ORIGINAL ARTICLE CODEN: AAJMBG

Recent trend in microbial profile and antimicrobial susceptibility pattern of aural discharge in a tertiary care teaching hospital of Kolkata, West Bengal

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Received: 03rd December 2024; ***Accepted:*** 13th February 2025; ***Published:*** 01st April 2025

Abstract: *Introduction:* Ear discharge is a frequently occurring common problem in India subcontinent. Microbial niche and profile of middle ear infection are frequently changing scenario in different environment. *Material & Methods:* A cross sectional observational study conducted in otolaryngology and microbiology department following inclusion and exclusion criteria with 130 patients recruited from outpatient department. The primary objective being to assess the prevalence of local bacterial profile from ear discharge in patients with Chronic Otitis Media (COM). Microbiological investigation including characterization of drug resistance was performed in department of microbiology. *Result:* Escherichia coli, Klebsiella pneumonia, Proteus mirabilis, Citrobacter freundii, Pseudomonas aeruginosa, Acinetobacter baumannii, Staphylococcus aureus, CoNSare among the frequently isolated bacteria with Pseudomonas aeruginosa and Staphylococcus aureusbeing the two most commonly occurring pathogens. The gram negative isolates are ESBL, carbapenemase producers and staphylococci are all methicillin resistant. *Discussion:* Most of the studies in world show the same bacteriological profile. but the antibiogram differs. Indian studies have the similar findings like ours. *Conclusion:* Knowledge on bacteriological profile help to start empirical therapy.
Keywords: Aural, Discharge, Profile, Bacteria.

Introduction

The microbiological habitat is a continuously changing landscape which requires watchful monitoring at periodic intervals as a retrospective study revealed the overall bacterial resistance increased twofold over the last decade [1]. This becomes more important when we take into account lone incidences of bacterial resistance of a particular strain in a particular hospital setup which may have the potential to flare up as a pandemic like New Delhi metallo-beta-lactamase 1 (NDM-1) gene containing Delhi superbug which is resistant to a broad range of beta lactam antibiotics including carbapenems [2]. In discharging ear patients these resistant microorganisms can lead to life threatening complications like brain abscess, meningitis etc. Our study is, in a sense, clinically vigilant to prevent emergence of resistant strains. Patients presenting to otolaryngologists with ear discharge (history of intermittent/ chronic discharge exceeding 6 weeks) from Chronic Otitis Media require antibiotics topically, and oral antibiotics are prescribed in most clinical practices [3].

In some instances, these are chronically discharging ears and not easily amenable to medications, and surgery is done with the hope of a safe dry functioning ear. Among the bacterial and fungal elements that are known to be causative organisms for chronic suppurative organisms, our study tries to identify the prevalent microorganisms in our

locality and differentiate commensals from pathogenic flora from local epidemiological data [4]. The knowledge of local antibiotic sensitivity/ resistance and bacterial profile of a particular region and period enables the rational use of antibiotics for treating ear discharge from chronic otitis media (COM) which is not a very uncommon entity in our tropical locality with poor socio-economic condition (about 4.76%) [5-6].

In our country, as the quackery and irrational general practices are unavoidably widespread due to innumerable social and economic reasons, rational empirical antimicrobial prescription based on this sensitivity profile, can be the best vaccine against emergence of drug resistant bacterial strains. Therefore, the study can be used as a guide for selection of antimicrobials in a cost efficient yet effective way in the treatment of ear discharge from CSOM in this eastern part of India. This study also seeks to follow the natural course of the disease and the outcome of treatment of COM of these patients which begins with medical treatment of active discharging ear and definitive management like surgical interventions and treatment of complications.

Aims and Objectives:

Primary Objective: To assess the prevalence of local bacterial profile from ear discharge in patients with Chronic Otitis Media (COM) and frame relevant resistogram / antibiogram based on culture, sensitivity from the collected specimens of ear discharge.

Secondary Objective: To get the data on the various outcomes of treatment of these patients with COM in the ENT department of the institute over specified period.

