (e.g. bacteroides, *Peptostreptococcus*, *Propionibacterium* or mixed organisms).[10]

Inadequate and inappropriate treatment of CSOM can result in a wide range of complications. These may be due to the spread of organisms to structures adjacent to the ear or to local damage in the middle ear itself. Such complications range from persistent otorrhoea, mastoiditis, labyrinthitis, facial nerve paralysis to more serious intracranial abscesses or thrombosis.[11,12]

It is a well-known fact that microbial drug resistance is a growing global problem. Among gram-negative bacteria, the most resistant pathogens are *E. coli*, *Klebsiella* species and *Psuedomonas aeruginosa*, with increasing trends observed for all major anti-gram negative agents (beta-lactams, fluorquinolones and aminoglycosides).[13] Serious infections caused by gram-positive bacteria are increasingly difficult to treat because of pathogens such as methicillin-resistant *S. aureus* (MRSA), and penicillin-resistant *S. pneumoniae*. The detection of multidrug resistant isolates may further limit therapeutic options. Therefore, the microbial culture and sensitivity will help in appropriate management of otitis media and its complications and thus prevent the emergence of resistant bacterial strain. There is a need to understand the epidemiology and microbiology of CSOM in order to develop effective strategies for primary prevention and better management of the disease.

Hence, the present study was aimed to analyze the microbiological agents that cause chronic suppurative otitis media and their antibiotic resistance patterns among the patients who attended the ENT department of our hospital.

METHODS

This clinical prospective cross - sectional study was aimed to isolate the organisms from ear discharge of patients with CSOM and to detect the antibiogram of the isolate. Total of 100 patients both males and females in the age group 3-70 years, clinically diagnosed of CSOM were enrolled in the study after obtaining informed consent. The study was conducted at department of ENT and department of microbiology at a tertiary care centre in Kochi during a period of 1 year from January to December 2019. Patients presenting for the first time in ENT OPD with chronic ear discharge were included in the study. Patients with cleft palate, patients on systemic and topical antibiotic treatment of CSOM, patients on follow up, patients with acute suppurative otitis media and patient or parent who does not give his or her consent were excluded from the study.

The external auditory canal (EAC) of each patient was cleaned well with sterile saline and the aural discharge was collected using 2 labelled sterile cotton swabs for gram stain and for culture and sensitivity respectively. The specimens collected were transported immediately to the microbiology laboratory for further processing. Smear was prepared using one of the swabs, heat fixed and gram staining was done. The other swab was inoculated on sterile blood agar, chocolate agar, and MacConkey agar plates and then incubated at 37°C for 24-48 h. Predominant bacterial colonies were identified according to the standard bacteriological methods.[14,15]

Antimicrobial susceptibility testing

All isolated strains were tested for susceptibility to antibiotics on Mueller Hinton agar (MHA) using modified Kirby Bauer disc diffusion method according to clinical and laboratory standards institute (CLSI) guidelines. A suspension of the isolated colonies of each test strain equivalent to a 0.5 McFarland's standard was prepared in sterile peptone water and plated as a lawn culture onto MHA. Antibiotic discs were placed and plates were incubated at 37°C for 18-24 h. Results were interpreted in accordance with CLSI guidelines. *Escherichia coli* ATCC 25922 and *P. aeruginosa* ATCC 27853 were used as control strains.[16] An isolate was considered as multidrug resistant (MDR) if it showed resistance to at least one agent in three or more of the antimicrobial categories described for the bacterial species according to the CLSI recommendations.[17]

The data was coded and entered into microsoft excel. Analysis was done using statistical package for social sciences (SPSS) software version 16. Qualitative data was summarized using frequency and percentage. Quantitative data was summarized using mean. Association between age group organism isolated was tested using fischers exact test, significance level was fixed at p value <0.05.

RESULTS

A total of 100 patients with clinically diagnosed CSOM were included in the study. The mean age of the study population was 39 years and the most common age group was of patients 31 to 40 years (24%). Out of the 100 patients,52 were males and 48 were females.74 patients presented with right ear discharge and 26 with left ear discharge. Of the 100 samples, predominant bacteria

were isolated in 58 patients (58%), whereas the remaining 42 samples showed mixed bacterial growth (39 samples) and no growth (3 samples). Table 1, shows the bacterial isolates obtained.

Table 1: Bacterial isolates obtained.

S. no.	Bacteria isolated	Number	Percentage
1	*Pseudomonas aeruginosa*	29	50
2	*Staphylococcus aureus*	24	41
3	*Klebsiella species*	3	5
4	*Pneumococci*	1	1.7
5	*Acinetobacter*	1	1.7

The most common isolate obtained was *Pseudomonas aeruginosa* (29 isolates) followed by *Staphylococcus aureus* 24 isolates), *Klebsiella species* (3 isolates) and 1 isolate each of *Pneumococci* and *Acinetobacter* species.

