



GENDER-WISE STUDIES OF BACTERIAL OTITIS MEDIA IN PATIENTS WITH HEARING LOSS

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ABSTRACT

Background: Ear is very sensitive hearing organ of the body having three parts; the outer, middle and the inner ear. It is more exposed to the outer environment that possesses allergens, microorganisms, water, air, sweat etc. Most significantly infectious agents, the microorganisms when enter in to the ear by any source cause mild to severe infection, which may lead to the hearing defects such as partial or permanent hearing loss irrespective to any age or sex. The hearing loss may occur by different factors like hereditary and contaminated environmental factors that include allergies, cold, infection of sinuses, accumulation of mucous and exposure to household and cigarette smoke. Mostly, the patients are suffering from otitis media; middle ear's infection which leads to the inner ear infection followed by hearing loss, if left untreated.

Objectives: (1) To observe the frequency of infection, (2) to determine the common pathogens of otitis media among the male and female patients of different age groups, (3) to determine the incidence rate of otitis media and hearing loss and (4) to observe the effective treatment by antibiotic profiling.

Study Design: Prospective study.

Place and Duration of Study: Outpatient Departments (OPD) of different hospitals and Department of ENT Liaquat University of Medical & Health Sciences (LUMHS), Jamshoro, Sindh Pakistan, from 1st January 2016 to 31st December 2018.

Methodology: Two hundred and seventy-three ear swab specimens were screened and only 187 positive cases were found. Four classes of patients of hearing loss were studied such as hereditary hearing loss (HHL), infected non-hearing loss (INHL), infected hearing loss (IHL) and the patients with inflamed ear.

Results: There were 103 males and 84 females positive (infected) patients of different age groups mainly of IHL. The samples collected from males were greater (61) in number as compared to the females (45) with infection rate (%) of 51%, 45%, 4% and 41%, 36%, 62% in male and female patients of 3-11, 12-25 and 26-40 years of age. The main bacterial isolates were *Staphylococcus aureus* 23%, *Streptococcus pneumoniae* 14%, *E. coli* 16.5%, *Klebsiella pneumoniae* 8%, *Pseudomonas aeruginosa* 18% and *Proteus mirabilis* 7% and in females 20%, 10%, 12%, 12%, 17%, 4% respectively. The number of clinical isolates from all specimen ranged n=81, n=64, n=63, n=54, n=36 and n=20 of *Staphylococcus aureus*, *E. coli*, *Pseudomonas aeruginosa*, *Streptococcus pneumoniae*, *Proteus mirabilis* and *Klebsiella pneumoniae* respectively. The greater resistance was observed by *Staphylococcus aureus* to methicillin 90%, penicillin, 42%; *Streptococcus pneumoniae* to gentamycin 31%, penicillin 30%; *E.coli* to Ciprofloxacin 28%, Ofloxacin 25%; *Klebsiella pneumoniae* to chloramphenicol 28%, ampicillin 22%; *Pseudomonas aeruginosa* to levofloxacin 22%, amoxicillin 21%, norfloxacin 21% and *Proteus mirabilis* to amoxicillin 30.5%, cephalosporin 28%, cefoxitin 22%.

Conclusion: The otitis media and the otitis media with effusion mainly in the patients of infected hearing loss greatly in children and elderly age mainly caused by bacterial isolates with the multidrug resistance (MDR) capability. The existence of MDR isolates is distressing that could be harmful and increase to the high resistance to other antibiotics that may lead more fatal incidences of chronic otitis (COM) media and COM with effusion.

Keywords: Gender, Bacterial otitis media, Hearing loss

INTRODUCTION

The ear is a hearing organ, an advanced and sensitive one that helps transmit and transduce sound to the brain and maintains the sense of balance through three different anatomical structures such as the outer, middle, and inner ear. The transportable sound waves move from the outer ear via the auditory canal, allowing the eardrum/tympanic membrane to vibrate. The vibrations move through the oval window by the fluid in the cochlea that motivates the tiny hair cells, which transform vibrations into electrical impulses that are supposed to sound by the brain. The ear consists of many parts but can be divided into three major parts: the outer, middle, and inner ear.¹

