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Bacteriological profile and drug sensitivity patterns in chronic suppurative otitis media patients at J. L. N. Hospital & Research Centre, Bhilai, Chhattisgarh State, India

Sonam Rathi[1], Ashwin A. Jaiswal[2,*], Neeta Sharma[3], P. K. Banerjee[4], A. K. Garg[5]

[1]DNB Resident, [2]Consultant, [3]Senior Deputy Director, [4]Joint Director, [5]Director & HOD, Dept. of ENT & Head Neck Surgery, Jawaharlal Nehru Hospital Research Centre, Bhilai, Chattisgarh, India

***Corresponding Author:**
Email: ash1978jaiswal@gmail.com

Abstract
Objective: To isolate and identify various bacterial pathogens in positive ear swab cultures of CSOM cases and to determine the antibiotic sensitivity pattern of different bacterial species identified.
Study design: Prospective study
Setting: J. L. N. Hospital & Research Centre, Bhilai (C.G).
Materials and Method: The study was done on the population of Bhilai and surrounding region. A sample size of 120 cases attending the ENT OPD with the diagnosis of Chronic Suppurative Otitis Media and active ear discharge were included in the study. Detailed history, general physical examination, local systemic examination was done along with aural swab for Gram's staining and aerobic bacterial culture and drug sensitivity . The data were then compared with the relevant & available literature.
Results: Most of the patients were in the age group of 11-20 years (38.33%), followed by 21-30 years age group (31.67%). More males (60%) were affected by the disease than females (40%). Unilateral (59.16%) infection was more common than bilateral (40.83%). Incidence of monobacterial (90%) etiology was more common than polymicrobial (9.1%). Staphylococcus aureus 67 (51.53%) was the most commonly isolated bacteria followed by the Pseudomonas 26 (20%). Antibiogram showed the most effective drugs in the present study are clindamycin, cotrimoxazole, ciprofloxacin, amikacin, chloramphenicol and ceftazidime
Conclusion: Staphylococcus aureus is the most common pathogen isolated, followed by Pseudomonas. Clindamycin was the most effective antibiotic followed by cotrimoxazole, ciprofloxacin, amikacin, chloramphenicol and ceftazidime. Antibiotic sensitivity of the organisms varies according to geographical area and local practice regarding the choice of antibiotics. A continuous and periodic evaluation of microbiological pattern and their antibiotic sensitivity pattern in local area is helpful in prescribing empirical antibiotics for successful treatment of otitis media and thus minimizing its complications and emergence of resistant strains.

Keywords: Chronic Suppurative Otitis Media (CSOM)**,** antibiotic, Antibiogram, Staphylococcus aureus.

Introduction
Chronic suppurative otitis media (CSOM) is a chronic inflammation of the mucoperiosteum of the middle ear cleft which leads to abundant discharge from the ear and hearing impairment that may have a serious long term effect on language, auditory & cognitive development and on educational progress.[1]

The assessment and management of CSOM presents many challenging and fascinating problems. CSOM is a disease of multiple aetiologies and is well known for its persistence and recurrence inspite of treatment. Accordingly the manifestations of CSOM are extremely variable and there may be any lesion from a small healed deformity of the Tympanic Membrane (TM), to a cholesteatoma infiltrating widely throughout the temporal bone.[2] It is a destructive and persistent disease with irreversible sequelae and can proceed to serious intra and/or extra cranial complications.

The incidence of CSOM appears to depend on race and socio-economic factors. Socio-economical factors such as poor living conditions and overcrowding, poor hygiene and nutrition have been suggested as a basis for the wide spread prevalence of CSOM. CSOM has received considerable attention, not only because of its high incidence and chronicity, but also because of issues such as bacterial resistance and ototoxicity with both topical and systematic antibiotics.[3]

The widespread indiscriminate, haphazard use of antibiotics and poor follow up of patients has precipitated the emergence of multiple resistant strains of bacteria which can produce both primary and post operative infections. Changes in the microbiological flora following the advent of sophisticated synthetic antibiotics increase the relevance of reappraisal of the modern day flora in CSOM and their in vitro antibiotic pattern is very important for the clinician to plan a general outline of treatment for a patient with a chronically discharging ear.[4] The principles of treatment such as knowledge of local microbial pattern and their drug sensitivity are essential for effective and low cost treatment.[5]

The changing flora of CSOM and emergence of strains resistant to the commonly employed antibiotics stimulated the study. The purpose of this study is to find the local pattern of bacteria associated with CSOM and to detect the antibiogram of the isolates.