Material and Methods

This was a hybrid cross sectional observational study. The institution based interdisciplinary study was conducted by the Dept of otolaryngology of a tertiary level teaching hospital in Kolkata, India in full collaboration with the Dept of Microbiology. The patients with ear discharge suffering from chronic otitis media (COM) arriving in the OPD and wards of the ENT (Ear-Nose-Throat) department, were chosen following preset inclusion and exclusion criteria for collection of ear discharge fluid in a cross-sectional manner and the samples were examined in the Microbiology department. These patients were prospectively followed up for a period of six months in the ENT department regarding treatment outcome (from June 2017 to November 2017 longitudinally) after proper consent from the patients and following Ethical guidelines.

Inclusion criteria: Patients having unilateral and bilateral active discharge- from both recent onset exacerbation of COM/ intermittent or long-standing discharge of COM, patients with or without complications from COM were included in the study. Active mucosal or squamous variety of chronic otitis media were included in the study population.

Exclusion Criteria: Patients on oral or topical antibiotics or where antibiotics have been started within the last two weeks for the treatment of chronic otitis media (at the time of presentation), patients with concomitant florid otitis externa, patients with known history of Koch's or suspicious of tubercular otitis media, patients with suspicion of carcinoma, were excluded from this study.

Methodology: 130 patients were recruited in the study from ENT OPD of the tertiary medical college and hospital of Kolkata in the span of six months in 2017, as per the inclusion exclusion criteria, after thorough otolaryngologic clinical history, and examinations of ear, mastoid, relevant nose, throat and neck regions, with otoscopy, tuning fork, and standard ENT OPD instruments. Swabs of ear discharge fluid were collected in this stage (see next paragraph for methodology). These were followed by investigations pertaining to imaging, blood parameters, and those that were required for pre anesthetic checkup when surgery was envisaged.

The academic data of sensitivity of isolated organisms from swab reports especially helped in those cases where there was a history of chronic persistent or frequent recurrent ear discharge or those with history of immune-compromise, in that it helped to choose the correct antibiotics and bring relief;

even IV antibiotics specific to flora were used in these cases and those where there were complications of COM. In certain instances, these cases were adequately rinsed with a 50: 50 mixtures of vinegar and boiled water with a dropper. In perforations, fluoroquinolone drops were started; antibiotic steroid drops were instilled in those with associated granulation or polypoid change in middle ear mucosa.

In otomycosis ear drops containing clotrimazole or in mixed infections, ear drops containing antibiotics, antimycotics and steroid combinations were used topically. For small or dry perforations or atelectatic ear drum without cholesteatoma- which remain free of discharge over time and have minimal/ mild hearing loss, even conservative management and observation may be taken up especially for those who are unwilling or where operation is unfeasible due to frailty of the patient.

For other perforations without cholesteatoma- for those desirous of active lifestyle or with recurrent ear discharge during upper respiratory tract infections or in rainy humid season, which can't be kept consistently dry over time despite all attempts, surgery remains the mainstay with or without ossiculoplasty/ mastoid exploration; otherwise for such repetitively draining ears, the alternative remains multiple office visits frequently (even monthly) and repeated application of ear drops and /or oral antibiotics intake keeping an mind the development of unsafe CSOM over time. For those patients with unsafe/ squamous COM with or without complications, surgical exploration of middle ear and mastoid, eradication of the disease, so as to give a safe dry ear, was the aim where hearing reconstruction was secondary. This was preceded by proper counseling regarding open cavity, staged surgery, follow up or recurrence. Cholesteatoma surgery remained difficult in the active stage and every effort was made to make the ear dry and quiescent before surgery (vide the aforementioned discussion). In refractory cases few surgeries were done in the angry stage. Post op follow up was done at the regular weekly, biweekly and monthly setting and recovery/ recurrence was noted.

We followed the procedure shown below in our ENT department. The following procedures were undertaken in the Microbiology department and ENT minor OT complex - methodology is stated below:

Informed consent was obtained from every patient before collection of samples. Patients were taken to the minor OT room for collection of ear discharge with sterile alginate/Dacron swab, in an aseptic manner with the help of microscope and aural speculum taking enough care not to touch the ear canal or the pinna while mopping the ear discharge with the swab sticks. Two swabs each of the infected ear cases were collected from each patient and sent to the Microbiology Department for bacterial culture and sensitivity testing.

