Bacteriological profile and antibiotic resistance pattern of ear discharge in a tertiary care hospital

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Abstract

Introduction: Ear discharge is a common clinical problem presented by patients in the ENT set up. It can be seen in a variety of infectious conditions like otitis externa, otomycosis, and otitis media. It is notorious for its persistence and recurrence despite treatment. It's importance lies in its refractoriness to treatment and chronicity. Thus the need to study the detailed bacteriological profile and resistance patterns of commonly used antibiotics to prevent their injudicious use, thus lowering antibiotic resistance and recurrence. The study aimed to isolate, identify and speciate the bacteria isolated from the patients presenting with ear discharge and to study the antimicrobial resistance of bacterial isolates.

Material and Methods: The study included 180 consecutive patients with ear discharge attending the ENT OPD. A proforma was maintained containing demographic and clinical details. Criteria for inclusion was any patient presenting with ear discharge whereas patients on antibiotics for more than seven days were excluded. Ear swabs were obtained and processed and bacteriological profile and antibiotic resistance patterns were studied in detail.

Results: Ear discharge has a diverse bacteriological pattern being prevalent in younger population and more commonly associated with poverty with male predominance. Pseudomonas aeruginosa, Staphylococcus aureus and Proteus mirabilis were among the commoner bacteriological agents isolated. Maximum resistance was found to Penicillin-G and Ampicillin.

Conclusion: It is emphasized that early diagnosis and proper antimicrobial treatment in addition to the patient education is mandatory to avoid complications and in decreasing morbidity and mortality.

Keywords: Ear discharge, Bacteriological profile, Antibiotic resistance

Introduction

Discharge from the ear is one of the commonest symptoms of infections of the ear. Infection of the ear is categorized into otitis externa (infection of external ear) and otitis media (infection of middle ear), the most common cause being otitis media.[1] As external and middle ear are exposed to outer environment and nasopharynx respectively, these sites are likely to be infected when the natural milieu is disturbed.

Otitis externa is a generalized condition of the skin of the external auditory canal that is characterized by edema and erythema associated with itchy discomfort and usually an ear discharge.[2]

Otitis Media comprises of the inflammation of the middle ear cleft. It can be acute, subacute or chronic.[3]

Acute Suppurative Otitis Media (ASOM): It is the commonest ear pathology in otorhinolaryngological practice, also the commonest pediatric otorhinolaryngological presentation[3] occurring mostly in infants and children, presenting with otalgia, aural pressure, decreased hearing and fever. Infective agents associated with ASOM are[4]:

Bacteria: *Haemophilus influenzae, Moraxella catarrhalis, Streptococcus pyogenes, Staphylococcus aureus.*

Viruses: Respiratory syncytial virus, Influenza A virus, Parainfluenza viruses, Human rhinovirus, Adenoviruses.

Chronic Suppurative Otitis Media (CSOM) is one of the most common diseases of all age groups especially of childhood. It is prevalent in developing countries and is a disease of poverty.[5] Chronic suppurative otitis media is a stage of ear disease in which there is a 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. The otorrhoea should be present for two weeks or longer.[6]

It is a disease of multiple etiology. It is well known for its persistence and recurrence inspite of treatment. Its importance lies in its refractoriness to treatment and chronicity leading to complications.[7] It is a major cause of acquired hearing impairment in children, especially in developing countries. Most approaches to treatment have been unsatisfactory or are very expensive and difficult. It is an important cause of preventable hearing loss, particularly in the developing world.[8]

Incidence of CSOM is higher in developing countries like India due to poor socioeconomic standards, poor nutrition and lack of health education. The urban to rural ratio of the disease is 1:2 and the poorer rural communities have highest prevalence.[9,10] It affects both sexes and all age groups. Cases usually present with ear discharge, hearing loss, perforation in tympanic membrane and itching.

Over 50 % of otitis media are caused by bacteria.[11] In CSOM, the most frequently isolated bacteria are *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Proteus spp* and *Klebsiella spp.* Occasionally otitis media may be caused by fungi, viruses, *Mycoplasma pneumoniae* and *Chlamydia trachomatis*.[12] Fungal infections can commonly co-exist with bacterial infections in cases of ear discharge.

