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Original Research Article

Study of bacteriology of chronic suppurative otits media in a teaching hospital: a prospective observational study

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ABSTRACT

Background: Otitis media (OM) is an infectious disease that frequently affects all age brackets, including children and adults. The morbidity and complication rates of OM have been increasing in developing countries due to poor medical environments for early treatment, resulting in reductions in quality of life. Appropriate early treatment, including the use of appropriate antibiotics, is essential, requiring information on bacteriology and antibiotic sensitivity. The objective of this was to study the bacteriology of chronic suppurative otitis media (CSOM) and provide recommendations according to susceptibility pattern to commonly used antibiotics based on the experience of ENT department in S. Nijalingappa Medical College.
Methods: Ear swabs were subjected to culture on specific culture media for bacterial growth for CSOM outpatients in S. N. Medical College, Bagalkot.
Results: The most effective antibiotic is amikacin followed by gentamicin and cefotaxime in both isolates namely *Pseudomonas* spp and *Staphylococcus aureus* in infected ear discharge of CSOM patients in the ENT OPD.
Conclusions: It was observed that varieties of colonies were grown on the specific cultured medium. Appropriate antibiotics can thus be found to control infection in CSOM patients.

Keywords: Chronic suppurative otitis media, Ear swabs, Bacterial isolates, Drug susceptibility, Antibiotic resistance, ENT

INTRODUCTION

Otitis media (OM) is a major health problem and occurs with a high incidence and prevalence in both developed and developing countries.[1] Chronic suppurative otitis media (CSOM) 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.[1] Studies in United States, United Kingdom, Japan, India, Ghana, Sierra-Leone and Nigeria revealed some group of organisms that have been recorded in CSOM.[1] 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, Proprionibacterium) or mixed organisms.[1]

The microbiological profiles of ear infection are well documented in developed world. However, so far few studies have been conducted in most developing countries.[2] Moreover, the signs and symptoms of earache may often mislead the etiology of the infection, which makes it very difficult for the clinician to relate the disease to the exact etiology. Hence, the physician may advocate antibiotic therapy irrespective of the etiology of the disease.[2]

The widespread use of antibiotics has precipitated in the emergence of multiple resistant strains of bacteria which can produce primary and postoperative infections. For these reasons, it is very important to study the microbiological profiles of ear infection and their extent of antibiotic resistance in those developing countries for the proper management of patients with ear infections.[2] Changes in the microbiological flora following the advent of sophisticated synthetic antibiotics increase the relevance of reappraisal of the modern day flora in CSOM, and their *in vitro* antibiotic sensitivity pattern is very important for the clinician to plan a general outline of treatment for a patient with a chronically discharging ear.[3]

Previous studies have shown that otitis media is a major health challenge among children and adolescents, occurring with a high incidence and prevalence in both developed and developing countries.[4] Current antibiotic therapy is guided by swab culture results.[5] Research into the putative microbial causes of CSOM has so far been reliant on culture-based techniques.[5] In these studies, *Staphylococcus aureus* and *Pseudomonas aeruginosa* were the most commonly isolated bacteria, with Methicillin-resistant *S. aureus* (MRSA) isolated in some cases.[5]

The aim of the study was to determine the pattern of bacterial isolates in patients with chronic suppurative otitis media. Objective of the study was to study the bacteriology of Chronic suppurative otitis media (CSOM) and provide recommendations according to susceptibility pattern to commonly used antibiotics.

METHODS

Study design

This was a hospital based case series study carried out at S. Nijlingappa Medical College, Bagalkot, Karnataka, India among consenting patients with chronic suppurative otitis media attending the Ear Nose and Throat clinic after obtaining approval from ethical committee of S. Nijlingappa Medical College, Bagalkot conducted from June 2021 to March 2022.

Ethical consideration

Ethical clearance was obtained from Ethical Review Committee of SNMC-Institutional ethics committee on human subject's research recognized by Medical council of India and affiliated to RGUHS, Banglore. Patient privacy was protected. All data obtained in the course of the study were kept confidential and used only for this study.

Sample size calculation

Sample size estimation was done with open epi software version 2.3.1 by the article title – study of bacterial flora in CSOM and its clinical significance, author- Poorey et al, Iyer et al.[6] According to study by Poorey et al the most common organism isolated from CSOM was pseudomonas in 32.2%=p. Sample size was calculated at 95% confidence level and at 10% absolute precision.

Sample size estimated was 88-90

Formula

The sample size was calculated by-

$$N = \frac{[DEF * N_p(1-P)]}{[\left(\frac{d^2}{z^2}\right)\left(1-\frac{\alpha}{2}\right) * (N-1) + P * (1-P)]}$$

Objectives

The objective of this study were (a) to study the bacteriology of CSOM; and (b) to determine their susceptibility pattern to commonly used antibiotics.

Inclusion criteria

Patient with CSOM- tubotympanic type who have not taken any treatment either systemic or topical ear drops for last seven days.