The first swab was used to perform Gram staining for detection of the presence of pus cells or microorganisms or any fungal hyphae or yeast forms. Following staining immediate microscopy was done in the Dept of Microbiology. The second swab was inoculated on 5% sheep blood agar, MacConkey'sagar, Nutrient agar and on Chocolate agar media and incubated aerobically at 37 ^{0}C for 24-48 hours. A set of brucella blood agar was put in GasPak system for anaerobic incubation and isolation at the same time for each group of sample [7].

For fungal isolation Sabouraud Dextrose Agar (SDA) was taken to inoculate each clinical sample followed by aerobic incubation for 2-7 days [8]. On arrival of bacterial growth in aerobic incubation; identification was done using conventional microbiological and biochemical techniques as described in the standard textbook of Microbiology [9]. Both monomicrobial and polymicrobial types of growths were included in the study.

For identification purpose of Gram-positive cocci catalase, tube coagulase, growth in 6.5% NaCl solution, Bile esculin agar test, heat tolerance test at 60^0 C for 30 minutes, fermentation of mannitol, arabinose and optochin sensitivity tests were used (Table 1). For identification of Gram-negative bacilli battery of biochemical tests including indole, methyl red, VP, citrate, oxidase, phenylalanine decarboxylase, urease, TSI,

amino acid decarboxylation tests were adopted.Identification of anaerobic isolates was done on the basis of morphology, arrangements and colony characters as described in standard literatures and guidelines [10]. Fungal growths were processed and identified by observation and examination of colony characters, appearance of teased wet mount in lactophenol cotton blue and germ tube testing [11].

Bacterial Identification was followed by antimicrobial susceptibility testing (AST) performed by Kirby Bauer's disk diffusion method (KBDDM)on Mueller-Hinton agar(MHA from Hi Media, Mumbai, India) as per Clinical and Laboratory Standard Institutes (CLSI) guidelinesusing commercially available antibiotic discs from HiMedia (Mumbai, India) [12].

In some isolates the study groups used automated Bacterial identification and Susceptibility testing methods (Vitek-2 compact). It was used when conventional methods could not identify the organisms beyond suspicion and/or the AST was difficult to interpret manually due to various reasons including poor growth of contamination in MHA plate. Some supplemental tests related to AST were also performed including Vancomycin screen agar testing, E test for cefoxitin and vancomycin for *staphylococci* and enterococci isolates. D-test for detection of inducible clindamycin resistance was also performed for *Staphylococcus aureus* isolates. Tests for extended spectrum beta lactamases (ESBLs) were performed for gram negative bacilli. As, the tests for ESBLs, carbapenemases and metallo-beta lactamases were not required as a routine laboratory procedure and were reserved for antimicrobial resistance surveillance and hospital infection prevention and control purposes; these tests were not done on all isolates [12].

Antifungal susceptibility testing was done with the available antifungal discs following CLSI guideline for *Candida albicans*isolates [13]. MIC detection of many of the antifungal drugs could not be done for non-availability of antifungal E test strips. No AST could be set for *Aspergillus flavus* and *Aspergillus fumigatus* isolates. No AST was put up for anaerobic organisms. AST for Streptococcus pneumoniae was performed by KBDDM using Muller Hinton agar with 5% sheep blood as medium, having *Streptococcus pneumoniae* ATCC 49619 strain been used as control strain following CLSI guideline.

Detection of extended spectrum beta lactamase (ESBL): Production of ESBL was initially detected by CLSI confirmatory test method using both cefotaxime (30 mg) and ceftazidime (30 mg) disks alone and in combination with clavulanic acid (10 mg) (Hi Media, Mumbai, India). The test was considered positive when an increase in the zone of inhibition of growth in Muller-Hinton agar plate around either the cefotaxime or the ceftazidime disk with clavulanic acid was 5 mm or greater than the diameter found around the disk containing cefotaxime or ceftazidime alone [12].

