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ANTIBIOTICS SUSCEPTIBILITY IN CHRONIC SUPPURATIVE OTITIS MEDIA (CSOM) AT THE SECONDARY CARE HOSPITAL IN NORTH INDIA

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ABSTRACT: Background: Chronic suppurative otitis media (CSOM) is defined as a persistent infection of the middle ear cleft with a perforated tympanic membrane and draining exudate for more than 6 weeks. Information about the organism responsible for CSOM and their antibiotic susceptibility is important for effective treatment. **Material and Methods:** A prospective cross-sectional study was conducted on 85 patients; the middle ear discharge sample was collected under strict aseptic conditions and antibiotic susceptibility done as per Clinical Laboratory Standards Institute guidelines. **Result:** 85 ear swabs were collected, and 89 bacterial isolates were identified, of which 72.94% sample with mono-microbial growth, 16.47% with polymicrobial growth, 9.41% show no growth, and the rest 1.17% was a contaminant. Among 89 isolates, 39.33% were Gram-positive, while 60.67% were Gram-negative bacteria. The most common isolates were *Pseudomonas species* 40.45% followed by *methicillin sensitive staphylococcus aureus (MSSA)* 38.20% and others 21.35%. *Pseudomonas species* showed 100% susceptible to colistin, linezolid, imipenem, amikacin (97%); ciprofloxacin (92%); gentamicin (95%); Ceftriaxone (83%); meropenem (93%); Netilmicin (98%) and Sulfamethoxazole and Trimethoprim (SXT) (90%). *Proteus species* was 100% susceptible to amikacin, ciprofloxacin, Imipenem, meropenem, netilmicin; ampicillin (71%); amoxicillin-clavulanic acid (85%); ceftriaxone (85%); gentamicin (85%) and SX (85%). Among Gram-positive bacteria, *MSSA* was 100% susceptible to meropenem and Imipenem, amikacin (97%); gentamicin (81%); amoxicillin-clavulanic acid (91%); linezolid (92%); Netilmicin (94%); Vancomycin (91%); Colistin (97%) and SXT (41%). **Conclusion:** *Pseudomonas* and *MSSA* were the principal bacterial isolate responsible for causing CSOM.

INTRODUCTION: Chronic suppurative otitis media (CSOM) is defined as a persistent infection of the middle ear with a perforated tympanic membrane and draining exudate for more than 6 weeks^{1,2}.

Thirty-one million people developed CSOM across the globe every year and with prevalence of disease is as much as three times higher in developing countries than western developed world around the world. The World Health Organization (WHO) has categorized CSOM as neglected tropical diseases and is more common in low socio-economical status³.

CSOM usually occurs due to poor and inadequate management of acute otitis media. The etiology and antimicrobial resistance patterns of CSOM

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infection are different in different geographical areas, and the population studied. CSOM is predominantly caused by *Pseudomonas aeruginosa*, *Escherichia coli*, *S. aureus*, *Streptococcus pyogenes*, *Proteus mirabilis*, *Klebsiella species* among aerobic bacteria. However, *Bacteroides*, *Pepto streptococcus*, *Propionibacterium* are common anaerobic bacteria^{4, 5}. In India, studies were conducted at various parts of the country to establish common pathogen and antibiotic susceptibility. Some studies concluded as *Pseudomonas species* other shows *Staphylococcus species*^{6, 7} as the most common aerobic bacterial isolate involved in CSOM^{8, 9, 10, 11}. Some show polymicrobial pathogens. Anaerobic pathogens like *Peptostreptococcus species*, *Bacteroides species* and *Peptococcus species* involved in 10-11% cases of CSOM⁹. The most common fungal agent to be *Aspergillus species*, which was nearly 83% of all fungal causes of CSOM and the second most common cause was *Candida species*¹².

Thus, information about the organism responsible for COSM and their antibiotic susceptibility pattern is important for effective treatment. Therefore, the aim of this study was to determine the bacterial profile and their antibiotic susceptibility patterns in COSM from patients attending the ENT clinic of the hospital.

