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An Analysis of the Bacteriological Spectrum of Chronic Suppurative Otitis Media

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Abstract: Chronic supportive otitis media is highly prevalent in the developing countries like India. The present study was conducted for duration of three years in two Medical Colleges of West Bengal, India, to find the prevalence of bacterial infections in otorrhoea. Chronic suppurative otitis media was more common in the rural population (66.8%) than in the urban population (33.2%). Out of the 226 patients in the study, 144 cases (63.7%) of purely bacterial, 59 cases (26.1%) of mixed (bacterial and fungal), and 23 cases (10.2%) of purely fungal infections were isolated. Out of the total 226 cases of chronic suppurative otitis media, the number of bacterial infections was 203 (89.8%). The most common age group observed was 1-10 years (32.3%). There was no significant difference between male and female preponderance, with a male, female ratio of 1.17:1. Pseudomonas aeruginosa was found in 87 (38.50%) cases and was the most common organism, followed by Staphylococcus aureus in 51 (22.57%) cases. Other bacteria found in our study were Klebsiella species in 20 patients (8.85%), Enterococcus species in 18 patients (7.96%), and Proteus species in 16 patients (7.07%), Citrobacter species in 9 patients (3.98%) and Serratia marcescens in 2 patients (0.88%). We found that antibiotics effective against most of the organisms were gentamicin, followed by ciprofloxacin. Coamoxyclav was found to be effective mainly against Staphylococcus aureus (94.1%) but ineffective against the Gram negative bacteria. Ciprofloxacin is recommended as a first line antimicrobial for chronic suppurative otitis media, as it has no ototoxicity, has lower cost and is available both in topical and oral preparations.

Keywords: Pseudomonas, staphylococcus, otorrhoea, CSOM, bacterial infection, chronic otitis media.

INTRODUCTION

Patients often present to an otolaryngologist with chronic ear discharge. In the last few decades, the number of patients with otorrhoea has significantly reduced. This is due to the advancement of medical facilities and the invention of newer antimicrobials. However, in developing countries like India, otorrhoea remains a significant clinical condition. In spite of proper treatment with antibiotics, ear discharge often fails to respond adequately. In this situation, a complete bacteriological profile of chronic otorrhoea is necessary to control it properly.

This study was done over a period of three years, to analyse the prevalence of different bacteria present in the chronic ear discharge of patients attending the ENT outpatient departments of two Medical Colleges of West Bengal, India.

An ear with a perforated tympanic membrane often presents with chronic discharging ear. Development of chronic otitis media may be related to the frequent infections of the upper respiratory tract and poor socioeconomic conditions like overcrowding, poor hygiene and malnutrition [1]. A WHO/CIBA Foundation workshop [2] in 1996, has defined chronic suppurative otitis media as a stage of disease in which there is chronic infection of the middle ear cleft, i.e. eustachian tube, middle ear and mastoid, and in which a non-intact tympanic membrane (e.g. perforation or tympanostomy tube) and discharge (otorrhoea) are present for two weeks or more. Unlike otitis media with effusion, which is common in the West, chronic discharging ears are highly prevalent in the tropical regions including India.

As per the study of Monasta *et al*. [3], chronic suppurative otitis media incidence rate is 4.76% i.e. 31 million cases, with 22.6% of cases occurring annually in under-fives. Otitis media related hearing impairment has a prevalence of 30.82 per ten thousand.

Recently, bacterial biofilm [4] are thought to have a major role in many otolaryngological infections. Over the past 20 years, a new appreciation has developed regarding how bacteria behave differently,

once bound to a surface. The formation of biofilm facilitates chronic bacterial infections and reduces the efficacy of anti-microbial therapy [5].

Aerobes, anaerobes, and fungi are all potential pathogens in CSOM. Bacteriological study of chronic otitis media is important for efficient and effective treatment, and prevention of complications and antibiotic resistance.

MATERIALS AND METHODS

This prospective study was conducted over a period of three years on 226 patients in two Medical Colleges of West Bengal, India.

All patients with active ear discharge, having history of otorrhoea for more than six weeks were selected for the study. Patients on antibiotic or antifungal treatment (ear drops or systemic) within the previous two weeks, patients with history of otorrhoea for less than six weeks, patients with otorrhoea but intact tympanic membrane (otitis externa), and patients who refused to consent to participate in the study were excluded. Children below the age of one year were also excluded from the study because of relative inconvenience in obtaining swabs for culture.

