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Microbial Aetiology and Its Antibiotic Sensitivity in Cases of Otorrhoea

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ABSTRACT

Background: Ear discharge is one of the commonest symptoms of ear infection others being progressive deafness, pain, tinnitus and vertigo. Objective of this study is to study the microbial aetiology of otorrhoea with antibiotic sensitivity pattern of these isolated organisms. Nearly 0.065-0.35 billion people suffer from ear infections leading to loss of hearing in 60% of them. As the middle ear is in close proximity to the cranium, ear infections may lead to intracranial complications. Inappropriate use of antibiotics in these situations can lead to persistence of otorrhoea and even multi-drug resistant bacterial strains. The knowledge of common micro-organisms causing these infections along with its susceptibility pattern remains a key to unravel the void left in otological microbial pattern.

Materials and Method: This prospective study was done at a tertiary care ENT Centre. Microbial analysis of otorrhoea samples taken from cases of middle ear infections was carried out at the Department of Microbiology for a period of 12 months (2023-24) at our Institute. The Hospital information system software was utilised in sharing the info and statistical details.

Results: In our study a total sample of 320 ear discharge were obtained and culture was done for causative microorganisms and antibiotic sensitivity of these microorganisms. Out of 320 samples, 131 (40.94%) were positive for growth of microorganisms while 189 (59.10%) samples were sterile. All positive samples for growth i.e. 40.94% were pure bacterial in nature.

Result: Out of 320 samples, 189 (59.10%) were found to be sterile while 131 samples (40.94%) were positive for growth. The microbiological profile of 131 pathogens were: Staphylococcus aureus 33.59%, Pseudomonas aeruginosa 32.02%, CONS 9.16%, Klebsiella species 6.87%, Acinetobacter species 4.58%, Escherichia coli 3.05%, Citrobacter koseri 2.29%, Enterococcus spp 3.05%, Proteus mirabilis 3.05%, Streptococcus species 0.76%. Staphylococcus aureus (MRSA) was the most common showing sensitivity to Gentamicin, Tetracycline, Erythromycin, Clindamycin, Vancomycin, etc. The second most common was Pseudomonas species being sensitive to Amikacin, Ciprofloxacin, Piperacillin/Tazobactam, Imipenem, Meropenem etc. Multi-drug-resistant strains were seen in around 57 samples predominantly Methicillin resistance. Pan-drug resistance was not reported.

Conclusion: Staphylococcus aureus (MRSA) was the most common pathogen grown in the culture with Pseudomonas species being the second most common showing sensitivity to both oral and injectable antibiotics. Based on our study, a total of 57(43.51%) isolates were MDR strains, hence it is imperative to do a culture and sensitivity pattern of ear infections for efficacious management, thereby reducing further complications.

Keywords: Ear infection, Antimicrobial sensitivity, Multidrug resistance, Antibiotic guidelines, MRSA.

INTRODUCTION

Otorrhea is the terminology used for any fluid coming from the external auditory canal. The nature of this can be mucoid, purulent, mucopurulent and can be even blood stained discharge. Otorrhoes is one of the most common symptoms of ear infection along with progressive deafness, pain, tinnitus and vertigo.

Infection of the ear can be classified depending upon the site: Otitis Externa (infection of external ear) and Otitis Media (infection of middle ear)[1]

Nearly 0.065 to 0.33 billion people worldwide experience ear infections, with about 60% of those individuals developing hearing loss[2]. Due to the middle ear's close proximity to the brain, otological infections can have a high morbidity and death rate if they are not promptly and properly treated. These infections can also cause cerebral infections and other intra cranial consequences.[3]

The majority of these infections are bacterial in origin with increasing and fulminant pyogenicity[4]. The emergence of several resistant bacterial strains due to callous, erroneous, and improper use of antibiotics has become a global public health concern.[5,6]. Some factors such as low socio-economic status, lack of hygiene, insufficient health care, overcrowding and recurrent upper respiratory tract infections play a major role in ear infections[7,8]. Hence, for appropriate treatment of patients with ear infections in developing nations, it is crucial to understand the local pattern of infectious organisms, their susceptibility pattern, and the degree of antibiotic resistance in these organisms[9].