Materials and Method
Patients attending ENT OPD at Jawaharlal Nehru Hospital and Research Centre, Bhilai, Chhattisgarh

state form the source of the sample for study. The samples of Ear discharge of more than 6 weeks duration coming to department during Study Period of July 2012 to June 2014 constitute the material for study.120 samples were received during the study period fulfilling the following inclusion and exclusion criterias.

Inclusion Criteria

1. Patients presenting with chronic ear discharge for more than 6-12 weeks.
2. Patients with perforated tympanic membrane.
3. Patients must not have received ototopical or systemic antibiotics (>12wks) prior to the inclusion in the study.

Exclusion Criteria

1. Patients who have taken systemic or topical antibiotics for CSOM in last 12 wks.
2. Patients with single and first episode of ear discharge will be excluded.
3. No dry ears are included in this study.
4. Patients with serious medical conditions such as immunocompromised states, malignancy or blood dyscrasia.
5. Patients without any informed consent

Detailed history, general physical examination and local systemic examination were done for each case. Clinical data was collected using a preformed questionnaire. Two swabs were collected from patients diagnosed with CSOM using sterile cotton wool swabs and ear specula. All care was taken to avoid surface contamination with contents of External Auditory Canal (EAC). Swabs were collected in a culture tube for Gram's staining, aerobic bacterial culture and drug sensitivity, while specimen for anaerobic bacteria were taken directly into the Liquid Thioglycollate medium. All the swabs were transported to microbiology department. From the first swab direct gram staining was done followed by immediate inoculation on Blood Agar, Chocolate agar & MacConkey Agar plates which were then kept at 37 degree Celsius for 24-48 hours. The other swab was inoculated immediately in Enriched Thioglycollate medium with indicator and transported to microbiology lab and cultured for anaerobes in it for 24-48 hours. Samples were processed and identification of sample was done by conventional methods which were Gram staining, Colony morphology& Biochemical tests. All the organisms were subjected to antibiogram by Kirby-Bauer disc diffusion method. Antibiotic discs used for the sensitivity study were amikacin, gentamicin, vancomycin, clindamycin, amoxyclav, cotrimoxazole, ciprofloxacin, ceftazidime and roxithromycin.

Analysis of Data (Statistical Method employed)

a. **Percentage**

b. **Mean & SD**

MEAN= $\frac{\sum X}{N}$, SD= $\sqrt{\frac{\sum(Xi-MEAN)^2}{N}}$

c. **Unpaired PAIRED "t' TEST** t= $\frac{Difference\ OF\ MEANS}{SE}$, where SE= CSD* $\sqrt{(\frac{1}{N1}+\frac{1}{N2})}$

CSD= Combined Standard Deviation = $\sqrt{(\frac{SD1^2}{N1}+\frac{SD2^2}{N2})}$

d. **Chi square value**= $\sum\frac{(O-E)^2}{E}$ degree of freedom= (r-1)(c-1)

O= observed Frequency

E= expected frequency

Level of significance was set at $p< 0.05$.

P value < 0.05 was considered to be significant.

P value <0.01 was considered to be highly significant

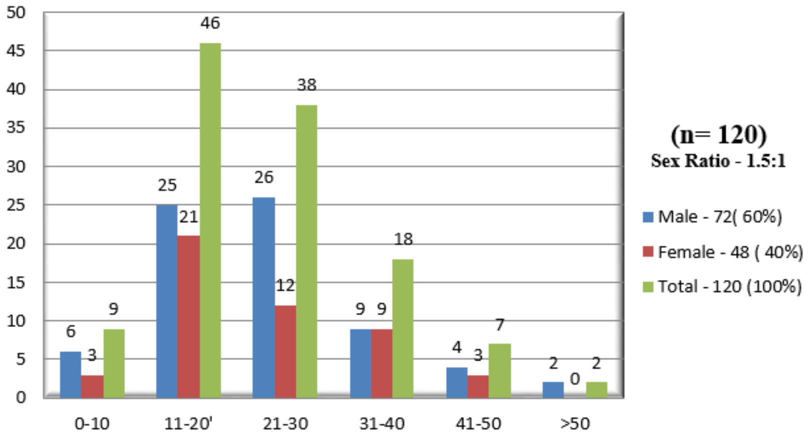
Results

In the present study of 'Bacteriological profile and drug sensitivity pattern of CSOM patients', conducted from July, 2012 to June, 2014; 120 patients fulfilling the inclusion criteria were randomly selected and analyzed.

