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Microbiological profile of Chronic Suppurative Otitis Media (CSOM) in a tertiary care hospital

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Abstract: Awareness regarding the microbial flora causing CSOM and their antibiotic susceptibility pattern will be of great help to maintain an antibiotic policy based on which treatment can be provided. Continuous and periodic evaluation of the microbiological profile and antibiotic sensitivity pattern of bacterial isolates is necessary to decrease the potential risk of complications by early institution of appropriate treatment. Identification of the etiological agents also help to find the modes of spread, methods of prevention, and anticipation of possible complications. As certain etiological agents are more common in healthcare settings, the healthcare personnel shall be instructed regarding importance of maintaining hand hygiene and sterility practices.

Key words: Microbial flora; Chronic Suppurative Otitis Media; CSOM

Introduction

Chronic Suppurative Otitis Media is the infection of middle ear cleft characterized by intermittent or persistent ear discharge and perforation of tympanic membrane (Prakash R, F *et al.,* (2013). Chronic Suppurative Otitis Media is usually considered as a sequel of acute infection of middle ear termed as acute otitis media (Orji FT *et al.,* (2015). This infection can spread from the middle ear to the vital structures such as facial nerve, lateral sinus, meninges and brain which may further cause major complications like deafness and meningitis (Saranya SK *et al.,* (2015). Incidence of this disease is higher in developing countries especially in low socio-economic group because of malnutrition, overcrowding, poor hygiene and inadequate health care. (Malkappa SK *et al.,* (2012), Shetty AK *et al.,* (2014)· As it is a chronic recurrent disease there is more chance of empirical use of antibiotics and hence the bacterial flora and their antibiotic susceptibility pattern changes constantly. The other main reason for change in antibiotic susceptibility pattern is that as soon as the symptoms subside, many patients stop taking antibiotics which provide a way for the resistant microbes to flourish. Hence the importance of performing culture and antibiotic sensitivity testing of the ear discharge in CSOM cases before initiation of antibiotic therapy becomes highly necessary. This prospective study also helps to identify the social demographic factors of the disease. Most commonly affected age group involves mainly children and adolescents for whom oral and local antibiotic administration is considered comfortable and thus the empirical use of antibiotics have become more common. Ototoxicity of antibiotics administered is also an important issue in cases of CSOM. Practically it is highly difficult to screen all patients with CSOM for microbial growth due to minimal number of microbiological laboratories. Hence updated knowledge about microbiological profile of CSOM has become essential in our tertiary care setup which would be beneficial for treatment of CSOM patients. As most of the cases are resistant to local antibiotics, this study is given more preference in our tertiary care hospital to overcome the poor outcome of treatment in CSOM cases.

Review

The prevalence of CSOM is worldwide in nature. As per Rahul Mittal *et al.,* (2015), this infection affects nearly 65-330 million people with 22.6 % incidence in children and around 31 million new cases of CSOM will arise every year on rough estimation. WHO has classified the countries into different groups according to the prevalence of CSOM like highest (> 4%), High (2-4%), low (1-2%), and lowest (<1%) in which India comes under highest category (WHO, 2004).

Microbiological profile varies in various geographical areas with different antibiotic sensitivity patterns as per the study by Jeyakumari *et al.,* (2015). As mentioned in the study by Saranya SK *et al.,* (2015) variation in climate, socioeconomic status and patient's self-hygiene also play a major role in determining the microbiological distribution in Chronic Suppurative Otitis Media. The burden of disease is rural population is higher when compared to urban population. WHO also estimated that the urban to rural ratio of the disease is 2:1 as per Kumar S *et al.,* (2015). Premature and low birth weight children are more commonly affected than term babies as per the study by Shamweel Ahmad *et al.,* (2013). This implies that the chances of infection is high in immune suppressed children.