Proper history was taken and the patients were examined completely. Special emphasis was given on the type and duration of treatment with antibiotic drops with or without steroids. Sterile swabs were taken from the ears as deep as possible, to avoid contaminants and were sent to the Microbiology department immediately for culture and sensitivity tests. Routine smears with Gram stain and 20% KOH were examined. Separate fungal culture was also done from the sample to study the fungal spectrum.

For bacterial cultures, all specimens were inoculated on blood and MacConkey's agar plates. Bacterial growth was identified using colonial morphology, Gram stain results and key biochemical reactions. All bacterial isolates were subjected to antimicrobial susceptibility testing using Kirby-Bauer method using selected antibiotic panel according to Clinical and Laboratory Standard Institute (CLSI) [6].

The relative distribution of bacteria among all cases of ear discharge was documented and studied. Age and sex distribution were additionally done.

RESULTS AND DISCUSSION

The chronic otitis media (COM) is defined as a permanent perforation of the tympanic membrane, which does not close by itself, and an inflammatory reaction in the mucosa of the middle ear. Two main forms of COM are distinct, the chronic suppurative otitis media and the cholesteatomatous COM. Bacterial infection is often the cause of exacerbation and treatment failure in CSOM [7].

Prevalence of chronic suppurative otitis media is more in the developing and underdeveloped countries. It is also common among the poorer sections of the developed world. The incidence is highest in the population with low hygiene, overcrowding, and malnutrition. In most of the cases, the disease starts in the childhood, when the eustachian tube is more horizontally placed and the immunity is relatively weak.

In our study, we took swab from the patients with active aural discharge. Out of the 226 patients in our study, we isolated 144 cases (63.7%) of purely bacterial, 59 cases (26.1%) of mixed (bacterial and fungal) and 23 cases (10.2%) of purely fungal infections.

Table-1: Types of infections

Type of infection	Number of cases	Percentage (%)
Purely bacterial	144	63.7%
Mixed (bacterial and fungal)	59	26.1%
Purely fungal	23	10.2%
Total	226	100%

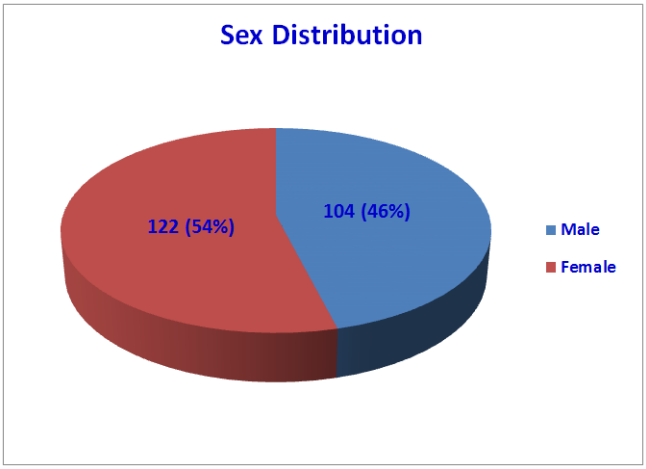
In their study of 84 young adult men with clinical otitic infections, Chow *et al*. [8] found 56.6% of bacterial, 6.7% of fungal, and 36.7% of both bacterial and fungal isolates. Balan *et al*. [9] in their study of 100 ear swab cultures, found positive fungal culture in 28 (28%) cases while combination of bacteria and fungi in 24 (24%) cases and only bacteria in 62 (62%) cases. No growth of any pathogen was found in 10 cases. Our finding was close to the above findings.

Considering the age distribution, 73 patients (32.3%) were 1-10 years of age, 33 patients (14.6%) were 11-20 years of age, 38 patients (16.8%) were 21-30 years of age, 31 patients (13.7%) were 31-40 years of age, and 51 patients (22.6%) were 41 years and above of age. The highest prevalence of CSOM was found in the age group of 0-20 years (46.9%). The mean age of the patients was 25.6 years. The age wise distribution of CSOM patients is described in Table-2. Prakash *et al*. [10] in his study of 204 cases also observed the peak incidence of CSOM in the age group of 0 to 20 years (51%).

Table-2: Age distribution of patients

Age groups	Number of cases	Percentage (%)
1-10 years	73	32.3%
11-20 years	33	14.6%
21-30 years	38	16.8%
31-40 years	31	13.7%
41 years and above	51	22.6%
Total	226	100%

Among the 226 patients of CSOM, 104 patients (46%) were found to be male and 122 patients (54%) were found to be female. Females (54%) were more commonly affected than males (46%) and the sex ratio, female: male was 1.17:1. Prakash *et al*. [10] in their study of 204 patients with documented diagnosis of CSOM with otorrhoea, found that females (53.92%) were more commonly affected than males (46.08%) and the sex ratio, female: male was 1.2:1.