Antibiotic susceptibility pattern

Pseudomonas aeruginosa

Among the 29 isolates of *Pseudomonas aeruginosa*, 8 (28%) were multidrug resistant. Sensitivity was 100% to imipenem followed by 97% to meropenem, 79% to gentamicin, 76% to amikacin, 66% to ciprofloxacin, 41% to piperacillin tazobactam and 17% to ceftazidime. Figure 1, shows the sensitivity pattern in *Pseudomonas aeruginosa*.

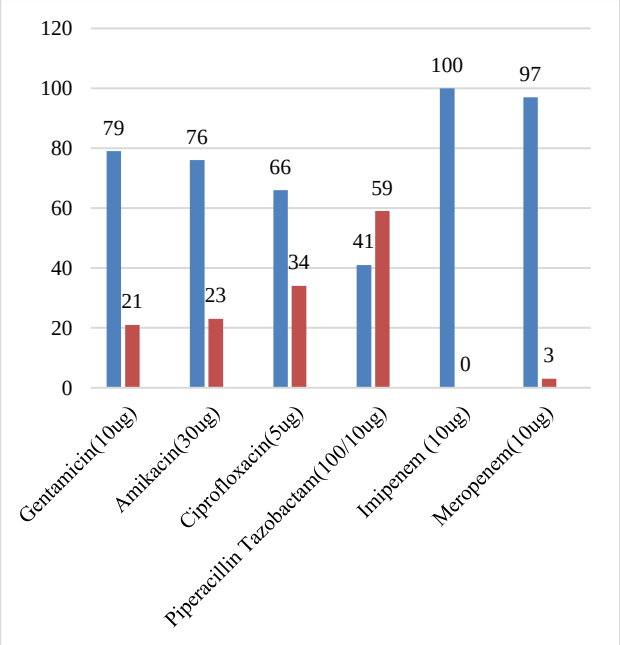

Figure 1: Sensitivity pattern of *Pseudomonas aeruginosa*.

Staphylococcus aureus

Out of the 24 isolates of *Staphylococcus aureus*, high sensitivity was seen to gentamicin (83%), cotrimoxazole (83%), cloxacillin (83%), and clindamycin (71%) while sensitivity was less to penicillin (13%), erythromycin (21%), and ciprofloxacin (87). All the isolates were sensitive to linezolid and rifampicin. 4 of the isolates 16% (4/24) were methicillin resistant *Staphylococcus aureus*. Sensitivity pattern of *Staphylococcus aureus* in shown in (Figure 2).

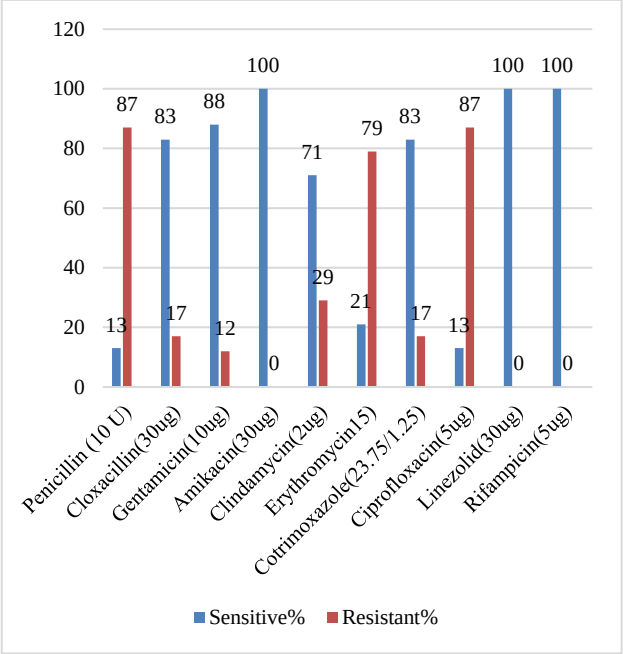

Figure 2: Sensitivity pattern of *Staphylococcus aureus*.

Klebsiella species

Among the 3 isolates of *Klebsiella*, 2 were resistant to ciprofloxacin, 1 was resistant to gentamicin. All 3 were sensitive to cephalothin, cefotaxime, ceftriaxone, cefoperazone, sulbactam, piperacillin tazobactam, amikacin, imipenem and meropenem.

Acinetobacter

The single isolate of *Acinetobacter* species was resistant to cefotaxime, ceftriaxone and sensitive to ciprofloxacin, gentamicin, amikacin, piperacillin, tazobactam, imipenem, and meropenem.

Pneumococci

The lone isolate of *Pneumococci* was sensitive to penicillin, cotrimoxazole, ceftriaxone, erythromycin, and clindamycin.

Table 2: Age group and organisms isolated.