Inadequate antibiotic treatment, frequent upper respiratory tract infections, nasal disease and poor living conditions with poor access to medical care are related to the development of CSOM. Poor housing, hygiene and nutrition are associated with higher prevalence rate of CSOM. Wasihun and Zemene *et al.,* (2015) has mentioned that the development and spread of resistant bacteria due to the over and indiscriminate use of antibiotics is a global public health threat. Due to the limited laboratory diagnosis in developing countries, physicians are often forced to symptomatic diagnosis and prescription of broad spectrum antibiotics for most infections that lead to emergence of drug resistant bacterial strains. To determine the microbiological profile of CSOM cases in our tertiary care set up. To establish the antibiotic susceptibility pattern of the bacterial agents causing CSOM. To assess the age group and sex prone to CSOM. To reduce morbidity and complications caused by CSOM.

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Methodology

Study design: The present study is a prospective observation carried out for a period of ten months from June 2016 till March 2017 in patients attending ENT OP who fulfil the inclusion criteria

Study population:
Inclusion criteria:

- Patients with complaints of intermittent or persistent ear discharge in one or both ears for at least four weeks, irrespective of age and sex.
- Patients who have not taken any antibiotic treatment either systemically or locally for the last one week.

Exclusion criteria:

- Patients who have taken antibiotics within one week.
- Patients with complications of CSOM.
- Patients with acute otitis media / otitis externa.

Place of study: Government Mohan Kumaramangalam Medical College Hospital, Salem
Study period: From the month of June 2016 to March 2017.
Nature of sample: Ear swab
Sample size: 100 samples

Sample collection:
Ear discharges were collected using three pre-sterilized swabs from the patients with symptoms of CSOM. Samples were collected from each ear separately in case of bilateral infection.

Sample transport:
The swabs were transported to the microbiological laboratory for further processing within half an hour.

Sample processing:
One swab was used for performing gram staining and KOH mount. A thin smear is prepared in a clean glass slide with one swab and gram staining is done and examined under oil immersion objective of the microscope. Similarly, 10% KOH mount is prepared and examined microscopically for detection of fungal infections.

Second swab is used for inoculating the culture media for aerobic bacterial culture. Nutrient agar, 5% Sheep blood agar, Chocolate agar and McConkey agar culture plates were inoculated and incubated for aerobic bacterial culture at 37°C for 18-24 hours. The bacterial growth is identified based on the morphology of the bacterial colonies on culture plates and confirmed using the biochemical reactions as done routinely. The antibiotic susceptibility testing of the bacterial isolates was performed as per Kirby Bauer's Disc Diffusion method in Mueller Hinton agar using the preferable antibiotics and interpretation is done based on Clinical Laboratory Standards Institute Guidelines (CLSI, 2014).

Third swab is used for inoculating two sterile slants of Sabouraud's Dextrose agar for fungal culture. One SDA slant is incubated at 28^0 C and another slant is incubated at 37^0 C and examined for fungal isolates. Identification of fungi is based on macroscopic and microscopic examination of fungi. The present study shall not include anaerobic culture.

Results

100 patients were included in this study. Ear swabs from all the patients were sent for culture. 77 bacterial isolates and 17 fungal isolates were obtained. Single bacterial growth was seen in 75 cultures and mixed bacterial growth in 2 cultures. Single fungal isolate was present in 11 and combined fungal and bacterial growth in 6 cultures. No growth of bacteria or fungi was observed in 6 swab cultures. Percentage of bacterial and fungal isolates is presented in the table 1 and 2 respectively. Among these 100 samples collected from the patients, 27% had infection with *Pseudomonas aeruginosa*, 16% had *Staphylococcus aureus*, 11% had Coagulase Negative Staphylococcus species, 10% had *Klebsiella species*, 5% patients had *Escherichia coli,* 3% had *Proteus mirabilis*, 1% had *Enterobacter species*, 1% had *Citrobacter species, 1*6% showed no growth in bacterial and fungal cultures. 2% had mixed growth with *Pseudomonas aeruginosa* with *Coagulase negative Staphylococcus species*. One rare isolate *Serratia species* and was also isolated in our study. These bacteria produce red pigment which is in Figure 3.