However, antibiotic resistance is a concerning global issue listed among the major threats to public health by the World Health Organization[10].

Keeping in view the widespread use of antibiotics in the community and the high rate of antibiotic resistance, the purpose of this study was to make an attempt to address the knowledge gap in the otological microbiome in our community.

ANATOMY OF THE EAR

Ear is primarily responsible for two important sensory functions: hearing and maintenance of equilibrium or balance of the body. Ear can be divided into three anatomical parts: External ear, Middle ear and Internal ear.[4]

External ear

It consists of two major parts, pinna and external auditory meatus. The external auditory meatus extends up to the tympanic membrane (ear drum). Pinna and external auditory meatus consists of fine hairs and wax secreting sebaceous glands.

Middle ear

Contains an air containing cavity with three ossicles - malleus, incus and stapes attached to one another in a chain-like fashion. Malleus is attached to the tympanic membrane and stapes is attached to the oval window of cochlea. These ossicles are mainly responsible for the conduction of sound vibrations. Eustachian tube connects the middle ear cavity with nasopharynx hence is responsible for the aeration and equalisation of middle pressure with the atmosphere.

Inner ear

Also called as Labyrinth, consists of two parts: bony part which is a series of channels and membraneous part which is filled with fluid called endolymph. The coiled portion of labyrinth is called cochlea. The organ of corti is a structure located on the basilar membrane containing hair cells which act as an auditory receptors[11]. Inner

ear also contains complex system called vestibular apparatus which is made up of three semi-circular canals and otolith organ containing saccule and utricle. With this basic knowledge of ear anatomy, let's move on to talk about ear infections and their microbial causes.
Ear infections can have a wide range of aggravating factors:

- Recurrent attacks of common cold
- Infections of tonsils and adenoids
- Chronic rhinitis and rhinosinusitis
- Nasal allergy
- Nasopharyngeal mass
- Cleft palate
- Loss of cerumen

Any of the aforementioned risk factors has the potential to allow microorganisms to invade and create an environment for a middle ear infection.

Ear infection in any form has a wide range of microbial etiology, which influences the selection of an efficacious anti-microbial agent. According to WHO survey Globally more than 1.5 billion people experience some degree of hearing loss. Of these, an estimated 430 million have hearing loss of moderate or higher severity in the better hearing ear. Multiple studies have been conducted focusing bacterial flora of ear discharge, but very less is known about its antibiotic sensitivity in our community. In recent past, importance of knowing this aspect has been increasing because of excessive empirical use of broad spectrum antibiotics, corticosteroids and cytotoxic chemotherapy.[4]

Hence, this study was undertaken with the objective of identification and isolation of etiological agents in patients coming to ENT OPD with complain of ear discharge so as to study the etiological agent and the resistance pattern of microorganisms and also act as a guideline for empirical antibiotic therapy.

AIMS AND OBJECTIVES

1. To study the various microbial causes of ear discharge and to isolate and identify the associated microorganisms.
2. To study the antibiotic susceptibility pattern of the Isolated microorganisms.

MATERIALS AND METHODS

A prospective observational study of culture and antibiotic susceptibility reports of ear swab representing middle ear infections sent from the Otorhinolaryngology department of HIMSR and HAHCH & Research during the period of one year (2023 to 2024).

Inclusion criteria

All patients were randomly selected in the study consecutively after the initial clinical examination of the patients with clinical history.

Sample collection

A thorough clinical examination was done in the ENT Department to assess the condition of external auditory canal for the presence of congestion, debris, discharge and perforation. After examination discharge material was collected under vision with one clean sterile swab stick. Specimen was sent to microbiology department for further culture and antibiotic sensitivity.