Otitis media is a known issue of human health that occurs in all ages and sex groups, especially in children, leading to the use of antibacterial therapy. It is frequently diagnosed in pediatric emergency departments, ranking second to upper respiratory infections. While it can develop at any age, it is more prevalent in children aged 6 to 24 months.² The middle ear can become infected by different viruses, bacteria, or both simultaneously. *Streptococcus pneumoniae* is the primary bacterial cause of otitis media, followed by un-typed *Haemophilus influenzae* and *Moraxella catarrhalis*. Common viruses that cause otitis media include respiratory syncytial virus (RSV), corona viruses, human meta-pneumovirus, adenoviruses, picorna viruses, and influenza viruses.³⁻⁵

Otitis media is a prevalent issue and is slightly more dominant in males than in females. Determining the exact number of cases each year is challenging due to underreporting and varying incidences across different geographical regions. The highest occurrence of otitis media happens between six and twelve months of age and declines after the age of five. Roughly 80% of children will encounter otitis media at some point in their lives.⁶⁻⁷ The present study was conducted to determine the bacterial otitis media in patients with hearing loss. Studying otitis media's particular bacterial origins in individuals with hearing loss will allow researchers to assess the prevalence of various bacteria and their potential relation with hearing problems.

METHODOLOGY

This study was approved by the University of Sindh, Jamshoro Sindh, Pakistan (Ref No. DRGS/758 Dated 01.10.2019). The participants were divided into three groups such as 3-11, 12-25 and 26-60 years. The ear swabs were collected from the patients with their consent, and the permission was included. Patients were sampled at different hospitals (surgical wards) and OPD from Hyderabad, Sindh, Pakistan. The patient's ear was cleaned with 70% ethanol, and ear discharge was obtained from the diseased ear of the patient using three separate pre-sterilized swabs. Samples from both loci were collected in Skim Milk Tryptone Glucose Glycerol medium (Sigma) and stored at -70°C till further processing. Swabs were used for aerobic culture and was placed on blood agar and MacConkey's agar (Oxoid) and incubated at 37°C for 48 h. incubated at 37°C .^{8,9}

The morphological characters of the clinical isolates were determined by Gram reaction, size, arrangement and spore formation of the cells under a microscope by standard Gram staining technique. Biochemical tests were performed for all different bacterial isolates from all samples using the Analytical Profile Index (API) system and Ramel rapid technique. The coagulase test, a modified oxidase test¹⁰, nitrate reduction test¹¹, nitrate broth¹² and phenylalanine deaminase (PDA)¹³ were performed using standard SOPs. Test cultures were further confirmed by the API kit system.¹⁴

The biochemical tests including hydrogen sulfide production in TSI medium, citrate utilization test, indole, methyl-red, Voges-Proskauer test, tryptophan deaminase, urease, gelatinase production, and the fermentation of glucose, mannose, sorbitol, sucrose, arabinose, hard nose, and inositol were also performed according to the standard methods. Moeller decarboxylase bases were composed of 1% lysine and were inoculated and overlaid with a paraffin layer. The tubes were incubated at 37°C for 96 hours with observation of the reaction.¹⁵ The clinical isolates from various specimens were examined for resistance and sensitivity to multiple antibiotics used by the Kirby-Bauer disc diffusion method.

RESULTS

There were 103 male and 84 female patients were having otitis media. All samples were collected from 3- 11, 12-25 and 26-40 years of male and female patients having hereditary hear loss (HHL, n=20), infected having no hear loss (INHL, n=34), infected having hear loss (IHL, n=61) and those patients who were suffering from ear inflammation (inflamed ear, n=12) of male patients (Tables 1-2).

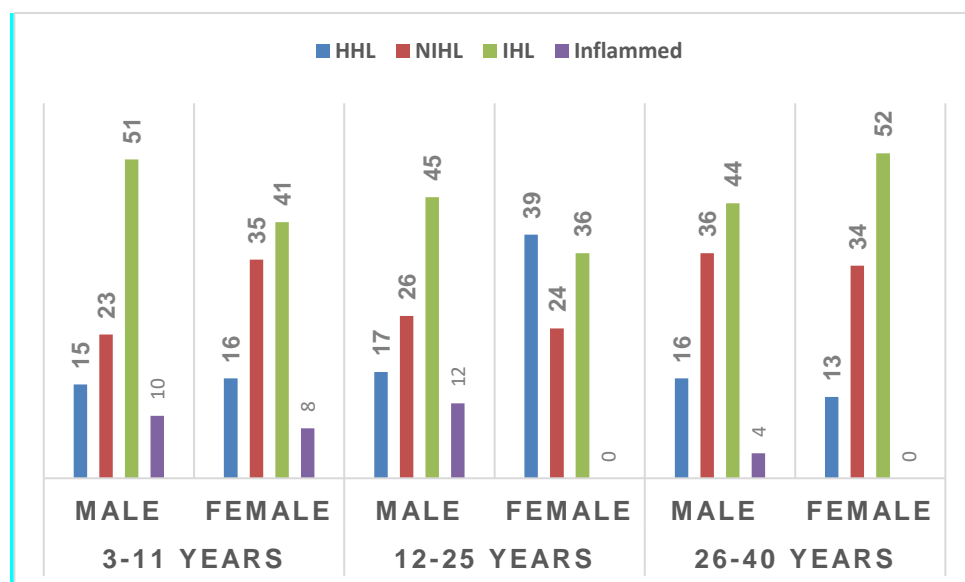
Table 1: Frequency of otitis media in genders (n=187)