MATERIALS AND METHODS:

Study Design and Setting: A cross-sectional study was conducted at the ENT department of the secondary care hospital in North India. A total of 85 patients with unilateral or bilateral active chronic otitis media were studied. The study participants were enrolled consecutively using a convenience sampling technique. All study participants had perforated tympanic membranes with active purulent discharge. The detailed information regarding age, sex, duration of discharge, and the antibiotic is taken prior to pus collection was collected from each study participant using a structured questionnaire in the ENT clinic. Whereas ear discharge of less than 6 weeks duration, otitis externa, and patient taking topical/systemic antibiotic within 7 days before pus collection were excluded.

Sample Collection: Middle ear discharge sample was collected at ENT clinic under strict aseptic conditions using single-use sterile cotton-tipped

culture swabs, after proper cleaning the external auditory canal using povidone-iodine and spirit swab for each ear to prevent contaminants. The swabs were transported to the microbiology laboratory in the department of pathology of the same hospital for culture and antibiotic susceptibility testing.

Culture and Identification: Swab was directly used for inoculating on 5% sheep blood agar, MacConkey agar. The blood and MacConkey agar plates were incubated aerobically were incubated at 37 °C for 24-48 h. The isolates were identified by colony morphology, Gram stain and standard microbiological tests like oxidase test, coagulase test and biochemical tests like triple sugar iron test, indole test, citrate utilization test, and urease test¹³.

Antibiotic susceptibility tests were performed using a modified Kirby–Bauer disc diffusion method following the Clinical Laboratory Standards Institute guidelines.

Data Analysis and Interpretation: Data were entered and analyzed using SPSS version 20 software. Results were presented through graphs and tables. The statistical significance of association was measured by using the Chi-square test. A p-value < 0.05 was considered as statistically significant.

RESULTS: A total of 85 patients participated in the study. Out of which 57 (67.05%) were male, and 28 (32.94%) were female. The mean age of the study participant was 23 years and ranging from 4 to 68 years. Thirty-nine (45.88%) of them were aged below 20 years, 37(43.57%) were between 21- 40 years, 7 (8.24%) were between 41- 60 years, and 2 (2.35%) were above 61 years. 29 (34.11%) patients had bilateral disease, 56 (65.88%) of the patients had unilateral CSOM. Left ear disease is seen in 33 (58.93%) patients.

Of the 85 ear swabs, 89 bacterial isolates were identified. Of which 62 (72.94%) sample with mono-microbial growth, 14 (16.47%) with polymicrobial growth, 8(9.41%) show no growth and remaining 1 (1.17%) shows contaminants. Among 89 isolates, 35 (39.33%) were Gram-positive bacteria, while 54 (60.67%) were Gram-negative bacteria. The most common isolates were *Pseudomonas species* (36; 40.45%), followed by

Methicillin sensitive *Staphylococcus aureus* MSSA (34; 38.20%), *Proteus* species (7; 7.87%), *Klebsiella* species (3; 3.37%), *Enterobacter* species (3; 3.37%), *E. coli* (3; 3.37%), *Actinobacteria* species (2; 2.25%) and Methicillin resistant *Staphylococcus aureus* (MRSA) (1; 1.12%).

Mixed cultures (14; 16.47%) seen in equal percentage in both adult and child population, with a combination of *Pseudomonas* species and MSSA in 50% (7/14); *Enterobacter* species and MSSA 14.29% (2/14); *Acinetobacter* species / *E. coli*/ *Proteus* species and MSSA 7.14% (each 1/14); *Proteus* species and *Pseudomonas* species 7.14% (1/14) and *Acinetobacter* species and *Enterobacter* species 7.14% (1/14). Antibiotic susceptibility patterns of most isolated Gram-negative and Gram-positive bacteria, respectively. *Pseudomonas* species showed 100% susceptible to colistin, linezolid, imipenem; amikacin (97%); ciprofloxacin (92%); gentamicin (95%); Ceftriaxone (83%); meropenem

(93%); Netilmicin (98%) and SXT (90%). *Proteus* species were 100% susceptible to amikacin, ciprofloxacin, Imipenem, meropenem, netilmicin; ampicillin (71%); amoxicillin-clavulanic acid (85%); ceftriaxone (85%); gentamicin (85%) and Sulfamethoxazole and Trimethoprim SXT (85%).