Instruments required were microscope, autoclave, hot air oven, incubator, teasing needles and sterile swab. Various culture media used were nutrient agar, macconkey's agar, blood agar, chocolate agar, yeast nitrogen based medium (YNB).

Biochemical medium for identification of bacterial growth: triple sugar iron, citrate agar slant, urea slant, phenylalanine slant, tryptophan broth, glucose phosphate broth.

Laboratory investigation of ear discharge

Day 1 : Sterile swab used to collect samples from patients having otorrhoea

Swab was cultured on media - 1. Nutrient agar

2. Macconkey's agar,
3. Blood agar,
4. Chocolate agar,
5. Yeast nitrogen based medium (YNB).

Day 3: Plates showing no growth at the end of 48 hours were reported as No Growth.

Those plates which showed growth were further processed for the identification of pathogens conventionally using appropriate biochemical reactions. Antibiotic susceptibility testing of the isolates were performed as per CLSI guidelines (2016 guidelines)

Day 4: Identification and result of antibiotic sensitivity test.

RESULTS

In our study of 320 samples of ear discharge, the causative microorganisms and its antibiotic sensitivity were recorded. Out of 320 samples, 131 (40.94%) were positive for growth of microorganisms and 189 (59.10%) samples were sterile.

All 40.94% positive samples were pure-bacterial growth.

TABLE : 1

Total sample	Bacterial growth	Sterile (no growth)
320	131	189

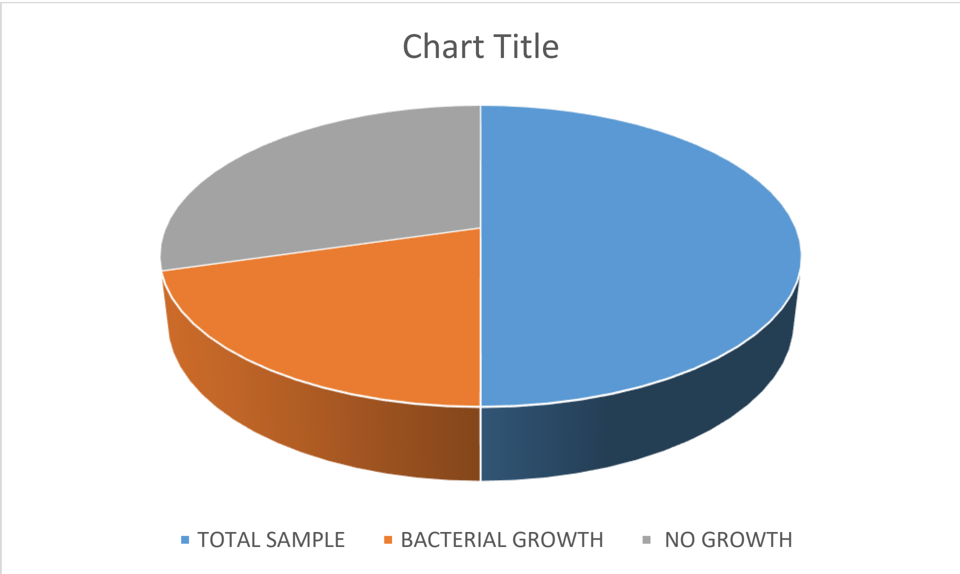

Figure 1: Samples showing growth/no growth of microorganism.

TABLE : 2

Microorganisms	number
Staphylococcus aureus (MRSA)	46
Pseudomonas spp	42
Coagulase negative staphylococcus	12
Klebsiella species	9
Escherichia coli	4
Citrobacter koseri	3
Acinetobacter spp	6
Enterococcus spp	4
Proteus mirabilis	4
Streptococcus species	1
Total	131