Detection of Methicillin Resistance: Detection of Methicillin resistance in the isolates of *Staphylococcus aureus* and Coagulase negative *Staphylococcus* (CoNS) was done using cefoxitin disc (30 µg) and cefoxitin E-test strips with *Staphylococcus aureus* ATCC 25923 being used as control strain. *Staphylococcus aureus* isolates having zone of inhibition ≥ 20mm and those with zone of inhibition ≤ 21mm around the disc were considered methicillin susceptible and resistant respectively Staphylococci other than *Staphylococcus aureus* i.e., CoNS were tested with the same discs and isolates with zone of inhibition ≤ 24 mm were considered methicillin resistant.

Testing with the E-test strip was also done for confirmation. Isolates of *Staphylococcus aureus* having minimal inhibitory concentration (MIC) against cefoxitin ≥ 8µg/mL were methicillin resistant and those with MIC ≤ 4µg/mL were considered susceptible. The MIC of CoNS for methicillin was ≥ 0.5µg/mL for resistant isolates and ≤ 0.25µg/ml for isolates to become susceptible; with oxacillin as the surrogate marker [14].

Detection of Vancomycin Resistance: Vancomycin resistance was detected for *Staphylococcus aureus*, *CoNS* and *Enterococcus fecalis* isolates. Vancomycin screen agar was prepared by incorporating crude vancomycin drug at the rate of 6 µg/mL into molten Brain Heart Infusion agar and

allowing the plates to be set. The suspected bacterial suspension having a load of 10^5 -10^6 was then inoculated in spot inoculation technique onto the plate and incubated at 35^0C for 24 hours. Growth of a single colony indicated Vancomycin resistance, whereas, no growth indicated susceptibility [12].

Results

The microbiological floral pattern and their susceptibility profile, were isolated and obtained from discharge of squamous and mucosal varieties of chronic otitis media in our setup. Out of 130 patients satisfying the inclusion criteria, 88 bacterial and four fungal isolates grew from 80 samples collected from 80 consenting patients (rate of incidence = 70.76%). No microorganism grew from 50 samples which were considered as sterile or non-infected ear discharge. Pure aerobic isolates were obtained from 72 samples only. Mixed growths including anaerobes, *Streptococcus pneumoniae* and fungal isolates were found from the remaining eight samples. The various microbial isolates and their relative incidence were as follows:

Table-1: Distribution of Isolated organisms

Name of organism	Number of isolates(n) (Total= 92)	Percentage (%)
Escherichia coli	10	10.86
Klebsiella pneumoniae	11	11.95
Proteus mirabilis	04	4.33
Citrobacter freundii	01	1.08
Pseudomonas aeruginosa	26	28.26
Acinetobacter baumannii	02	2.17
Staphylococcus aureus	13	14.13
CoNS	04	4.33
Enterococcus fecalis	05	5.43
Streptococcus pneumoniae	04	4.33
Candida albicans	04	4.33
Non albicans Candida	02	2.17
Aspergillus fumigatus	01	1.08
Aspergillus flavus	01	1.08
Peptostreptococcusspp	02	2.17
Porphyromonasspp	01	1.08
Prevotellaspp	01	1.08

The isolated organisms in decreasing order of frequency were *Pseudomonas aeruginosa (28.26%), Staphylococcus aureus (14.13%), Klebsiella pneumoniae (11.96%), Escherichia coli (10.86%), Enterococcus fecalis (5.43%), Proteus mirabilis (4.35%), CoNS (4.35%), Streptococcus pneumoniae (4.35%), Candida albicans (4.35%), Acinetobacter baumannii (2.17%), Non albicans Candida (2.17%), Peptostreptococcus spp. (2.17%). Aspergillus flavus, Aspergillus fumigatus, Citrobacter freundii, Porphyromonas spp. and Prevotella spp.* were isolated only once each (Table-1).