Age and Sex distribution

Majority of the patients were of the age group 11-20 years (38.33%), among which males were more common, Followed by 21-30 years age group (31.67%). Least number of patients were found in >50 years age group (1.67%). In all the age groups males were more commonly affected, but p value of 0.59 depicted that there was no statistically significant association between age group of ear discharge and distribution of sex. Males (60%) outnumbered the females (40%) in this study with a male to female sex ratio of 1.5:1 (**Graph 1).** Mean age was 24.07 ± 10.89 in females and 23.04 ± 10.6 for males but no significant association of mean age with sex was noted. (p= 0.61).

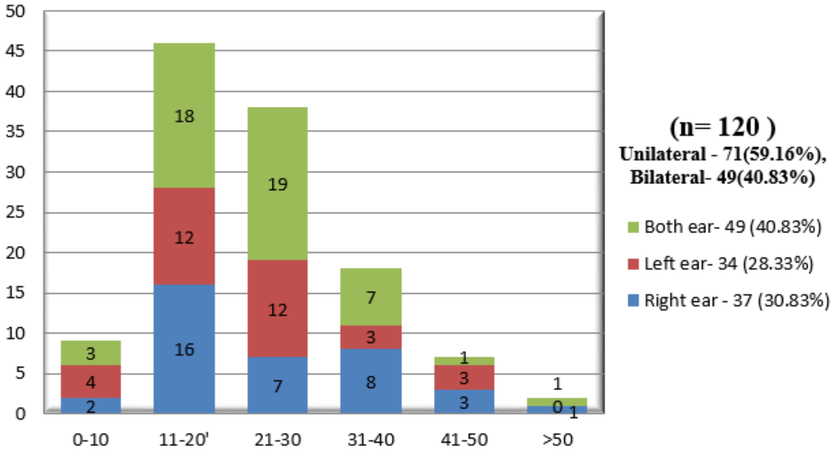
Graph 1: Age & Sex distribution



Distribution of Ear Involvement

In our study we found that disease most commonly involved unilateral ear (59.16%) in both male (58.33%) and female (60.41%) subjects. (p= 0.88). In cases of unilateral involvement slightly greater predilection for right ear (30.8%) than left ear (28.3%) was noticed **(Graph 2).** On comparing, p value= 0.46 showed no significant association between the laterality of ear and age.

Graph 2: Distribution of Ear Involvement



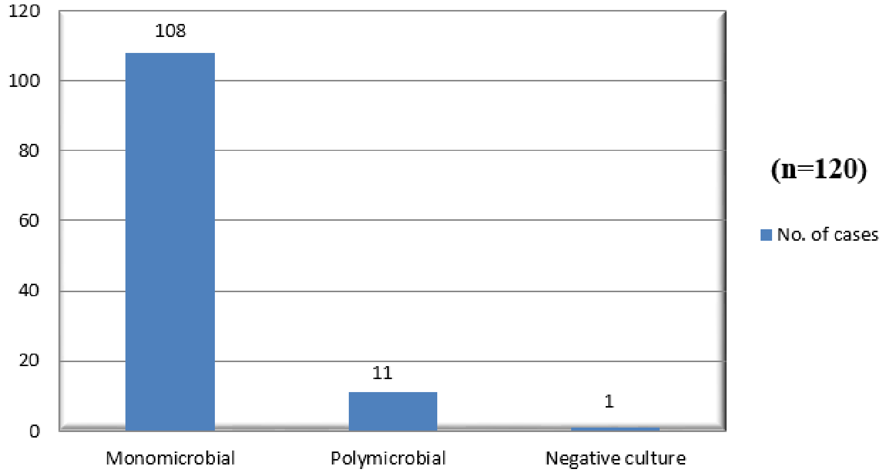
Characteristics of Ear discharge

In most of the cases patient had 1-5 years (33.33%) history of ear discharge, only 11.67% of patients had ear discharge for > 20 years. In most of the cases (73.3%), discharge was of insidious onset. Out of 120 discharging ear, fluctuation was present in 77.5% cases. Discharge was moderate in maximum number (52.5%) of cases, while it was scanty in only 19.17% cases. Mucopurulent discharge was present in most of the cases (90%). In 74.17% it was non-foul smelling while in rest 25.83% discharge were foul smelling. Most of the patients (79.17%) had yellow coloured discharge followed by white colour in 14.17% of cases.