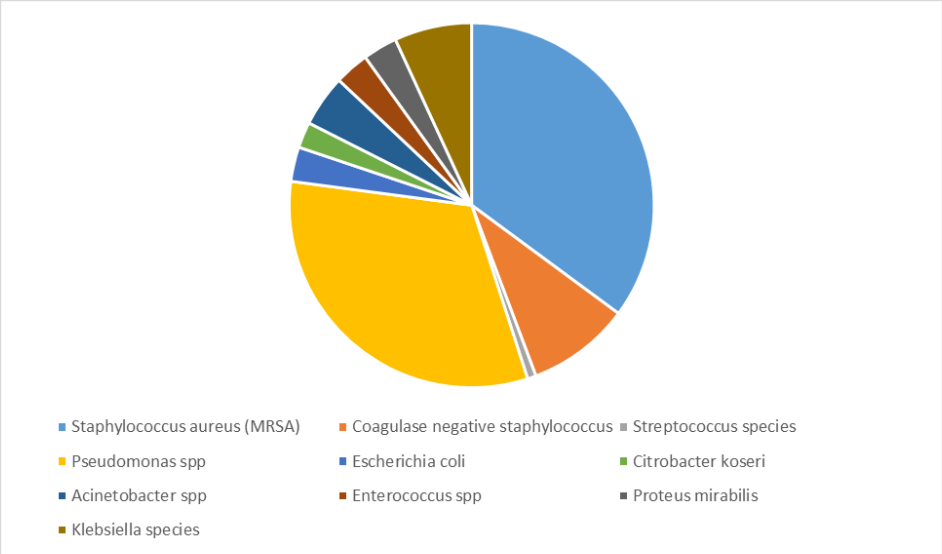

Figure 2: sample showing growth of different types of microorganisms

Table : 3

Microorganisms	Percentage
Staphylococcus aureus (MRSA)	33.59
Pseudomonas spp.	32.02
Coagulase negative staphylococcus	9.16
Klebsiella species	6.87
Escherichia coli	3.05
Citrobacter koseri	2.29
Acinetobacter spp	4.58
Enterococcus spp	3.05
Proteus mirabilis	3.05
Streptococcus species	0.76

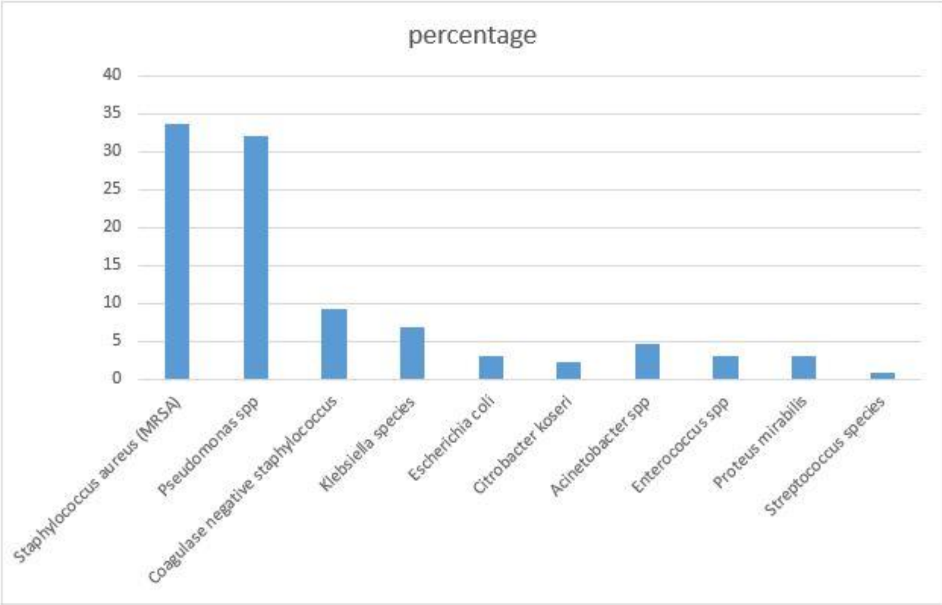

Figure : 3 - Percentage of growth of microorganisms.