Due to the notorious nature of CSOM for chronicity, persistance and recurrence inspite of treatment, a need was felt to study the bacteriology of the disease in detail followed by antibiotic resistance patterns of the most common etiological organisms so that a more specific antibiotic treatment be targeted towards the most common pathogens for better treatment results as well as prevention of antibiotic resistance.

Materials and Methods

The prospective study was carried out in the Department of Microbiology in conjunction with Department of ENT in a tertiary care hospital. A total of 180 consecutive patients with ear discharge attending the ENT out patients department were included in the study. After taking an informed consent from the patient, relevant history, regarding patient's name, age, sex, nature of discharge, duration of ear discharge and any antibiotic treatment taken were noted in the structured proforma. Sterile ear swabs were collected from each patient.

Inclusion Criteria: Any patient presenting with ear discharge.

Exclusion Criteria: Patient on antibiotics for more than seven days before presenting to the ENT outpatients department (OPD).

Methods: Clinical samples from the discharging ear were collected with sterile swabs taking care not to touch the external acoustic canal and transported to the Department of Microbiology and processed without any delay.

Laboratory processing of samples was done taking sterile swabs, one for direct microscopic examination and another for culture for bacterial isolation.

The second swab was inoculated onto the plates of blood agar and Mac Conkey's agar, and also into a tube of Brain heart infusion broth (BHI). Identification of bacterial isolates was done using their colony morphology, motility by hanging drop technique, gram staining and a battery of biochemical tests.[13]

Antimicrobial Susceptibility Testing

All the aerobic bacterial isolates obtained were subjected to antimicrobial susceptibility testing for a wide range of antimicrobial agents, by Kirby Bauer Disc diffusion method. The antimicrobial agents tested for Gram positive bacteria were Penicillin G (30 µg/disc), Ampicillin (10 µg/disc), Cephalexin (30 µg/disc), Erythromycin (15 µg/disc), Gentamicin (10 µg/disc), Amikacin(30 µg/disc), Clindamycin (2 µg/disc), Ciprofloxacin (5 µg/disc), Ofloxacin(5 µg/disc), Fusidic Acid (10 µg/disc), Chloramphenicol (30 µg/disc), Vancomycin (30 µg/disc) and Teicoplanin (30 µg/disc). While for Gram negative bacteria, the antimicrobial agents tested were Ciprofloxacin(5 µg/disc), Ofloxacin (5 µg/disc), Gentamicin(10 µg/disc), Amikacin(30 µg/disc), Netilmicin(30 µg/disc), Ceftazidime(30 µg/disc), Piperacillin/ Tazobactum (100/10 µg/disc), Imipenem(10 µg/disc) and Meropenem(10 µg/disc).

Screening for methicillin resistance in *staphylococcus aureus*

All the strains of *Staphylococcus aureus* isolated were also tested for methicillin resistance by Cefoxitin disc method as recommended by the CLSI.[14]

Procedure: The test strain was inoculated in peptone water and the turbidity was adjusted to 0.5 McFarland Standard. The inoculum was seeded evenly on a Mueller-Hinton agar plate using a sterile forceps. The plates were incubated at 33^0C–35^0C and readings were taken exactly after 24 hours. The mecA negative control strain ATCC 25923 was also put up side by side.

Interpretation: An inhibition zone diameter of greater than or equal to 22 mm was regarded as mecA negative and that of less than or equal to 21 mm regarded as mecA positive. The mecA positive strains were reported as Methicillin resistant strains in accordance with standard recommendations.[14]

Data so obtained was statistically analyzed.

Results and Observations

A total of 180 patients with ear discharge were included in the present study and all the cases were investigated and observed as described under material and methods. The age distribution of the study is shown in Table 1. Maximum number of patients (36.7%) belonged to the age group of 11-20 years and minimum number of patients (0.6%) belonged to the age group of 71-80 years.