Culture Results

Among the 120 patients studied, the bacteriological study was sterile in 1 case (0.833%), a monomicrobial isolate was seen in 108 cases (90%) while 11 (9.1%) cases had polymicrobial growth. **(Graph 3)**

Graph 3: Type of Bacterial culture



Gram Staining of Isolates

On Gram staining of isolates predominantly gram positive bacteria **{Fig. 1(a, b)}** were seen in 56.1% whereas gram negative bacteria **{Fig. 2(a, b)}** were seen in 43.8%. 91.78% of the gram positive isolates cultured Staphylococcus aureus whereas Pseudomonas (45.61%) was the most common gram negative isolate followed by Klebsiella (19.29%) and E. coli (17.54%). **(Graph 4)**

Fig. 1: (a) Blood Agar culture plate showing colonies of staphylococcal growth; (b) Gram staining of Isolates showing Gram positive cocci arranged in clusters

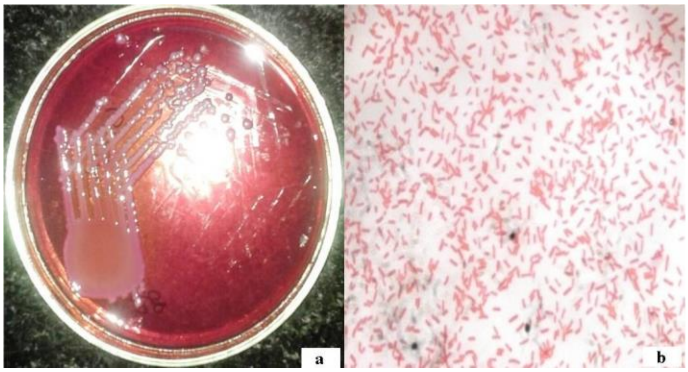
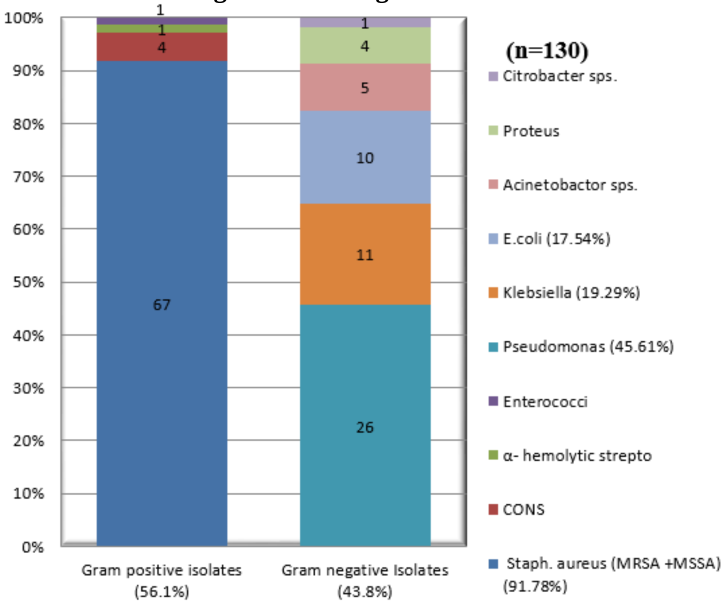


Fig. 2: (a) Mac-conkey Agar Culture plate showing colonies of lactose fermenting Gram negative microorganism; (b) Gram staining of Isolates showing Gram negative Bacilli

Graph 4: Type of Isolates on Gram staining & Bacteriological Profile



Bacteriological profile of the isolates

Total 130 bacterial isolates were recovered from the 119 positive cultures. All the isolates showed aerobic flora (100%) and no anaerobes (0%) were isolated in any of the culture. Staphylococcus aureus was the most common isolated bacteria, seen in 51.5% (67) of isolates followed by the Pseudomonas sp. in 20% (26) of isolates. Among the Staphylococcus aureus isolates, 34.62% (45) were MRSA and 16.92% (22) were MSSA. Other isolates included Klebsiella sp. in 11 (8.46%), E. coli in 10 (7.69%), Acinetobacter in 5 (3.85%), CONS and Proteus sp. in 4 (3.08% each), and α-haemolytic streptococcus, Citrobacter sp. & Enterococci in 1 (0.77% each) isolate. **(Graph 4)**

Antibiotic Sensitivity Patterns

Antibiotic sensitivity was carried out for 130 isolates by Kirby-Bauer disc diffusion method by using antibiotic discs. Most sensitive antibiotic for gram positives was clindamycin (87.67%) followed by cotrimoxazole (56.16%), whereas gram negative isolates showed maximum sensitivity to amikacin (59.64%) followed by ciprofloxacin.