Gender	No.	%
Male	103	55.08
Female	84	44.92

Table 2: Frequency of types of specimens according to age in genders (n=187)

Age (year)	Types and number of cases			
	Hereditary hear loss	Infected (non-hear loss)	Infected (hear loss)	Inflamed ear
Male				
3-11	9	14	31	6
12-25	7	11	19	5
26-40	4	9	11	1
Female				
3-11	8	18	21	4
12-25	13	8	12	-
26-40	3	8	12	-

The general percentage of infection in male patients revealed 15, 17, 16%; 23, 26, 36%; 51, 45, 14% and 10, 12, 04% in HHL, INHL, IHL and inflamed ear cases whereas the samples from female patients of (HHL, n=24), (INHL, n=34), (IHL, n=45) and (inflamed ear, n=4). The infection rate in female patients revealed 16, 39, 13%; 35, 24, 34%; 41, 36, 52% and 8, 0, 0% in HHL, INHL, IHL and inflamed ear cases (Figure 1).



Fig/ 1: Age and gender wise comparative analysis of ear infection

The comparative studies of infection rate in male and female patients revealed the greater percentage in females (63%) and males (53%) in IHL. It also revealed 23%, 19%, 5% and 13%, 21%, 3% infection rate in HHL, INHL, and inflamed ear of male and female patients respectively (Fig.2).

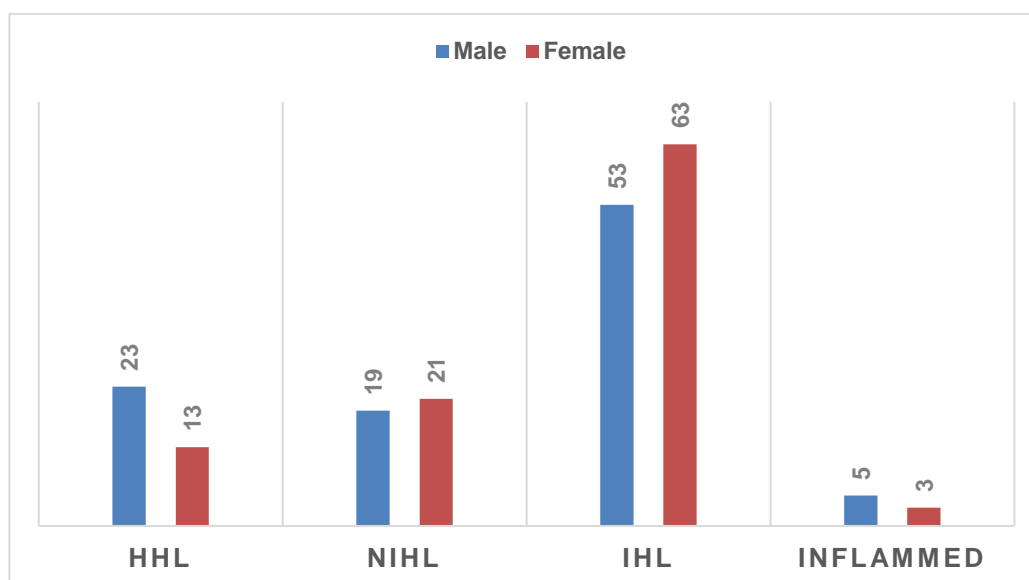


Fig. 2: The comparative studies of infection rate in male and female patients

The most prominent pathogens were observed during this study that include *Staphylococcus aureus*; *Streptococcus pneumoniae*; *E.coli*; *Klebsiella pneumoniae*; *Pseudomonas aeruginosa* and *Proteus mirabilis* in both genders with varying numbers. The findings revealed insignificant growth of any bacterium in HHL cases whereas it showed 13, 29, 09; 09, 18, 04; 11, 21, 07; 02, 10, 03; 6, 23, 04; 03, 09, 02 in INHL, IHL and inflamed ear cases of male patients respectively. The percentage of clinical isolates in males was observed 10, 23, 07%; 07, 14, 03%; 09, 16.5, 5.5%; 02, 08, 02%; 05,