Table 1: Age distribution of patients (n=180)

Age	Number	Percentage
0-10	22	12.2
11-20	66	36.7
21-30	31	17.2
31-40	25	13.9
41-50	13	7.2
51-60	14	7.8
61-70	8	4.4
71-80	1	0.6
Total	180	100

Table 2: Sex distribution of patients (n=180)

Sex	No.	Percentage
Male	109	60.6
Female	71	39.4
Total	180	100

In this study, M: F ratio was 1.53: 1 with males accounting for 60.6% of the patient group (Table 2). The common complaints in the patients presenting with ear discharge were loss of hearing (53.3%) and pain in ear (17.2%). Out of 180 patients of ear discharge, 166 patients clinically suffered from ASOM and CSOM which have a predominantly bacterial etiology, whereas the remaining 14 patients were clinically of Otomycosis. (Table 3).

Table 3: Clinical Diagnosis of Cases (n=180)

Clinical diagnosis	No. of cases	Percentage
ASOM	12	6.6
CSOM	154	85.6
OTOMYCOSIS	14	7.8
Total	180	100

Table 4: Distribution of Culture Isolates (n=180)

Types of isolates	No. of cases	Percentage
Bacteria alone	124	68.9
Bacteria + fungi	28	15.6
Fungi alone	15	8.3
Sterile	13	7.2
Total	180	100

Bacteria alone were isolated in 68.9% cases, bacteria along with fungi in 15.6% cases and fungi alone in 8.3% cases. Sterile culture was obtained in 7.2% of cases. (Table 4).Thereafter, these 180 cases were studied for individual bacterial isolates. In most cases, a single bacterial isolate was found. In a few, more than 1 bacterial isolate was found in a single case whereas in a few other cases, bacterial growth mixed with fungi was found, making the number of bacterial isolate to 189, i.e. n = 189 (Table 5). There were 189 bacterial isolates. Amongst these, *Pseudomonas aeruginosa* was the most common bacterium isolated (34.9%) followed by *Staphylococcus aureus* (24.4%) and *Proteus mirabilis* (6.3%). (Table 5)

Table 5: Bacterial Isolates (n=189)

Bacteria	Number	Percentage
Gram Negative Bacteria	**107**	**56.61**
Pseudomonas aeruginosa	66	34.9
Proteus mirabilis	12	6.3
Escherichia coli	09	4.8
Klebsiella pneumoniae sub spp. Pneumonia	06	3.2
Providencia stuartii	05	2.6
Enterobacter aerogenes	04	2.1
Acinetobacter baumanii	03	1.6
Alcaligenes faecalis	02	1.1
Gram Positive Bacteria	**82**	**43.33**
Staphylococcus aureus	46	24.4
Streptococcus pyogenes	08	4.2
Streptococcus pneumoniae	04	2.1
Staphylococcus auricularis	04	2.1
Staphylococcus epidermidis	04	2.1
Enterococcus faecalis	02	1.1
Diphtheroids	14	7.4
Total	189	100

By the disc diffusion method, *Staphylococcus aureus* showed maximum resistance to Pencillin G and Ampicillin (100%) followed by Flouroquinolones i.e. Ciprofloxacin (67.4%) & Ofloxacin (47.8%), whereas 32.6% resistance was seen to Erythromycin and Clindamycin, followed by Cephalexin (30%) and Gentamicin (23.9%). No resistance was found to Amikacin, Netilmicin, Chloramphenicol, Fusidic acid, Vancomycin and Telcoplanin.

All isolates of Coagulase negative Staphylococcal species showed maximum resistance to Pencillin G and Ampicillin (100%) followed by Ciprofloxacin (75%) and 37.5% resistance to each of Ofloxacin and Gentamicin. 12.5% resistance was seen to both Erythromycin and Clindamycin. (Table 6).