Antibiotic Sensitivity Patterns of Gram Positive Isolates

Antibiogram showed most of the MRSA isolates were sensitive to clindamycin (88.88%), lincomycin (84.44%) and vancomycin (82.22%). 4.44% were found to be resistant to all antibiotics tested. 40% isolates showed sensitivity to cotrimoxazole and fewer number to roxithromycin (26.66%) and cloxacillin (11.1%). MSSA showed higher sensitivity to most of the drugs, 95.45% were sensitive to clindamycin, 90.90% to ciprofloxacin and cloxacillin, 81.81% to cotrimoxazole and lincomycin. Chloramphenical and roxithromycin showed sensitivity in 77.27% cases. 3 (75%) out of 4 CONS isolates showed sensitivity to cotrimoxazole, amoxicillin-clavulinic acid, cloxacillin, clindamycin. 50% of the isolates were sensitive to ciprofloxacin, chloramphenicol, ceftazidime and 25% to roxithromycin & lincomycin. Single isolate of α- haemolytic streptococcus was isolated from the culture, which showed 100% sensitivity to ciprofloxacin, cotrimoxazole, chloramphenicol, cloxacillin, ceftazidime, amoxicillin-clavulinic acid, vancomycin, lincomycin. Enterococci showed 100% sensitivity to cotrimoxazole and vancomycin. **(Table 1)**

Table 1: Antibiotic Sensitivity Patterns of Gram Positive Isolates (Antibiogram) (Number of isolates and percentage of each organism sensitive to various antibiotics)

	MRSA	MSSA	CONS	α-hemolytic streptococci	Enterococci
Roxithromycin	12 (26.66 %)	17 (77.27%)	1 (25%)		
Vancomycin	37(82.22%)	16 (72.72%)	2 (50%)	1 (100%)	1 (100%)
Clindamycin	40 (88.88%)	21 (95.45%)	3 (75%)		
Lincomycin	38 (84.44%)	18 (81.81%)	1 (25%)	1 (100%)	
Cotrimoxazole	18 (40%)	18 (81.81%)	3 (75%)	1 (100%)	1 (100%)
Ciprofloxacin		20 (90.9%)	2 (50%)	1 (100%)	
Cloxacillin	5 (11.11%)	20 (90.9%)	3 (75%)	1 (100%)	

Amoxyclav		11 (50%)	3 (75%)	1 (100%)	
Chloramphenicol		17 (77.27%)	2 (50%)	1(100%)	
Gentamicin		4 (18%)			
Ceftazidime		15 (68.18%)	2 (50%)	1(100%)	
Cefixime		2 (9.09%)			
Piperacillin		1(4.54%)			
Resistant to all	2 (4.44%)		1 (25%)		

Antibiotic Sensitivity Patterns of Gram Negative Isolates

46.15% Pseudomonas isolates were found to be sensitive to amikacin and 30.76% to gentamicin. Ceftazidime and ciprofloxacin were sensitive in 34.61% of isolates. Amoxicillin-clavulinic acid showed lower sensitivity, in 3.84%. 4 (15.38%) of the isolates were found to be resistant to all the antibiotics tested. All the Klebsiella isolates were found to be sensitive to amikacin (100%). 90.90% were sensitive to chloramphenicol and 81.81% to ciprofloxacin. Lesser number of isolates were sensitive to gentamicin (63.63%), cotrimoxazole (45.45%), ceftazidime (36.36%) and amoxicillin-clavulinic acid (18.18%). 90% of the E. coli isolates showed sensitivity to amikacin, 70% to chloramphenicol, 60% to ciprofloxacin and 50% to gentamicin. Lesser number isolates showed sensitivity to ceftazidime and cotrimoxazole (in 40% isolates) & 20% to amoxicillin-clavulinic. All the Acinetobacter isolates were sensitive to ceftazidime and cotrimoxazole (100%). Only 40% isolates showed sensitivity to chloramphenicol. Out of the 4 Proteus isolates 3 (75%) were sensitive to ciprofloxacin, cotrimoxazole, gentamicin and ceftazidime. 50% were sensitive to amikacin and chloramphenicol. Only 25% isolates showed sensitivity to amoxicillin-clavulinic acid and piperacillin. Single Citrobacter isolate which was isolated showed 100% sensitivity to chloramphenicol and amoxicillin-clavulinic acid. **(Table 2)**

Table 2: Antibiotic Sensitivity Patterns of Gram Negative Isolates (Antibiogram) (Number of isolates and percentage of each organism sensitive to various antibiotics)