The resistogram study and the supplemental test for the isolated organism revealed that among gram negative bacilli all the isolates of *Klebsiella pneumoniae, Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa, Acinetobacter baumanii and Citrobacter freundii*were ESBL producer and hence resistant to all the cephalosporin group of antimicrobials. Resistance against carbapenems were highest in *Klebsiella pneumonia* (72.72%) followed by *Escherichia coli* (60%), *Pseudomonas aeruginosa* (53.84%), *Proteus mirabilis* (50%), *Acinetobcterbaumannii* (50%). Resistance against doripenem was least (46.1%) among the carbapenems in *Pseudomonas aeruginosa*. Among the aminoglycosides least resistance was found against tobramycin (10% against *E.coli* and nil against rest of the organisms tested).Highest resistance for aminoglycosides was observed in *Klebsiella pneumoniae* as shown against amikacin (27.27%). Organisms showed considerable resistance against fluoroquinolones.

Highest resistance observed for ciprofloxacin and ofloxacin 50% in *Proteusmirabilis*, *Acinetobacterbaumanii*, 40% in E. *coli). Pseudomonas aeruginosa* and *Citrobacter freundii* showed good susceptibility against fluoroquinolones. Overall levofloxacin emerged as the most effective amongst the drugs of its group with least (30% in *E. coli*, 25% in *Proteus mirabilis*, 15.38% in *Pseudomonas aeruginosa*) or no resistance (*Klebsiella pneumoniae, Acinetobacter baumanii, C. freundii*) at all. Noresistance was found against colistin, polymyxin B and minocycline when tested

For Gram positive organisms the resistogram showed that all the isolates of *Staphylococcus aureus* and Coagulase negative *Staphylococci (CoNS*) were methicillin resistant and hence resistant to all beta lactam antibiotics tested including penicillin. *Staphylococcus aureus, CoNS, Enterococcus fecalis*isolates showed highest susceptibility towards vancomycin (16.66% resistance in *E.fecalis* only), teicoplanin (16.66% resistance in *E.fecalis*only) and linezolid (0 % resistance).

Among the other antimicrobials, *Staphylococcus aureus* was least resistant to levofloxacin (18.75%), followed by gentamicin and amikacin (25% each), ciprofloxacin and clindamycin(37.5% resistance each) and erythromycin (62.5%).CoNS isolates were resistant mostly to erythromycin and clindamycin (100% resistance in each) followed by gentamicin (33.33%), amikacin (16.66%) and ciprofloxacin(16.66%). *E.fecalis*isolates were resistant to penicillin (66.66%), ciprofloxacin (66.66%), ampicillin (50%), high level gentamicin (50%) more in comparison to levofloxacin, vancomycin, teicoplanin (16.66% in each).

All the isolates of *Streptococcus pneumoniae* on the other hand were susceptible to penicillin as detected by the zone of inhibition against oxacillin discs. It was resistant to ciprofloxacin (50%) and levofloxacin (50%) among the antimicrobials tested. All the *Candida albicans* isolates were resistant to fluconazole.

Table-2: Antibiogram of Gram Negative isolates

Antimicrobials	***E.coli (n=10)***	***Klebsiella pneumonia (n=11)***	***Pseudomonas aeruginosa (n=26)***	***Proteus mirabilis (n=4)***	***Acinetobacter baumannii(2)***	***Citrobacter freundi (1)***
Amoxicillin-clavulanic acid	10	11	-	3	2	1
Ceftazidime	10	11	17	3	2	1
Ceftriaxone	10	11	-	3	2	1
Cefotaxime	10	11	-	3	2	1
Cefpodoxime	10	11	-	3	2	1
Imipenem	6	8	14	2	1	0
Meropenem	6	8	14	2	1	0
Doripenem	6	8	12	2	1	0
Amikacin	2	3	2	0	0	0
Gentamycin	2	2	2	0	0	0
Tobramycin	1	0	0	0	0	0
Ciprofloxacin	4	3	5	2	1	0
Ofloxacin	4	3	4	2	1	0
Levofloxacin	3	0	4	1	0	0
Colistin	0	0	0	-	0	0
Minocycline	-	-	-	-	0	-
Polymyxin B	0	0	0	-	0	0

The resistograms correspond to Table 2 and 3, where each cell denotes the percentage of specimens among the isolated organisms that have been found to be resistant against corresponding antibiotics; n signifies the number of patients from whose ear discharge the organisms have been isolated.