37% of total *Staphylococcus aureus* were found to be Methicillin resistant. (Table 7)

Among the *Pseudomonas aeruginosa* isolates maximum resistance was found for Ciprofloxacin (74.2%) followed by Gentamicin and Netilmicin (63.6% each. No resistance was observed against Imipenem and Meropenem. (Table 8). *Proteus mirabilis* showed maximum resistance to Ciprofloxacin (83.3%) followed by Gentamicin (66.7%), Netilmicin. (Table 9)

Table 6: Resistance Pattern in Staphylococcal Isolates

Name of antibiotics	*Staphylococcus aureus* (n=46)		Coagulase negative Staphylococcal species (CONS) (n=8)	
	No.	% Resistance	No.	% Resistance
Penicillin G	46	100	8	100
Ampicillin	46	100	8	100
Ciprofloxacin	31	67.4	6	75
Ofloxacin	22	47.8	3	37.5
Cephalexin	14	30	0	0
Amikacin	0	0	0	0
Gentamicin	11	23.9	3	37.5
Erythromycin	15	32.6	1	12.5
Clindamycin	15	32.6	1	12.5
Fusidic acid	0	0	0	0
Chloramphenicol	0	0	0	0

Table 7: Methicillin Resistance amongst Staphylococcal Isolates

Staphylococcus aureus (n=46)	No.	%	Coagulase negative staphylococcal species (n=8)	No.	%
Methicillin Resistant *Staphylococcus aureus* (MRSA)	17	37	Methicillin Resistant	0	0
Methicillin Sensitive *Staphylococcus aureus* (MSSA)	29	63	Methicillin Sensitive	8	100
Total	46	100	Total	8	100

Table 8: Resistance Pattern in *Pseudomonas aeruginosa* (n=66)

Antibiotics	No.	% Resistance
Ciprofloxacin	49	74.2
Ofloxacin	36	54.5
Gentamicin	42	63.6
Netilmicin	42	63.6
Cefotaxime	32	48.5
Ceftazidime	32	48.5
Amikacin	27	41
Piperacillin + Tazobactam	01	1.5
Imipenem	0	0
Meropenem	0	0

Table 9: Resistance Pattern in Members of Enterobacteriaceae

Antibiotics	*Proteus mirabilis* (no=12) No. (% R)	*Providencia stuartii* (no=5) No. (%R)	*Klebsiella pneumoniae* (no=6) No. (%R)	*Escherichia coli* (no=9) No. (%R)	*Klebsiella vs Escherichia* p value
Ceftazidime	4(33.3)	5(100)	1(16.7)	6(66.7)	0.057
Ciprofloxacin	10(83.3)	3(60)	0(0)	6(66.7)	0.010*
Chloramphenicol	6(50)	3(60)	2(33.3)	1(11.1)	0.292
Netilmicin	6(50)	0(0)	0(0)	2(22.2)	0.215
Ofloxacin	6(50)	5(100)	0(0)	6(66.7)	0.010*
Cefotaxime	4(33.3)	5(100)	5(83.3)	6(66.7)	0.475
Piperacillin + Tazobactam	0(0)	0(0)	0(0)	1(11.1)	0.398
Gentamicin	8(66.7)	3(60)	1(16.7)	3(33.3)	0.475
Amikacin	0(0)	2(40)	0(0)	0(0)	NA

Discussion

The youngest patient was 2 years old, while the oldest patient was 78 years old with a male: female ratio of 1.53:1. Maximum number of patients (36.7%) belonged to the age group of 11-20 years, similar to a study by Kumar et al[9] who reported an incidence of 35% cases in the age group of 11-20 years. Also, study by Agrawal et al reporting an incidence of 62.4 % patients, a study in (Burdwan) India reporting 31.9% and in Malaysia 69.3% patients, among age group less than 20 years showed similar results.[15,16,17] Out of 180 patients, 154 were clinically diagnosed as CSOM, 12 as ASOM and rest 14 of Otomycosis. Ear discharge (100%) followed by loss of hearing (53.3%) were the most common symptoms. Various studies in India as well as abroad have reported males out numbering females, explaining the male predominance because of their more exposed way of life.[9,17]

Most of the patients (57.8 %) in our study belonged to the rural group, the study being conducted in the rural area. Similar results were seen in studies by Agrawal et al[17] who reported 56% patients and Prakash et al[18] who reported 66.6% patients belonging to rural area. Factors like unhygienic conditions overcrowding, ignorance regarding ear disease and lack of medical facilities might have been responsible for the high prevalence in this group of patients.

Microbiological profile of total 180 cases revealed, bacteria alone in 68.9% cases, bacteria along with fungi in 15.6% cases and fungi alone in 8.3% cases. Amongst these, *Pseudomonas aeruginosa* was the most common bacterium isolated (34.9%) followed by *Staphylococcus aureus* (24.4%) and *Proteus mirabilis* (6.3%).