Among Gram-positive bacteria, MSSA was 100 % susceptible to meropenem and Imipenem; amikacin (97%); gentamicin (81%); amoxicillin-clavulanic acid (91%); linezolid (92%); Netilmicin (94%); Vancomycin (91%); Colistin (97%) and SXT (41%). MRSA showed 100% susceptibility to gentamicin, netilmicin and vancomycin.

The resistance pattern among the gram-positive isolates was, MRSA was 100% resistant to ampicillin, linezolid, and SXT. MSSA was found resistant to ampicillin (65%) and SXT (59%) **Fig. 1** and **Table 1**.

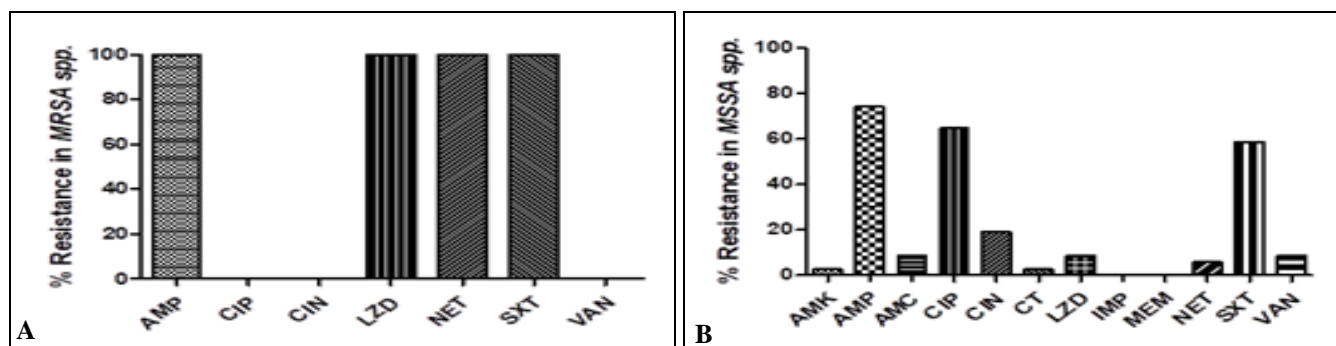


FIG. 1: ANTIBIOTICS RESISTANCE PATTERN IN MRSA SPP (A) MSSA SPP (B)

TABLE 1: ANTIMICROBIAL RESISTANCE IN GRAM-POSITIVE ORGANISM

Isolates	Antibiotic Resistance (Gram-Positive)													
	AMK n (%)	AMP n (%)	AMC n (%)	CIP n (%)	CRO n (%)	CIN n (%)	CT n (%)	LZD n (%)	IMP n (%)	MEM n (%)	NET n (%)	SXT n (%)	VAN n (%)	
MRSA (n=1) Resistance (R)	ND	1 (100)	ND	0	ND	0	ND	1(100)	ND	ND	1(100)	1(100)	0	
MSSA (n=34) Resistance (R)	1(2.94)	23(74.19)	3(8.82)	22(64.71)	ND	6(19.35)	1(2.94)	3(8.82)	0	0	2(5.88)	20(58.82)	3(8.82)	

In gram-negative isolates, *Pseudomonas species* found resistance to Ampicillin (100%), amoxicillin-clavulanic acid (97%), ceftriaxone (47%) and SXT (28%); *Proteus species* found resistance to Colistin (86%) and ampicillin (29%); *Klebsiella species* found resistance to Colistin (100%), ampicillin (67%) and SXT (33%); *Enterobacter species* spp. and *Acinetobacter species* spp. found 100% resistant to ampicillin; *E. coli* was 33% resistant to amoxicillin-clavulanic acid, ciprofloxacin, and ceftriaxone. All the resistance patterns are represented in **Fig. 2** and **Table 2**.