	Pseudomonas sps.	**Klebsiella sps.**	**E.coli**	**Acinetobacter sps.**	**Proteus sps.**	**Citrobacter sps.**
Cotrimoxazole	4 (15.38%)	5 (45.45%)	4 (40%)	5 (100%)	3 (75%)	
Ciprofloxacin	9(34.61%)	9 (81.81%)	6 (60%)		3 (75%0	
Amoxyclav	1 (3.84%)	2 (18.18%)	2 (20%)		1 (25%)	1 (100%)
Chloramphenicol	6 (23.07%)	10 (90.9%)	7 (70%)	2 (40%)	2 (50%)	1 (100%)
Amikacin	12 (46.15%)	11 (100%)	9 (90%)		2 (50%)	
Gentamicin	8 (31%)	7 (64%)	5 (50%)		3 (75%)	
Ceftazidime	9 (34.61%)	4 (36.36%)	4 (40%)	5 (100%)	3 (75%)	
Piperacillin	4 (15.38%)		1 (10%)		1 (25%)	
Moderate Sensitivity to Amikacin	1(3.84%)					
Resistant to all	4 (15.38%)					

Discussion

Due to changing pattern of bacteriological profile of Otitis media and sensitivity of microorganisms towards antibiotics, it has become very important to find out the organism causing the disease.

High prevalence of culture positive cases of CSOM (91.18%) was seen in the present study. It was found that the prevalence of CSOM was higher in the age group of 11-20 years (38.33%), followed by 21-30 years (31.67%). These findings are in correlation with mentioned workers in **Table 3.** However Rao B.N. et al,[9] Taneja M.K. et al,[10] Iseh K.R. et al (75.43%),[11] Mariam et al (39.2%),[12] have reported maximum number of patients in first decade. According to study of Poorey V K & Iyer A[4] common age group was first and second decade of life, but among them 1-10years age group was more common. Agrawal et al[13] also reported highest incidence in 0-20 year age group (62.4%). Vineetha Gupta et al,[14] Loy A.H.C. et al,[5] Gh Ettehad et al (26.22%)[15] and Shamweel Ahmad (31.70%),[16] have reported maximum number of patients in third decade. Incidence of CSOM decreases as the age advances.

Males were more affected, 72 (60%) than the females 48 (40%) in the present study. This finding is correlated with other series **(Table 4)** Shrestha B L et al[20] found the female predominance (55.2%), also supported by Prakash M et al (55%).[21] The male predominance may be because of their more exposed way of life.[22]

In the present study unilateral infection (59.16%) was more common compared to bilateral infection (40.83%). Our findings are correlated with other studies.

(Table 5) Right and left ears were found to be equally affected in our study (30.83% vs 28.33%).

The onset of ear discharge was insidious in about 73.33% of patients, while in 26.67% it was of sudden onset. The discharge was fluctuant with intermittent discharge in about 77.5% of cases while fluctuation was not seen in 22.5% of cases. In most of the cases discharge was moderate in amount (52.5%), mucopurulent (90%) in character and non foul smelling (74.17%). In some cases discharge was profuse or scanty. These findings are consistent with as mentioned by Mills,[28] Chowdhury and Alauddin,[29] Hamilton J [30] and Youngs.[31]

In the present study 119 (99.1%) specimens were positive and 1 (0.83%) was negative for the culture. The culture results are variable compared to other workers. **(Table 6)**

Negative cultures can be attributed to Non-bacterial growth, anaerobic growth, Prior-antibiotic therapy, Presence of antimicrobial enzymes i.e. lysozyme alone or in combination with immunoglobulins that suppress the bacterial growth.[18,33,34]

In the present study monomicrobial etiology was 108 (90%) and polymicrobial was 11 (9.1%) which is correlated with the other studies. **(Table 7)** However Rama Rao M.V. et al[36] found equal incidence of mixed and pure culture and Baruah P.C. et al[37] found predominance of mixed culture. Availability and use of topical and systemic broad spectrum antibiotics in the period before consultation was probably responsible for the lower incidence of mixed infection.

All the isolated microorganisms were aerobes (100%), no anaerobes were isolated. Although this is in contrast to most of the previous studies but Gh Ettehad et al[15] study is coherent with this finding.

The finding of predominant gram positive bacteria in 73 (56.15%) out of 130 isolates is consistent with few of the previous studies such as Marium et al[12] in their study predominantly reported gram positive bacteria in 30 isolates (65.2%) and Shamweel Ahmad[16] in his study found 102 (62.19%) gram positive isolates.

Among the organisms isolated, Staphylococcus aureus was the predominant organism 67 (51.53%) followed by Pseudomonas spp. 26 (20%). This finding is correlated with other studies. **(Table 8)** However workers like Arya S.C. et al.[17] Nandy A. et al,[18] Grewal R.S. et al,[41] Urmil Mohan et al,[25] Hiremath S.L. et al,[33] Loy A.H.C. et al[5] have found Staphylococcus aureus as the second most common organism causing CSOM. Some of the studies conducted by Ballal M. et al,[42] Saurabh V. et al,[43] Hiremath S.L. et al[33] and Loy A.C.[5] have found Pseudomonas spp. as the predominant organism causing CSOM.