Chronic suppurative otitis media was found to be more common in the rural population (66.8%) than in urban population (33.2%). This was probably due to the lower socioeconomic conditions and social habits of the rural people like bathing in ponds and others.

Table-3: Residential distribution of patients

Residence	No. of Cases	Percentage%
Rural	151	66.8%
Urban	75	33.2%
Total	226	100.0%

In the present study, Pseudomonas aeruginosa was the most common organism and was found in 87 (38.50%) cases, followed by Staphylococcus aureus in 51 (22.57%) cases. Other bacteria found in our study were Klebsiella species in 20 (8.85%) patients, Enterococcus species in 18 (7.96%) patients, Proteus species in 16 (7.07%) patients, Citrobacter species in 9 (3.98%) patients, and Serratia marcescens in 2 (0.88%) patients. No bacterial growth was found in 23 (10.18%) patients.

Table-4: Distribution of bacterial species

Bacterial species	No. of cases(Total=226)	Percentage
Pseudomonas aeruginosa	87	38.50%
Staphylococcus aureus	51	22.57%
Kleibsella species	20	8.85%
Enterococcus species	18	7.96%
Proteus mirabilis	10	4.42%
Proteus vulgaris`	6	2.65%
Citrobacter species	9	3.98%
Serratia marcescens	2	0.88%
No bacterial growth	23	10.18%

Total	226	100%

Balan & Viswanatha [9] in their study found Pseudomonas aeruginosa (37.21%) to be the most common organism, followed by Staphylococcus aureus (27.91%). Poorey and Iyer [11] found Pseudomonas pyocyanea (35.2%) as the commonest organism isolated from ear discharge, followed by Klebsiella aerogenes (25.4%), Staphylococcus aureus (14.70%), Bacillus proteus (9.8%), Escherichia. coli (5.88%), Staphylococcus albus (4.90%), and haemolytic Streptococci (3.92%). Prakash *et al*. [10] in their 191 aerobic isolates from ear discharge found that the common organisms were Staphylococcus aureus (48.69%) and Pseudomonas aeruginosa (19.89%). In Nigeria, Osazuwa *et al*. [12] found that Pseudomonas aeruginosa (28.3%) was the predominant bacteria causing otitis media, followed by Staphylococcus aureus (21.0%), Klebsiella species (8.9%), Proteus species (8.2%), Alkaligenes species (4.3%), Streptococcus pneumoniae (3.9%), Escherichia coli (3.0%), and Citrobacter freundii (1.7%). In Pakistan, Mansoor *et al*. [13] found that Pseudomonas aeruginosa (40%) and Staphylococcus aureus (30.9%) were the most common bacterial agents found in CSOM. Afolabi *et al*. [14] in their study found that majority of the bacteria isolated from the middle ear of the patients with CSOM were Pseudomonas aeruginosa and Klebsiella species, in 31.3% and 23.9% respectively. Vishwanath *et al*. [15] found Pseudomonas aeruginosa (32.2%) as the most common isolate, followed by Staphylococcus aureus (17.4%).

We could isolate Pseudomonas in 87 (38.50 %).patients. All of them were Pseudomonas aeruginosa species. Pseudomonas however is not usually present in the upper respiratory tract. Its presence in the middle ear cannot be explained as an invasion through the eustachian tube, rather it can be considered as secondary invader entering the middle ear via the defect in the tympanic membrane.

Klebsiella pneumoniae and Escherichia coli were isolated in 9.85% and 8.87% cases respectively. These findings were similar to the reports by Mansoor *et al.* [13], who reported the same to be 8% and 4%. Poorey and Iyer [11] reported a high incidence of Klebsiella in their study (25.4%). Hasan and Adeyemi [16] recorded the prevalence of Pseudomonas aeruginosa in 38.5% cases, Staphylococcus aureus in 30.8% cases, Proteus mirabilis in 15.4% cases, Klebsiella species in 9.6% cases, and Escherichia coli in 3.8% cases. A recent study by Shyamala and Reddy [17] from India found that Pseudomonas aeruginosa was the most predominant organism (40%) isolated in CSOM. It was followed in order of predominance by Staphylococcus aureus (31%), Escherichia coli (21%), Proteus mirabilis (5%), and Klebsiella pneumoniae (5%).

More frequent isolation of bacteria like Escherichia coli, Klebsiella, and Pseudomonas was probably related to increased risk due to the poor hygiene of patients. Our study revealed that both Gram positive and Gram negative organisms were responsible for infection of the middle ear. We also observed that Gram negative rods outnumbered the Gram positive organisms in CSOM as reported by various authors.