Exclusion criteria

Patients with following criteria were excluded- (a) acute infections less than 3 months duration; (b) CSOM-atticoantral type; and (c) patients with traumatic perforations.

Patients with active ear discharge who are eligible for the study were counseled about their condition and an informed consent was obtained for the study. A total of 100 patients were recruited for the study. The pus was collected from the ear canal in CSOM patient with the help of sterile ear swab (Figure 1).

The samples was subjected to culture by the standard loop method on the blood agar and Mac Conkey agar incubated at 37 degree over night for pathogenic bacteria. The identification of organisms was done by standard microbiological procedures.[7] Antibiotic sensitivity testing was done using Vitek-2 automated system and MIC was determined and interpretation guidelines of Clinical laboratory standard institute (CLSI) was used. Vitek-2 antibiotic susceptibility panels for gram positive cocci (P-628, SR-03) and gram negative bacilli (N-280 and N-281) was used (Figure 2).

Statistical analysis

Statistical analysis was done using SPSS software 19.0. Data obtained was tabulated in the Excel sheet and was analyzed. All values are expressed as mean±standard deviation and nonparametric data will be expressed as

median and min-max values. Proportions was used for qualitative data. Student t test for quantitative data was used. Chi-square test for proportions in qualitative data. Other appropriate statistical tests were applied. P<0.05 was considered statistically significant.

Figure 1: Collection of pus from the external auditory canal using sterile swab.

Figure 2: Vitek-2 antibiotic susceptibility panel.

RESULTS

A total of 100 ear swabs were subjected to culture on specific culture media for bacterial growth. In this study the prevalence of bacteria among CSOM patients was 82.6%. It was observed that varieties of colonies were grown on the specific cultured medium. In certain plate single type of colony and in other cases two, three or more than 3 types of colonies were grown. The percentage of frequency of the colony was documented (Table 1).

The total of 100 patients consisted of 25 paediatric patients aged <16 years and 75 adult patients aged ≥16 years. The most effective antibiotic is amikacin followed by gentamicin and cefotaxime in both isolates namely *Pseudomonas* spp and *Staphylococcus aureus*.

The sensitivity rates for amikacin, gentamicin and cefotaxime are 100, 86, 85.4 in Pseudomonas and 100, 87.5, 80.3 percent for *Staphylococcus aureus* respectively. Sensitivity rates for a commonly used antibiotic like ciprofloxacin is 46.6% for pseudomonas and 64.3% for *Staphylococcus aureus* only.

Table 1: Number of varieties of colony observed macroscopically on the cultured plate.

No. of different colony	N	Bacteria isolate (%)
No growth	17	17
Single colony	43	43
Two colony	17	17
Three or more colony	23	Treated as contaminated
Total	100	77

Table 2: Differences in the distribution of microorganisms and bacterial detection rates in children (age<16 years) and adults (age≥16 years) with CSOM and ear discharge.

Variables	CSOM
Children less than 16	
Distribution	25
Bacterial detection rate (%)	63.6
Adults more than 16	
Distribution	75
Bacterial detection rate	78.4
Children vs adults bacterial detection rate	P=0.000

Table 3: Distribution of microorganisms in children (age<16 years) and adults (age≥16 years) with CSOM and ear discharge.

Variables	CSOM
Children less than 16	25
None	9
MSSA	5
SP	0
MRSA	0
CNS	2
PA	8
MC	0
Others	1
Adults more than 16	75
None	16
MSSA	18
SP	0
MRSA	5
CNS	9
PA	14
MC	0
Others	13

Note: CSOM- Chronic suppurative otitis media; MSSA- Methicillin-susceptible *Staphylococcus aureus*; SP- *Streptococcus pneumpniae*; MRSA- Methicillin-resistant *Staphylococcus aureus*; CNS- Coagulase-negative *Staphylococcus aureus*; PA- *Pseudomonas aeruginosa*; MC- *Moraxiella catarrhalis*.

Table 4: Percentage susceptibility patterns of isolates.

Antimicrobials	Pseud-omonas (%)	Staphylo-coccus species aureus (%)
Ampicillin	0	7.1
Amikacin	100	100
Cloxacillin	2.9	51.8
Cefotaxime	85.4	80.3
Cephalexin	2	12.5
Ciprofloxacin	46.6	64.3
Cefuroxime	9.6	7.1
Chloramphenicol	2	7
Gatifloxacin	47.6	69.6
Gentamicin	86.0	87.5
Levofloxacin	29.4	41.1
Norfloxacin	31.1	41.1
Netilmicin	55.3	57.1
Tobramycin	43.7	17.8
Ofloxacin	2.9	<1