The next most common organism was Klebsiella spp. 11 (8.46%) in the present study and Proteus species were isolated from 4(3.07%) cases However, Singh N. et al,[34] Rama Rao M.V. et al[36] and Saurabh V. et al[43] have found them as the second most leading cause for CSOM.

In the present study Enterococcus spp. was isolated in 1 (0.77%) cases. Other workers who have isolated Enterococci in CSOM are Hiremath S.L. et al[33] in 0.79% cases and Loy A.H.C. et al[5] in 2.2% cases. E. coli was isolated in 10 (7.69%) cases in the present study. However Rama Rao M.V. et al[36] has reported a high incidence of E. coli, i.e. 18.7% cases.

In the present study CONS was isolated in 4 (3.07%) cases. However many workers have found higher incidence of CONS like Srivastava V.K. et al[23] in 10.2% cases, Rama Rao M.V. et al[36] in 21.6% cases and Loy A.H.C. et al[5] in 21.1% cases.

The frequency of Staphylococcus aureus in the middle ear infections can be attributed to their ubiquitous nature and high carriage of resistant strains in the external auditory canal and upper respiratory tract.

The organisms like Pseudomonas spp. and Proteus spp. are considered mostly as secondary invaders from external auditory canal gaining access to the middle ear via a defect in tympanic membrane resulting from an acute episode of otitis media. Organisms like E. coli and Klebsiella spp. become opportunistic pathogens in the middle ear when resistance is low.

Although CONS are generally considered as non-pathogenic, their association in some cases can be attributed to the extreme lowering of resistance in middle ear due to invasion by other organisms. Under these circumstances they assume pathogenic role either singly or more often in combination with other organisms.[1]

In the present study 49.23% of organisms were sensitive to clindamycin, followed by cotrimoxazole (47.69%), ciprofloxacin (38.46%), chloramphenicol (36.92%), ceftazidime (33.07%).The most effective antibiotic against gram positive bacteria was found to be clindamycin (87.67%), followed by cotrimoxazole (56.16%) and cloxacillin (39.7%). Amongst gram negative bacteria most sensitive antibiotic was amikacin (59.64%) followed by ciprofloxacin (47.36%). Thus the most effective drugs in the present study are clindamycin, cotrimoxazole, ciprofloxacin, amikacin, chloramphenicol and ceftazidime. Similar sensitivity pattern was reported by Gulati et al,[24] S.Varshney et al[43] and Hiremath S.L.et al.[33] However Nandy A. et al[18] and Rao B.N. et al[9] have found gentamicin as the most effective drug. In the present study majority of the isolates showed multiple drug resistance for amoxicillin-clavulinic acid and cefixime. 7 (5.3%) isolates showed resistance to all the antibiotics tested.

Table 3: Age wise distribution

Study series	Year	Total no. Of patients in 11-20 years age group	Percentage
Swarooprani N.B. et al[6]	2013	30	31%
Rajat Prakash et al[7]	2014	54	26.47%
Naz Perween et al[8]	2014	23	29.8%
Present study	2012-14	46	38.33%

Table 4:- Sex wise distribution

Study Series	Year	Total no. of male patients	Percentage
Arya S C et al[17]	1966	116	70.13%
Nandy A et al[18]	1991	77	52.74%
Taneja M K et al[10]	1995	470	71.87%
Srivastava A et al[19]	2010	62	56.3%
Swarooprani N B[6]	2014	56	56.6%
Agrawal et al[13]	2014	67	53.6%
Present study	2012-14	72	60%

Table 5: Side wise distribution

Study series	Year	Affected unilaterally (%)
Srivastava et al[23]	1979	92.61%
Gulati et al[24]	1997	80%
Urmil Mohan et al[25]	1998	86.3%
Rakesh Kumar et al[26]	2013	79.13%
Hirapure P.V. et al [27]	2014	71.42%
Present study	2012-14	59.16%

Table 6: Culture results of cases studied

Study series	Year	Positive culture no. (%)	Negative culture (%)
Srivastava V K et al[23]	1979	99 (97.05%)	3 (2.94%)
Nandy A et al[18]	1991	356 (92.70%)	28 (7.29%)
Taneja M K et al[10]	1995	618 (84%)	118 (16%)
Gulati et al[24]	1997	78 (78%)	22 (22%)
Srivastava A et al[19]	2010	90 (80.3%)	22 (19.7%)
Singh A H et al[32]	2012	142 (94.6%)	8 (5.33%)
Prakash M et al[21]	2013	75 (93.75%)	5 (6.25%)
Prakash R et al[7]	2014	186 (91.18%)	18 (8.82%)
Present study	2012-2014	119 (99.1%)	1 (0.83%)