18, 03%; 02, 07, 02% of *Staphylococcus aureus*; *Streptococcus pneumoniae*; *E.coli*; *Klebsiella pneumoniae*; *Pseudomonas aeruginosa* and *Proteus mirabilis* respectively. The number of clinical isolates in female patients revealed insignificant growth of any bacterium in HHL cases whereas it showed 5, 21, 04; 9, 11, 3; 10, 15, 0; 5, 13, 4; 7, 18, 5; 6, 12, 4 in INHL, IHL and inflamed ear cases respectively. The percentage of clinical isolates in females was observed 05, 20, 04%; 08, 10, 03%; 09, 12, 00%; 05, 12, 04; 6.5, 17, 05 of *Staphylococcus aureus*; *Streptococcus pneumoniae*; *E.coli*; *Klebsiella pneumoniae*; *Pseudomonas aeruginosa* and *Proteus mirabilis* respectively. Comparative studies of the percentage of bacterial isolates revealed greater percentage of *Staphylococcus aureus* followed by *Pseudomonas aeruginosa*, *E. coli*, *Streptococcus pneumoniae*, *Klebsiella pneumoniae* and *Proteus mirabilis* in male patients whereas in female patients *Staphylococcus aureus* followed by *Pseudomonas aeruginosa*, *E. coli*, *Klebsiella pneumoniae*, *Proteus mirabilis* and *Streptococcus pneumoniae* (Table-3).

Table 3: Distribution of various identified bacterial infection agents within Male and Female having various infected ear conditions

Identified Bacterial Infecting Agent	Type of Cases							
	HHL		NIHL		IHL		Inflamed	
	Male	Female	Male	Female	Male	Female	Male	Female
<i>Staphylococcus aureus</i>	Insignificant Growth		13	5	29	21	9	4
<i>Streptococcus pneumoniae</i>			9	9	18	11	4	3
<i>E. coli</i>			11	10	21	15	7	0
<i>Klebsiella pneumoniae</i>			2	5	10	13	3	4
<i>Pseudomonas aeruginosa</i>			6	7	23	18	4	5
<i>Proteus mirabilis</i>			3	6	9	12	2	4

All clinical isolates were tested for antibiotic resistance on commercial antibiotics {Oxoid}. It revealed multidrug resistance of all clinical isolates. The number of clinical isolates of male and females were observed *Staphylococcus aureus* (81), *Streptococcus pneumoniae* (54), *E.coli* (64), *Klebsiella pneumoniae* (37), *Pseudomonas aeruginosa* (63), and *Proteus mirabilis* (36). The antibiotic resistance revealed 42, 26, 16, 10, 6, 90% to penicillin, erythromycin, gentamycin, azithromycin, clarithromycin, methicillin respectively (*S. aureus*); 30, 22, 31, 17% to penicillin, erythromycin, gentamycin, oxacillin respectively (*S. pneumoniae*); 17, 28, 14, 25, 16% to amikacin, ciprofloxacin, cefoxitin, ofloxacin, tetracycline respectively (*E.coli*); 22, 28, 13.5, 16, 19% to ampicillin, chloramphenicol, cefoxitin, imipenim, tetracycline respectively (*K. pneumoniae*); 21, 17, 22, 21, 19% to amoxicillin, amikacin, levofloxacin, norfloxacin, ofloxacin respectively (*P. aeruginosa*) and 30.5, 28, 22, 19% to amoxicillin, cephalosporin, cefoxitin, ofloxacin respectively (*P. mirabilis*) (Fig. 3)