DISCUSSION

Acute suppurative otitis media (ASOM) is a common childhood illness and can progress to chronic supportive otitis media (CSOM).[1] Otitis media (OM), an inflammation of the middle ear cleft, is a common problem worldwide.[9] The clinical diagnosis of COM points toward a permanent abnormality of the pars tensa or flaccida, probably as a result of a previous acute otitis media which has been poorly managed; negative ME pressure from the spread of inflammation in the nasopharyngeal area, affecting the opening of the Eustachian tube (ET); or a ME effusion.[4] One of the most significant pathogenic factors in the development of otitis media is ET dysfunction, most likely resulting from inflammatory response.[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.[1] The bacteria may gain entry to the middle ear through a chronic perforation.[1] 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.[1] It can cause chronic hearing loss which has a negative impact on the development of speech, language and social interaction as well as school and workplace performance and is responsible for significant morbidity and mortality due to complications.[10]

Previous publications have reported its incidence to depend on race and socio- economic factors.1 A high prevalence has been reported among the Eskimos, American Indians, Australian aboriginal children and among black South Africans.[1] Poor living conditions, overcrowding, poor hygiene and nutrition have been suggested as a basis for the widespread prevalence of CSOM in developing countries.[1] According to a report by WHO, India belongs to the highest (>4%) CSOM prevalent countries.[10] Topical antibiotics are the mainstay of therapy while systemic antibiotics are given in acute exacerbations and in complications due to CSOM.

The causative agents of ear infection might be bacterial, viral, or fungal.[2] However, the major causative agents of ear infection are bacterial isolates such as *Pseudomonas aeruginosa*, *Escherichia coli*, *S. aureus*, *Streptococcus pyogenes*, *Proteus mirabilis*, *Klebsiella spp*, or mixed bacterial infection.[2] Highlighting the etiologies of ear infection and their antibiotic susceptibility pattern will help to lessen the severe complication of the infection and guide the empirical antibiotic prescribed by the physicians, especially for developing countries.[2]

In the study by Renukananda, et al *Pseudomonas aeruginosa* was the most common organism isolated followed by Klebsiella.[3] Topical ciprofloxacin was found to be as effective as combination of oral and topical ciprofloxacin ear drops though the chances of recurrence was found to be more when topical ear drops was used as the sole agent in the first line management of discharging chronic supportive otitis media.[3]

P. aeruginosa and *E. faecalis* were the most prevalent organisms in the ME and nasopharyngeal specimens, respectively, of patients with COM in the study conducted by Afolabi et al.[4] CSOM may arise from middle ear or mastoid commensal bacteria alone, without contributions from adjacent anatomical sites.[5] Indeed, potential pathogens, such as Staphylococcus, Pseudomonas, Streptococcus, and Moraxella, which have been implicated in ear disease using cultivation techniques, were also detected among healthy controls, supporting the notion of the resident microbiota as a potential source of infection from within as observed in the study by Neeff et al.[5]

Yeo et al and Lee et al, studies have analyzed the bacteriology of OM, but most focused on COM and CSOM in adults, especially regarding associated nosocomial infections such as MRSA and PA. Gram negative bacteria predominance (60.6%) matches other studies in India.[10] *S. aureus* was the predominant bacteria followed by *P. aeruginosa* which are in opposite with other studies. Whereas similar results reported in other studies i.e.; *S. aureus* as predominant isolate followed by *P. aeruginosa*.

The findings of predominant gram negative bacilli is consistent with many previous investigators Gulati et al, Goyal et al, Kumar et al, Nene et al, Fule et al, Gulati et al, Mishra et al.[6] Gram positive bacilli as the predominant organism was found in studies conducted by various investigators.[6] Douglas et al, Friedmann et al, Baruah et al, Singh et al, Siraj et al, Rao et al, Vantain et al, Finland et al, Rao et al found *Staphylococcus aureus* to be the most common causative organism.

In the study of Hailu et al, P. aeruginosa (30.4 %) followed by *S. aureus* (26.9 %) and *Proteus* spp. (22.3 %) were the leading isolates.[11] This trend is similar to reports of other researchers (Aslam et al, Iseh and Adegbite et al, Weckwerth et al, Fatima et al, Raghvendra et al).

In the study done by Oni et al, he recommended penicillin as first line drugs treatment and quinolone as second line.[1,12]

Limitations

The result of this study may not completely represent all the antibiotics used in the clinical practice in the study area since only those who visited our tertiary facility were included in the study.

CONCLUSION

Otitis media is a serious healthcare concern worldwide, not only because of the distress it causes the patient and their family but also because of the substantial economic burden it imposes on the health care system. Due to the low socio-economic status, overcrowding, poor hygiene, inadequate health care, and recurrent upper respiratory tract infection, the burden of CSOM is high in low and middle income countries. CSOM is a common clinical entity where topical and systemic antibiotic are the main treatment. However the emergence of antibiotic resistant strains is leading to increasing treatment failure. It is important to be aware of the current trend of the bacteriological profiles and to revise the antibiotic regime according to both the sensitivity and age groups. Strains of P.aeruginosa and MSSA were most prevalent in ear discharges of patients with CSOM. Continuous and periodic evaluation of microbiological profile and antimicrobial sensitivity pattern of bacterial is essential for optimum management of CSOM patients.

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