Table-3: Antibiogram of Gram Positive isolates				
Antimicrobials	***Staphylococcus aureus (n= 16)***	***CoNS (N= 6)***	***Enterococcus fecalis (n= 6)***	***Streptococcus pneumonia(n=4)***
Cefoxitin	16	6	-	-
Oxacillin	16	6	-	0
Co-Amoxiclav	16	6	-	-
Penicillin	16	6	4	-
Ampicillin	16	6	3	
High-Level Gentamicin	-	-	3	-
Gentamicin	4	2	-	-
Amikacin	4	1	-	-
Ciprofloxacin	6	1	4	2
Levofloxacin	3	0	1	2
Erythromycin	10	6	-	0
Clindamycin	6	6	-	0
Vancomycin	0	0	1	0
Teicoplanin	0	0	1	-
Linezolid	0	0	0	0

Discussion

The aerobic organisms, in the table below, and their frequency/relative incidence that we found in our study are in keeping with other studies like that of Mittal et al (Table 4) [4]. Our study differs from it in the absence of *Streptococcus pneumoniae*, and presence of *Citrobacter* (found in study of Khatoon et al- 9.47% [15], *Enterococcus* (found in study of Udden et al- 8.8% [16]. As for mixed culture, isolation of two aerobic bacterial mix in various permutations as stated below in this study, is in consonance with studies like Erkan et al [17].

Table-4: Comparison of similar studies			
Bacterial species	**No of patients (70)**	**% of bacterial population**	**Mittal et al[4]**
Pure culture			
Pseudomonas aeruginosa	21	30	22-44
Staphylococcus aureus	16	22.9	17-37
E coli	7	10	1-21
Coagulase negative staphylococcus	6	8.6	-
Klebsiella	6	8.6	4-7
Proteus mirabilis	4	5.7	3-20
Acinetobacter	1	1.4	1-3
Citrobacter	1	1.4	-
Enterococcus	1	1.4	-

Table-5: Comparison of Similar Studies				
Year of study	**Author et al**	**Most common organism**	**Second most common**	**Country**
1989	Brook & Yocum [18]	*Pseudomonas, Klebsiella& Staphylococcus*		USA
1986	Kenna [19]	*Pseudomonas& Staphylococcus*		USA
1992	Fliss,D.M [20]	*Pseudomonas*	*Staphylococcus*	Israel
2001	Oni [21]	*Pseudomonas*	*Staphylococcus*	Nigeria
2002	Loy [22]	*Pseudomonas & Staphylococcus*	Coagulase negative *Staphylococcus*	Singapore
2004	Aslam [23]	*Pseudomonas & Staphylococcus*		Pakistan
2005	Olajide [24]	*E coli*	*Staphylococcus*	Nigeria
2011	Mozafari [25]	*Staphylococcus*		Iran
2012	Afolabi [26]	*Pseudomonas*	*Klebsiella*	Nigeria
2012	Malkappa [27]	*Pseudomonas*	*Staphylococcus*	Andhra India
2013	Prakash [28]	*Staphylococcus*	*Pseudomonas*	Uttarakhand India
2013	Ahmad [29]	*Staphylococcus*	*Pseudomonas*	Saudi Arabia
2015	Akter [30]	*Staphylococcus*	*Pseudomonas*	Bangladesh
2015	Denboba [1]	*Proteus*	*Staphylococcus*	Ethiopia
2015	Khatoon [15]	*Pseudomonas*	*Staphylococcus*	Uttar Pradesh, India
2016	Maiti [31]	*Staphylococcus*	Coagulase negative *Staphylococcus*	West Bengal, India
2016	Vaghela [32]	*Pseudomonas*	Coagulase negative *Staphylococcus*	Gujarat, India
2017	Ilechukwu [33]	*Proteus*	*Staphylococcus*	Nigeria
2018	Goswami [34]	*Pseudomonas*	*Staphylococcus*	West Bengal, India
2018	Udden [16]	*Proteus*	*Pseudomonas*	Angola
2019	Adhikari et al (Present study)	*Pseudomonas*	*Staphylococcus*	West Bengal, India
2020	Singh M [35]	*Staphylococcus*	*Pseudomonas*	Himachal Pradesh, India
2021	Wan Draman WNA [36]	Pseudomonas	Staphylococcus aureus	Malaysia
2022	Robert Priscilla [37]	*Pseudomonas*	*Staphylococcus*	West Bengal, India

The table above and our study analysis reveal that the mostly occurring organism in otitis media is *Pseudomonas aeruginosa*, followed by *Staphylococcus aureus* (Table 5). This on the contrary to the finding of many, is susceptible to cheap oral and injectable commonly available antimicrobials like ciprofloxacin, ofloxacin, levofloxacin amikacin and gentamicin and tobramycin as found in our study.