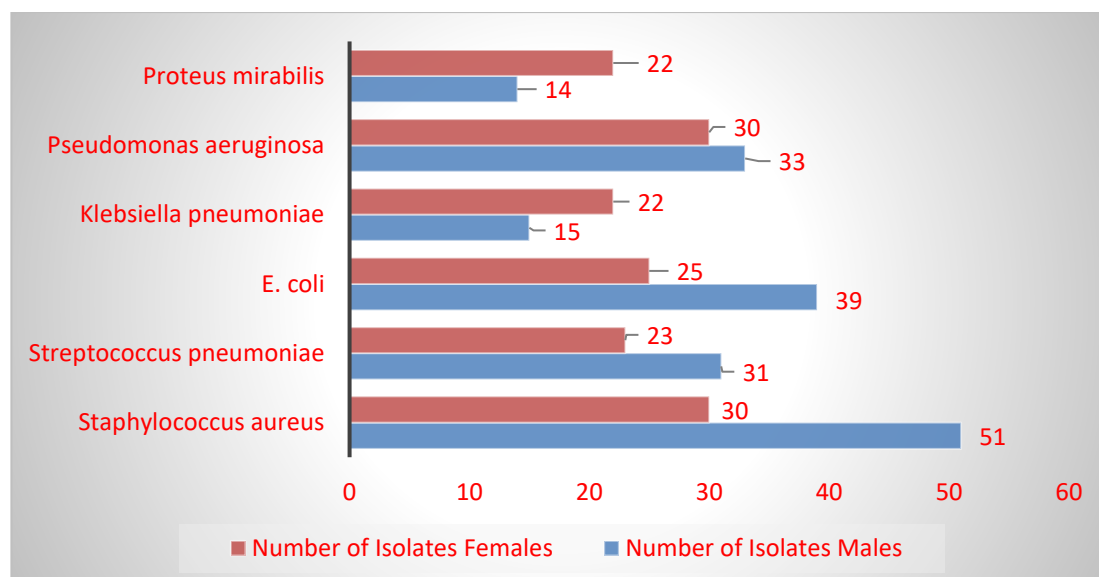


Fig. 3: Comparison of the number of isolates identified within Males and Females

DISCUSSION

This study showed a greater percentage of 51% in males and 52% in 3-11 and 26-40 years of male and female patients, respectively. This may be because males are more exposed to the environment, such as canal baths, agricultural practices, sweating, and laborious work in the hot season. The fact behind this is the colonization of bacteria in the nasopharynx and the Eustachian tube that access the pathogens into the middle ear.¹⁶⁻¹⁹

In the present study, the antimicrobial susceptibility patterns of both Gram-positive strains and Gram-negative clinical isolates (showed varying degrees of resistance to different test antibiotics. The number of strains of the isolates showed different percentages of resistance to test antibiotics. The historical background of the patients revealed that most of the patients were living in overcrowded environments (small houses with large family setups) with improper hygienic measures and belonged to poor families with nutritional deficiencies.⁹ The otitis media cases in this study were found to be mainly caused in infected hearing loss (IHL) patients compared to infected non-hearing loss (INHL) and patients with inflamed ears. A small prevalence of infection (15-17%) in males and (13-39%) in females was observed in the patients with hereditary hearing loss (HHI), which is in accordance with Melaku & Lulseged¹⁹ and Ako-Nai et al.²⁰

Our findings revealed the absence of *H. influenzae* and *M. catarrhalis*, which supports the concluding remarks of Tanon-Anoh et al.²¹, stating that *H. influenza* and *M. catarrhalis* had no important role in the pathogenicity of otitis media. The basic concept of hearing loss has different factors that include birth defect issues, close family marriages, and other genetic factors. Low weight, premature birth, and unavailability of proper oxygen supply. Viral and bacterial infections, excessive accumulation of wax, noise-oriented sounds, smart phones, and also through drug-resistant strains causing tuberculosis and cancerous complications may be the source of a permanent defect in hearing.^{22,23}

Antibiotic resistance involves several mechanisms that can cause chemical changes.²⁴ Resistance to microorganisms is due to the patients' ignorance of the properly prescribed therapy, low-quality drugs²⁵, self-medication of unreasonable intake of antibiotics with insufficient doses, misuse of the antibiotic, insignificant infection control in hospitals also enhance the drug resistance, baseless medication in animals²⁶⁻²⁸ for growth and infection control could affect the human beings indirectly when we utilize animals as food.

CONCLUSION

There is no significant variance in ear infections within genders with a slight increase incidence in females than males. However, a higher incidence of *Staphylococcus aureus* and *E. coli* among

males in infected hearing loss cases was presented in the study groups. Children having higher incidence of infected hearing loss affected from acute and chronic otitis media. Adults within the age group of 26-40 years had higher risk of chronic otitis media.

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