Age group (in years)	No growth	Mixed growth	*Pseudomonas aeruginosa*	*Staph. aureus*	*Klebsiella*	*Acinetobacter*	*Pneumococci*	Total
1-10	0	3	3	0	0	0	1	7
11-20	1	6	3	4	0	0	0	14
21-30	0	6	2	3	0	0	0	11
31-40	1	7	10	4	1	1	0	24
41-50	0	7	3	8	0	0	0	18
51-60	0	5	3	3	1	0	0	12
61-70	0	4	1	1	1	0	0	7
71-80	1	0	3	0	0	0	0	4
81-90	0	1	1	1	0	0	0	3

There was so significant association between age group and type of organism isolated (p value=0.437).

DISCUSSION

CSOM is an important chronic disease seen worldwide beginning in childhood and causing significant morbidity in adulthood. In our study peak incidence of CSOM was in the age group 31-40 years, the mean age of the study population being 39 years. This was similar to the findings of Patel et al and Rangaiah et al in Gujarat and Karnataka respectively.[18,19] The increased incidence in this age group may be due to increased environmental and occupational exposure in this age group. In our study population, 52 were males and 48 were females, indicating a slight male predominance. This was in agreement with some other studies while contradicting certain other studies.[18-21] The majority i.e.76 patients presented with right sided ear discharge, whereas 24 presented with left ear discharge. There were no cases of bilateral ear discharge.

A predominant bacterial growth was obtained in 58 patients, while the remaining showed mixed bacterial growth and no growth on culture. This was less compared to other similar studies. This may be because patients referred to our tertiary care center were already on antibiotics.

The most common bacteria isolated in our study was *Pseudomonas aeruginosa* (29%) followed by *Staphylococcus aureus* (24%), *Klebsiella species* (5%) and 1 isolate each of *Acinetobacter* and *Pneumococci*. In similar studies by Patel et al and Nagraj et al, *Pseudomonas* was found to be the commonest isolate from cases of CSOM.[18,22] However studies by Prakash et al and Sharma et al demonstrated a predominant growth of *Staphylococcus aureus*.[20,21] This could be due to geographical variations and the different population studied.

Pseudomonas aeruginosa being ubiquitous in our physical environment with a predilection for moist areas is commonly isolated in CSOM.[18,21] The increased isolation of *Pseudomonas aeruginosa* has several implications since it is an important cause of hospital acquired infections. Moreover, *Pseudomonas aeruginosa* is difficult to treat since it has no particular environmental or nutritional requirements to grow and is highly resistant to antibiotics. It is also implicated in bony necrosis and mucosal disease.[23,24]

Antibiotic susceptibility testing was carried out on all the isolates. *Pseudomonas aeruginosa* showed a high susceptibility to the carbapenems, aminoglycosides and ciprofloxacin. However the sensitivity to piperacillin tazobactam and ceftazidime was low, compared to similar studies done elsewhere which demonstrated a higher sensitivity to ceftazidime and piperacillin tazobactam.[19,23] However, a good sensitivity was observed to the aminoglycosides and quinolones which again was in contrast to other similar studies done.[25] 28% of *Pseudomonas aeruginosa* isolates were 2 multidrug resistant ,which was quite high. These strains pose a risk of hospital acquired infections. They are also difficult to treat and leads to significant economic burden on the patient. These multi drug resistant strains may reflect an accumulation of mutations due to selective pressure exerted by injudicious use of antibiotics.[25]

Staphylococcus aureus was the second most common isolate obtained in our study. The involvement of *S. aureus* in the middle ear infection may be due to their ubiquitous nature and the high carrier rate of resistant strains in the external auditory canal and upper respiratory tract. *S. aureus* is known to cause infection by direct invasion from the external auditory meatus after the tympanic membrane has perforated.[26] 16% of these strains were methicillin resistant Staphylococcus aureus and this was in agreement with a similar study by Prachita et al. MRSA infection has been implicated in increased postoperative complications and can adversely affect the outcome of hearing improvement and tympanic membrane graft success rate. Thus, it is imperative to diagnose an MRSA infection sooner. The sensitivity to gentamicin, amikacin, cotrimoxazole, clindamycin was high, whereas it was low for penicillin, erythromycin, and ciprofloxacin, this was similar to the finding of other studies.[18,26]

CONCLUSION

Complications associated with CSOM were frequent in pre-antibiotic era, however, the introduction of antibiotics gave clinicians a tool to be used even without the precise etiological diagnosis and the irrational use of antibiotics led to the emergence of multi-drug resistant bacterial strains and disease complication in return. In our study on bacterial pathogens in CSOM, the predominant bacteria isolated was *Pseudomonas aeruginosa* of which 16% were multi drug resistant. This calls for the judicious use of antibiotics and alternative measures for the treatment of drug resistant strains. Formulating an antibiotic policy based on the local antimicrobial susceptibility profile will play a key role in preventing the emergence and spread of resistant pathogens.

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