All the isolates of *Klebsiella pneumoniae, Escherichia coli, Proteus mirabilis, Acinetobacter baumannii and C.freundii*are ESBL producers. This finding has the implication for the otolaryngology practitioners that the beta-lactam group of antimicrobials commonly prescribed for otorrhea with or without itching,may not combat the situation or bring the desired relief

for the patients. Third generation oral cephalosporins including cefpodoxime proxetil, cefixime, cefuroxime axetil or fourth generation cephalosporin.

Staphylococcus aureus is only 50% susceptible to co amoxiclav, contrary to our common sense. But from our study, it has been found to be sensitive to doxycycline, levofloxacin (among quinolones) and gentamicin (81, 75 and 62% respectively). This trend is in keeping with the study of Denboba et al where the *Staphylococcus aureus* is most susceptible tociprofloxacin [1].

Thus the two most common organisms, *Pseudomonas* and *Staphylococcus*, if taken together are thus most sensitive to doxycycline, linezolid and cefuroxime. Cefuroxime which is potent against *Pseudomonas, Proteus* had been found resistant in earlier studies by Olajide [24]. In combination with *Pseudomonas*, *Klebsiella* is more resistant to the quinolones (25% sensitivity) than in isolation (83.3%). The study reveals the ratio of mucosal to squamous disease is 69:31, which is close to the ratio of 60:40 according to Shrestha et al [38]. The male female ratio stands at 54:26 or 2:1 (67%:33%). The demographic faith wise ratio of Hindu Muslim stood at 42:28 or 1.5 (52.5%:47.5%). The age range is between 2 to 80 years. The average age is 26.5 years and the median age is 22.

The study started with 130 enrolled patients from whom ear discharge samples had been collected. 24 patients were subsequently lost to follow up; thus, the attrition rate was 18.5% (24/130). Among 106 patients who remained, 68.9% (73) were mucosal and 31.1% (33) were Squamous diseases. Of 73 patients with Mucosal disease, 52.1% underwent Tympanoplasty with or without cortical mastoidectomy, 30.1% were kept under observation because of either small or dry central perforations with informed consent, 8.2% were too frail for operative intervention, 9.6% were unwilling to be operated despite repeated infection and hospital visits, 9.6% had history of chronically discharging ear which were eventually operated upon.

Among 33 cases of Squamous disease, 87.9% went through operative procedures of mastoid exploration/ mastoidectomy with or without Tympanoplasty, 12.1% were conservatively followed by repeated suctioning of keratin debris from visible fundus of cholesteatoma sac or by observation of inactivity of the disease; otherwise non discharging earwith a draped drum in geriatric patients or those with poor general condition. 36.4% had chronically discharging ear which were ultimately managed with surgery (with all efforts made to make the ear dry before operation). Only 6.1% had recurrence.

Limitations of the study: Being hospital based the outcome may not be representative of the true general population of the locality; the attrition in the longitudinal arm of the study may further skew the statistics.

Conclusion

Ear infection is one of the major causes of COM. Careful history taking and microbiological investigation may resolve the infection at an early stage arresting the progression of disease. This will considerably reduce the morbidity. *Pseudomonas aeruginosa* and *Staphylococcus aureus* are two most common isolates.

Financial Support and sponsorship: Nil

Conflicts of interest: There are no conflicts of interest.

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Cite this article as: Kundu S, Adhikary BK, Mondal AS, Banu H, Raj HJ and Ghosh B. Recent trend in microbial profile and antimicrobial susceptibility pattern of aural discharge in a tertiary care teaching hospital of Kolkata, West Bengal. *Al Ameen J Med Sci* 2025; 18(2): 127-137.

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