Table : 4 – Sensitivity of Staphylococcus aureus (MRSA) to antibiotics

ANTIBIOTICS	No. of sensitive Isolates	No. of resistant isolates	No. of Intermediate isolates
Gentamicin	35	6	
Ciprofloxacin	3	37	
Levofloxacin	3	39	
Benzylpenicillin	nil	42	
Oxacillin	13	28	
Cefoxitin screen	26 +	13-	
Tetracycline	37	1	1
Erythromycin	15	21	4
Clindamycin	30	12	
Vancomycin	40	1	
Teicoplanin	41	nil	
Tigecycline	41	nil	
Daptomycin	40	nil	
Linezolid	40	1	
Trimethoprim/ Sulfamethoxazole	31	11	
Rifampicin	22	nil	
Nitrofurantoin	9	nil	

Staphylococcus aureus (MRSA) 100% sensitive to Vancomycin, Linezolid, Rifampicin, Nitrofurantoin, Tetracycline, Teicoplanin, Tigecycline, Daptomycin and most sensitive to Gentamicin and Trimethoprim/ Sulfametgoxazole. It was completely resistant to Benzylpenicillin and mostly resistant to Ciprofloxacin, Levofloxacin, Oxacillin and Erythromycin.

Table : 5 - Sensitivity of pseudomonas to antibiotics.

ANTIBIOTICS	No. of sensitive Isolates	No. of resistant isolates	No. of Intermediate isolates
Amikacin	15	2	
Ciprofloxacin	14	3	
Amoxicillin/ Clavulanic Acid	Nil	2	
Piperacillin/ Tazobactam	11	2	1
Cefepime	34	nil	4
Ceftazidime	16	3	
Cefoperazone/ Sulbactam	33	3	1
Ceftriaxone		2	
Imipenem	38	3	
Meropenem	38	2	
Tigecycline	3	26	
Trimethoprim/ Sulfamethoxazole	1	7	
Colistin	8	1	23
Polymyxine B	2	nil	

Pseudomonas 100% sensitive to Cefepime and Polymyxine B and most sensitive to Imipenem, Meropenem, Cefoperazone/ Sulbactam, Ceftazidime, Amikacin, Ciprofloxacin and Piperacillin/ Tazobactam.

Table : 6 - Antibiotic sensitivity for Coagulase Negative Staphylococcus.

ANTIBIOTICS	No. of sensitive Isolates	No. of resistant isolates	No. of Intermediate isolates
Gentamicin	9	2	
Ciprofloxacin	2	7	1
levofloxacin	3	8	
Benzylpenicillin	Nil	12	
Oxacillin	2	10	
Cefoxitine screen	9 +	2-	
Erythromycin	5	6	
Clindamycin	9	3	
Vancomycin	8	nil	
Teicoplanin	11	1	
Tigecycline	11	nil	
Daptomycin	9	nil	
Linezolid	11	nil	
Tetracycline	5	5	
Trimethoprim/ Sulfametgoxazole	8	4	
Rifampicin	8	1	
Nitrofurantoin	6	1	

Coagulase Negative Staphylococcus 100% sensitive to Linezolid, Vancomycin, Tigecycline, Daptomycin and most sensitive to Gentamicin, Clindamycin, Trimethoprim/ Sulfametgoxazole, Rifampicin, Nitrofurantoin, Teicoplanin and complete resistant to Benzylpenicillin and most resistant to Ciprofloxacin, levofloxacin, Oxacillin and least resistant to Erythromycin.

TABLE 4 : Antibiotic sensitivity for Klebsiella species

ANTIBIOTICS	No. of sensitive Isolates	No. of resistant isolates	No. of Intermediate isolates
Amikacin	6	1	
Gentamicin	6	3	
Ciprofloxacin	6	1	2
Levofloxacin	1	2	
Amoxicillin/ Clavulanic Acid	2	5	
Piperacillin/ Tazobactam	6	3	
Cefepime	5	3	
Ceftriaxone	5	4	
Cefuroxime	6	2	
Imipenem	6	2	
Meropenem	6	2	
Ertapenem	6	2	
Fosfomycin	4	nil	
Tigecycline	7	1	

Klesbsiella was 100% sensitive to Fosfomycin only and most sensitive to Amikacin, Gentamicin, Ciprofloxacin, Piperacillin/ Tazobactam, Cefepime, Ceftriaxone, Cefuroxime, Imipenem, Meropenem, Ertapenem, Tigecycline. It was mostly resistant to Amoxicillin/ Clavulanic Acid.