In the present study, 85.6% cases were of CSOM. Out of these cases, 68.2% were of safe variety. Research workers in a study at Vellore also observed safe variety of CSOM to be commoner than unsafe type.[19] Among the CSOM cases, bacteria were isolated alone in 76.6%, bacteria along with fungi in 13% and fungi alone in 2.6% cases. *Pseudomonas aeruginosa* (33.5%) followed by *Staphylococcus aureus* (19.7%) were the commonest bacterial pathogens isolated. Mixed bacterial infections were caused by *Staphylococcus aureus* or *Pseudomonas aeruginosa* along with either CONS or Diphtheroids.

All the isolates of *Staphylococcus aureus* showed maximum resistance to Pencillin G and Ampicillin (100%) followed by Flouroquinolones i.e. Ciprofloxacin (67.4%) & Ofloxacin (47.8%), whereas 32.6% resistance was seen to Erythromycin and Clindamycin, followed by Cephalexin (30%) and Gentamicin (23.9). Similar high resistant rates to these antibiotics have also been reported by others.[20,21,22] No resistance was found to Amikacin, Netilmicin, Chloramphenicol, Fusidic acid, Vancomycin and Telcoplanin. CONS showed maximum resistance to Pencillin G and Ampicillin (100%) followed by Ciprofloxacin (75%) and 37.5 % resistance to each of Ofloxacin and Gentamicin. 12.5 % resistance was seen to both Erythromycin and Clindamycin. MRSA strains were 37%. None of the CONS was Methicillin resistant. No isolate of *Streptococcus pyogenes* and *Streptococcus pneumoniae* was resistant to commonly used antimicrobial drugs like Cephalexin, Erythromycin, Clindamycin, Chloramphenicol, Ciprofloxacin, Ofloxacin, Gentamicin and Amikacin. Among the *Pseudomonas aeruginosa* isolates, maximum resistance was found to Ciprofloxacin (74.2%) which is somewhat similar to figure of 53.4% reported from Burdwan in 2007.[16] This was followed by Gentamicin and Netilmicin (63.6% each), Ofloxacin (54.5%), Cefotaxime and Ceftazidime (48.5% each) and Amikacin (41%). The relatively high resistance rate to ceftazidime reported in this study correlates with a study by Prakash et al who reported 100% resistance to Ceftazidime.[18] The lone isolate of *Pseudomonas aeruginosa* was found resistant to Piperacillin + Tazobactam. No resistance was observed against Imipenem and Meropenem. On statistical analysis, the difference between resistance pattern against Ceftazidime and Piperacillin + Tazobactam is highly significant (p value < 0.001). *Proteus mirabilis* showed maximum resistance to Ciprofloxacin (83.3%) followed by Gentamicin (66.7%), Netilmicin, Chloramphenicol and Ofloxacin (50% each). Both Ceftazidime and Cefotaxime showed 33.3% resistance. In *Providencia stuartii*, 100% resistance was observed against Ceftazidime, Cefotaxime and Ofloxacin.

Otitis Media remains a common & important diseases responsible for chronic ear disease and a common source of misery for patients and frustration for doctors. With the advent of antibiotics, it is seen that there has been a rapid disappearance of active cases of otitis media and a change in microbiological profile of the disease, with elimination of the more susceptible organisms like *Streptococcus pyogenes, Streptococcus pneumonia, Haemophillus influenza*, and emergence of more resistant microbial flora.

Conclusion

CSOM and Otomycosis remain the common & important diseases responsible for chronic ear disease and a common source of misery for patients and frustration for doctors. With the advent of antibiotics, it is seen that there has been a rapid disappearance of active cases of otitis media and a change in microbiological profile of the disease, with elimination of the more susceptible organisms like *Streptococcus pyogenes, Streptococcus pneumonia, Haemophillus influenza*, and emergence of more resistant microbial flora.

It is emphasized that early diagnosis and proper antimicrobial treatment in addition to the patient education is mandatory to avoid complications and in decreasing morbidity and mortality.

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