Table-5: Sensitivity to antibiotics

Organism	Co-amoxyclav	Cefoperazone + sulbactum	Imipenems	Ofloxacin	Ciprofloxacin	Amikacin	Gentamicin
Pseudomonas aeruginosa (87)		80	83		78	84	82
Staphylococcus aureus (51)	48	50		5	32	14	42
Klebsiella pneumoniae (20)	7	14	18	10	18	16	18
Enterococcus species (18)	2	1	7		9	14	10
Proteus species (16)	3	3	18	4	12	14	14
Citrobacter species (9)		8	9	9			
Serratia marcescens (2)							

The sensitivities of most bacteria isolated in this study were comparable to the reports of most investigators. Most of the investigators reported high sensitivity rate for Pseudomonas and Staphylococci species to ciprofloxacin. We found that antibiotics effective against most of the organisms were gentamicin, followed by ciprofloxacin. Coamoxyclav was found to be effective mainly against Staphylococcus aureus (94.1%) but ineffective against the Gram negative bacteria. This was is in agreement with the report of other investigators in which the

sensitivities to amino glycosides (amikacin and gentamicin) approached 100% [18].

Mansoor *et al.* [13] found that Pseudomonas aeruginosa was sensitive to amikacin in 96% cases followed by ceftazidime in 89% cases, ciprofloxacin in 85% cases, gentamicin in 81% cases, imipenem in 76% cases, aztreonam in 42% cases and ceftriaxone in 21% cases.

Afolabi *et al.* [14] found that almost all the bacterial organisms in the middle ear were sensitive to ciprofloxacin except Proteus mirabilis. The highest sensitivity pattern was recorded among the Pseudomonas aeruginosa, and then streptococcus faecalis. Gentamicin was also found to be an effective antibacterial agent against Streptococcus faecalis. Ciprofloxacin, azithromycin, and coamoxyclav were found to be effective against Pseudomonas aeruginosa

Viswanath *et al.* [15] found that aamong the commonly used topical agents in the treatment of CSOM, tobramycin was the most effective (sensitive against 83.8% of the Pseudomonas aeruginosa isolates), followed by gentamicin (78.1%) and ciprofloxacin (75.6%). Neomycin was the least effective (3.5%). Other amino glycosides like amikacin and netilmicin were effective against 93.9% and 81.4% of the isolates, respectively.

Hasan *et al.* [16] found that the most prevalent organism Pseudomonas aeruginosa had a high susceptibility to gentamicin (80%) and ofloxin (70%) and the only Gram positive organism Staphylococcus aureus had a moderate sensitivity to erythromycin (75%), gentamicin (62.5%) and streptomycin (65.6%).

Shyamala and Reddy [17] found that the sensitivity pattern for the isolated aerobes was maximum for coamoxyclav and the least for clindamycin. Deb and Ray [19] found that majority of the Gram negative bacteria were sensitive to ciprofloxacin. Pseudomonas was found to be sensitive in almost 100% cases.

Majhi *et al.* [18] found that the most effective antibiotic against Pseudomonas species and Staphylococcus aureus was amikacin, followed by cefotaxime. The sensitivity rates for amikacin, gentamicin and cefotaxime were 100%, 86%, and 85.4% in Pseudomonas and 100%, 87.5%, and 80.3% for Staphylococcus aureus respectively. Sensitivity rates for Ciprofloxacin were 46.6% for Pseudomonas and 64.3% for Staphylococcus aureus. In the amino glycosides group of antibiotics, amikacin was the only antibiotic, which was 100% effective for both of the two important isolates. Sensitivity rate for gentamicin was 86%, and 87.5%, for netilmicin was 55.3% and 57.1%, and for tobramycin was 43.7% and 17.8 % for the two important isolates, Pseudomonas species and Staphylococcus aureus respectively.

CONCLUSION

Pseudomonas aeruginosa and Staphylococcus aureus were the most common bacteria found in chronic suppurative otitis media in India. Chronic suppurative otitis media was more prevalent in the rural area than in the urban area. The most effective antibiotic was gentamicin followed by ciprofloxacin. Pseudomonas and Staphylococcus were sensitive to ciprofloxacin in most of the cases. As ciprofloxacin has no ototoxicity, has lower cost and is available both in topical and oral preparations, it may be used as a first line antimicrobial for chronic suppurative otitis media. Alternatively, coamoxyclav may be used as a first line of treatment. However, the organisms responsible for chronic suppurative otitis media are increasingly becoming resistant to fluoro quinolones and penicillin group of antibiotics. Hence, culture and sensitivity tests should guide the management of chronic suppurative otitis media.

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