DISCUSSION: CSOM is defined as chronic otorrhea of more than 6 weeks duration through a perforated tympanic membrane. CSOM is a disease of multiple etiologies and is well known for persistence and recurrence in spite of treatment. The disease has irreversible sequelae and leads to serious intra and extracranial complications due to the proximity of various important structures viz. facial nerve, auditory labyrinth, lateral sinus, and middle and posterior fossa dura. CSOM is mainly classified as attic-antral (squamous COM) and tubo-tympanic (mucosal) type. According to the

world health organization (WHO) the prevalence of CSOM in Asian countries is about 4% which is much more than the developed western world⁴. The indiscriminate use of antimicrobials in Asian countries lead to multiple drugs resistance among the infective organisms leading to treatment challenges. There are no gender predilections

though most surveys were done on children, CSOM can affect both the children as well the adults, as presented in this study. Many researchers had addressed the issue of finding the common isolates and their sensitivity pattern among the antimicrobials in line with developing the treatment protocols in different regions of the world.

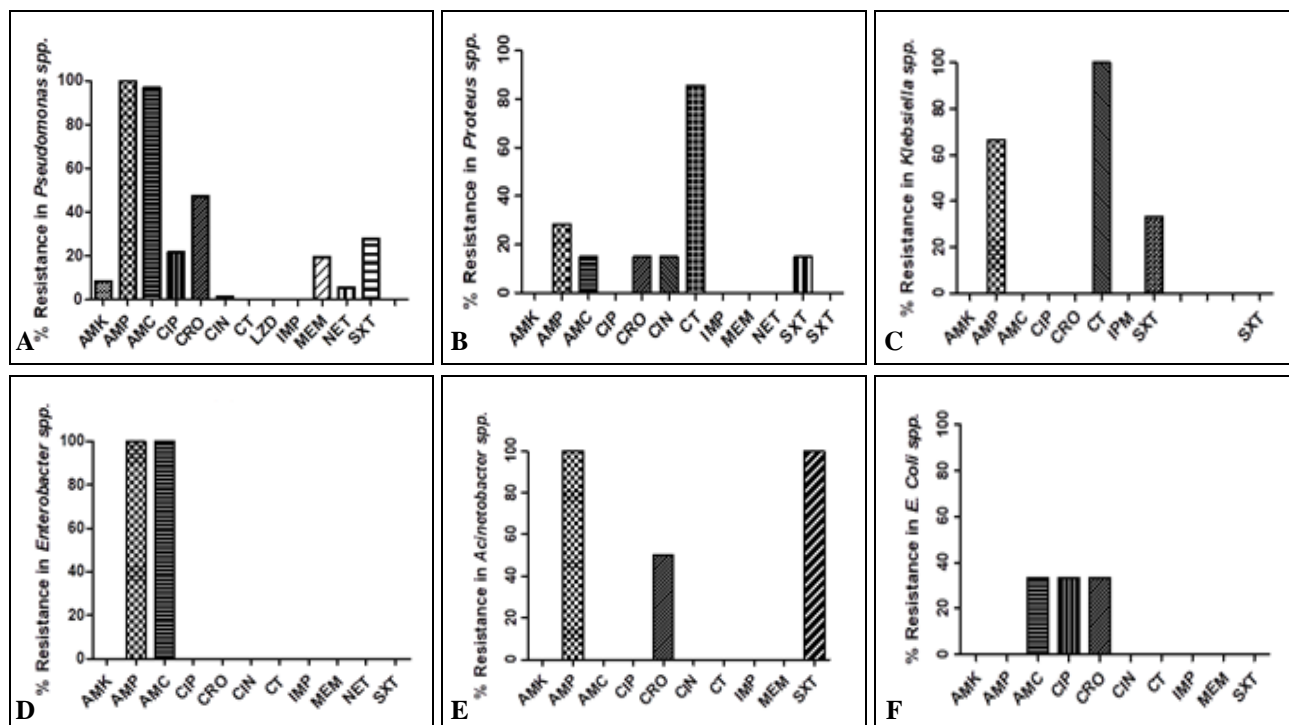


FIG. 2: ANTIBIOTICS RESISTANCE PATTERN IN (A) *PSEUDOMONAS* (B) *PROTEUS* (C) *KLEBSIELLA* (D) *ENTEROBACTER* (E) *ACINETOBACTER* (F) *E. COLI*