Table 7: Incidence of pure and mixed cultures

Study series	Year	Monomicrobial no. (%)	Polymicrobial no. (%)
Arya S C et al[17]	1966	129 (83.77%)	25 (16.23%)
Srivastava et al[23]	1979	84 (82.3%)	12 (11.7%)
Taneja M K et al[10]	1995	594 (80.7%)	24 (3.3%)
Srivastava et al[19]	2010	73 (81.1%)	17 (18.9%)
Singh A H et al[32]	2012	96 (64%)	46 (30.67%)
Nageshwari et al[35]	2012	84 (69.4%)	37 (30.57%)
Prakash M et al[21]	2013	64 (85%)	12 (13%)
Prakash R et al[7]	2014	118 (57.84%)	68 (33.33%)
Present study	2012-2014	108 (90%)	11 (9.1%)

Table 8: Commonest organism isolated

Study series	Year	Commonest isolate (%)	Second commonest (%)
Iseh K R et al[11]	2004	Staph aureus (46.2%)	E. coli (23.1%)
Patricia N Ayson et al[38]	2006	Staph aureus (50%)	Pseudomonas (33.3%)
Gh Ettehad et al[15]	2006	Staph aureus (31.15%)	Pseudomonas (26.23%)
Nikakhlagh et al[39]	2008	Staph aureus (32.4%)	Pseudomonas (21.6%)
Srivastava A et al[19]	2010	Staph aureus (29.2%)	Pseudomonas (28.3%)
Mozafari et al[40]	2011	Staph aureus (50.3%)	Pseudomonas (23.4%)
Singh A H et al[32]	2012	Staph aureus (36%)	Proteus (32%)
Nageswari et al[35]	2012	Staph aureus (42%)	Pseudomonas (17%)
Mariam et al[12]	2013	Staph aureus (65.2%)	Pseudomonas (15.2%)
Shamweel Ahmad[16]	2013	Staph aureus (56.7%)	Pseudomonas (19.5%)
Prakash M et al[21]	2013	Staph aureus (41.25%)	Pseudomonas (37.5%)
Swarooprani N B et al[6]	2014	Staph aureus (29.23%)	Pseudomonas (21.4%)
Prakash R et al[7]	2014	Staph aureus (48.69%)	Pseudomonas (19.89%)
Naz Perween et al[8]	2014	Staph aureus (40.2%)	Pseudomonas (29.8%)
Agrawal et al[13]	2014	Staph aureus (37.6%)	Pseudomonas (32.8%)
Present study	2012-2014	Staph aureus (51.53%)	Pseudomonas (20%)

Conclusion

In our geographical area

1. Aerobic bacterial infection is common, with Gram positives out numbering Gram negatives. Staphylococcus aureus is the most common pathogen isolated, followed by Pseudomonas.
2. Clindamycin was the most effective antibiotic followed by cotrimoxazole, ciprofloxacin, amikacin, chloramphenicol and ceftazidime. Thus Sensitivity to older antibiotics is again emerging, as with more and more use of newer antibiotics and in resistant cases, these can be another good option.
3. Antibiotic sensitivity of the organisms varies according to geographical area and local practice regarding the choice of antibiotics. Thus pre-culture antibiotic should be active against both Gram positive and negative bacteria.
4. Timely diagnosis and treatment of upper respiratory tract infections, during childhood can prevent chronic suppurative otitis media and its complications later in life; hence awareness among people for seeking earlier medical opinion & treatment should be created.
5. With the development and widespread use of antibiotics, the types of pathogenic microorganisms and their resistance to antibiotics have changed. Thus Antibiotics should be used judiciously along-with avoiding over the counter antibiotics to prevent development of resistance
6. The most important factor responsible for the development of antibiotic resistance is human negligence. As soon as, symptoms subside, patients stop taking antibiotics before completion of therapy and allow partially resistant microbes to flourish. Such practice should be discouraged and patients should be educated to avoid the same.
7. A continuous and periodic evaluation of microbiological pattern and their antibiotic sensitivity pattern in local area is helpful in building an antibiotic policy, prescribing empirical antibiotics for successful treatment of otitis media and minimizing its complications and emergence of resistant strains as well as in long term, reduces the burden of the infection and cost of treatment on the patient.

Compliance with Ethical Standards

All the accepted principles of ethical and professional conduct have been followed and compliance is maintained. All the authors have contributed equally in the study.

Disclosure of potential conflicts of interest

All the authors have filled the potential conflict of interest disclosure forms and declare that they have no conflict of interest.

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Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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