DISCUSSION

In our study it is evident that around more than 59% of the samples failed to grow any microorganism. This highlights the fact that in more than half of our patients there may not be any defined role of antibiotics. The growth pattern also suggests that multiple organisms can infect the ear if the defence barrier mechanism is breached. It is reported to occur in more so in the developing countries due to overcrowding, poor socioeconomic status and low education.[5]

This study provides crucial insights into the microbial etiology and antimicrobial susceptibility patterns of ear discharge in patients with otitis media. 40.94% of the samples showed positive bacterial growth, with Staphylococcus aureus (particularly MRSA) and Pseudomonas aeruginosa being the most prevalent pathogens. There were other multiple organisms like coagulase negative Staphylococcus, Kliebsella, Acinobacter, E Coli, Proteus in the order of prevalence and Streptococcus being the lowest in the list.

Staphylococcus aureus (MRSA) was found to be sensitive to Vancomycin, Linezolid, Rifampicin, Nitrofurantoin, Tetracycline, Teicoplanin, Tigecycline, Daptomycin and most sensitive to Gentamicin and Trimethoprim/ Sulfametgoxazole. However it was completely resistant to Benzylpenicillin and mostly resistant to Ciprofloxacin, Levofloxacin, Oxacillin and Erythromycin, the drugs routinely used empirically in Otorrhoea. Pseudomonas were found to be sensitive to Cefepime and Polymyxine B and most sensitive to Imipenem, Meropenem, Cefoperazone/ Sulbactam, Ceftazidime, Amikacin, Ciprofloxacin and Piperacillin/ Tazobactam.
Coagulase Negative Staphylococcus were 100% sensitive to Linezolid, Vancomycin, Tigecycline, Daptomycin and most sensitive to Gentamicin, Clindamycin, Trimethoprim/ Sulfametgoxazole, Rifampicin, Nitrofurantoin,

Teicoplanin and complete resistant to Benzylpenicillin and most resistant to Ciprofloxacin, levofloxacin, Oxacillin and least resistant to Erythromycin.

Klesbsiella was 100% sensitive to Fosfomycin only and most sensitive to Amikacin, Gentamicin, Ciprofloxacin, Piperacillin/ Tazobactam, Cefepime, Ceftriaxone, Cefuroxime, Imipenem, Meropenem, Ertapenem, Tigecycline. It was mostly resistant to Amoxicillin/ Clavulanic Acid.

This emphasises the fact that targeted and specific antibiotics will be more beneficial and evidence based. The high prevalence of multidrug-resistant (MDR) organisms, particularly MRSA and Pseudomonas, highlights the ongoing threat of antimicrobial resistance in otological infections.

The presence of MDR strains in 43.51% of isolates underscores the importance of culture and sensitivity-guided antibiotic therapy to prevent treatment failures and reduce the risk of complications, including hearing loss and intracranial spread.

CONCLUSION

Any organism can infect the ear if the defence barrier mechanism is breached. It is reported to occur in develoing countries due to overcrowding, poor socioeconomic status and low education standard.5 More than 59% of the otorrhoea samples were sterile stressing the fact that there may not be any role of empirical antibiotics. Staphylococcus aureus (MRSA) was the most common pathogen grown in the culture with Pseudomonas species being the second most common showing sensitivity to both mainly injectable antibiotics. Most of them showed resistance to the routinely used oral antibiotics. A total of 57(43.51%) isolates were MDR strains, hence it is imperative to do a culture and sensitivity pattern of ear infections for efficacious management, thereby ensuring proper response and reducing further complications.

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