TABLE 2: ANTIMICROBIAL RESISTANCE IN GRAM-NEGATIVE ORGANISM

Isolates	Antibiotic Resistance (Gram Negative)												
	AMK n (%)	AMP n (%)	AMC n (%)	CIP n (%)	CRO n (%)	CIN n (%)	CT n (%)	LZD n (%)	IMP n (%)	MEM n (%)	NET n (%)	SXT n (%)	VAN n (%)
<i>Pseudomonas</i> spp. (n=36) Resistance (R)	3(8.33)	36(100)	35(96.7)	8(21.74)	17(47.22)	5(1.39)	0(0)	0(0)	0(0)	7(19.44)	2(5.55)	10(27.78)	ND
<i>Proteus</i> spp. (n=7) Resistance (R)	0	2(28.57)	1(14.9)	0	1(14.9)	1(14.9)	6(85.71)	ND	0	0	0	1(14.9)	ND
<i>Klebsiella</i> spp. (n=3) Resistance (R)	0	2(66.66)	0	0	0	ND	3(100)	ND	0	ND	ND	1(33.33)	ND
<i>Enterobacter</i> spp. (n=3) Resistance (R)	0	3(100)	3	0	0	0	0	ND	0	0	0	0	ND
<i>Acinetobacter</i> spp. (n=2) Resistance (R)	0	2(100)	0	0	1(50)	0	0	ND	0	0	ND	2(100)	ND
<i>E. coli</i> (n=3) Resistance (R)	0	0	1(33.33)	1(33.33)	1(33.33)	0	0	ND	0	0	ND	0	ND

In the present study 62 (72.94%) sample with mono-microbial growth, 14 (16.47%) with polymicrobial growth, 8(9.41%) show no growth, and the remaining 1 (1.17%) shows contaminants. Our study is correlated with Gopichand WR et al.,¹¹ and Tadesse et al.,¹⁴ in which most isolates are pure culture rather than the mixed one.

The aerobic bacterial isolates in our study are *Pseudomonas* species (40.45%), followed by *MSSA* (38.20%), *Proteus* species (7.87%), *Klebsiella* species (3.37%), *Enterobacter* species (3.37%), *E. coli* (3.37%), *Actinobacteria* species (2.25%) and *MRSA* (1.12%).

In our study, the most common isolate was *Pseudomonas species*, and it was similar to other studies, where also *Pseudomonas species* predominantly found in 48-98% of patients^{15, 16, 17}. Imipenem was 100% sensitive to all gram-negative isolates, consistent with the study of Rahim et al.¹⁸ Amikacin was 100% sensitive in gram-negative isolates except 8.33% of *Pseudomonas* spp. and 2.94% samples of MSSA shows resistance to amikacin; this study is also at par of observation done by Maji et al., SXT was most effective antibiotic against MRSA as shown by Park et al.,¹⁹ in contrary to our study shows 100% resistance of MRSA spp. for SXT though it was not statistically significant.

In general, our result has demonstrated that amikacin, ciprofloxacin, gentamicin, colistin, linezolid, imipenem and ceftriaxone are very sensitive to gram-negative organism. Among Gram-positive bacteria meropenem, Imipenem, amikacin, gentamicin, amoxicillin-clavulanic acid, linezolid, Netilmicin, Vancomycin, and Colistin are had bactericidal effects in the majority.

The small sample size of this study may restrict the value of our finding, the frequently used antimicrobials in CSOM like penicillin developed high levels of resistance among the organisms like *Pseudomonas* and MSSA leading to treatment failures.

CONCLUSION: CSOM still one of the most common causes of hearing impairment in India and the patients attending the ENT clinics have most frequent complaints of ear discharge with hard of hearing shows the morbidity among the population due to CSOM. *Pseudomonas species* and MSSA were the principal bacterial isolate responsible for causing CSOM in this study through the most common organism was *Pseudomonas species*. The effective treatment, as per the cultural sensitivity of CSOM, can reduce the morbidity considerably.

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CONFLICTS OF INTEREST: Authors declare no conflict of interest.

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