Antibiotic susceptibility testing (AST) of the bacteria isolated was done and the percentage of resistance and susceptibility pattern was derived as in Table 3 and 4. The antibiotics used for testing are Ampicillin, Piperacillin, Amikacin, Tobramycin, Gentamicin, Ciprofloxacin, Ofloxacin, Levofloxacin, Cefuroxime, Cefixime, Cefpodoxime, Ceftazidime, Cefaperazone, Cetriaxone, Cefepime, Piperacillin tazobactum and Ceftriaxone clavulanic acid for gram negative bacteria. Erythromycin, doxycycline, tetracycline, cotrimoxazole, vancomycin and linezolid were included for gram positive bacteria. All the antibiotic discs used are of Himedia Laboratories Private Limited. Common age group affected by CSOM is 1 – 20 years. Male patients are more commonly infected than females and the sex ratio for Male: Female is 2:1 among the patients included in our study. Age and sex wise distribution of the infected CSOM patients is described in Table 5 and Table 6 respectively.

Table 1: Percentile of Bacterial isolates

Bacterial isolates	Percentage %
Gram positive bacteria	27
Stapylococcus aureus	16
Coagulase negative Staphylococcus species	11
Gram negative bacteria	48
Pseudomonas aeruginosa	27
Klebsiella species	10
Escherichia coli	5
Proteus species	3
Enterobacter species	1
Citrobacter species	1
Serratia species	1
Mixed growth (*Pseudomas aeruginosa* with *Coagulase negative Staphylococcus species)*	2
No growth	6

Table 2: Fungal isolates in CSOM

Fungal isolates	Mono microbial fungal growth	Polymicrobial growth with bacteria
Candida species	4	5 with *Coagulase negative Staphylococcus*
Aspergillus niger	4	1 with *Pseudomonas aeruginosa*
Aspergillus flavus	3	-

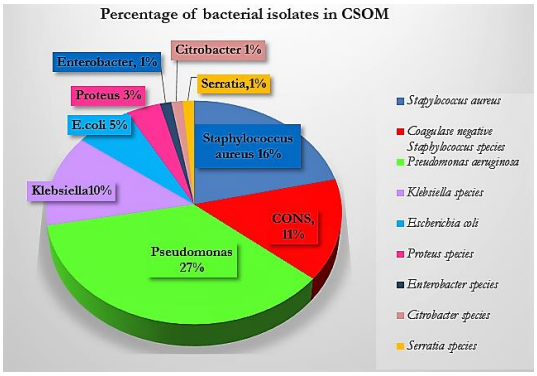

Figure 1: Diagrammatic representation percentage of bacterial isolates in CSOM

Table 3: Antibiotic sensitivity pattern of gram positive bacteria

CONS	*Staphylococcus aureus*	Bacteria isolated
82	74	Ampicillin
99	98	Amikacin
73	75	Cephalexin
74	72	Cefuroxime
76	76	Cefixime
78	74	Cefpodoxime
80	78	Ceftriaxone
76	79	Cefotaxime
75	74	Clarithromycin
72	71	Erythromycin
99	97	Vancomycin
98	98	Linezolid
80	88	Cefaperazone sulbactum
79	83	Piperacillin tazobactum
89	86	Amoxycillin clavulanic acid
90	87	Ceftriaxone clavulanic acid
88	89	Cefoxitin
24	28	Cotrimoxazole
20	24	Ciprofloxacin

Table 4: Antibiotic sensitivity pattern of gram negative bacteria

Bacteria isolated	Ampicillin	Piperacillin	Amikacin	Tobramycin	Gentamicin	Cephalexin	Cefuroxime	Cefixime	Cefpodoxime	Ceftriaxone	Cefotaxime	Ceftazidime	Cotrimoxazole	Ciprofloxacin	Levofloxacin	Ofloxacin	Cefaperazone sulbactum	Piperacillin tazobactum	Amoxycillin clavulanic acid	Ceftriaxone clavulanic acid
P. aeruginosa	-	89	100	98	67	-	-	-	-	81	77	88	-	56	67	61	89	94	-	90
Klebsiella sp.	42	88	89	88	78	65	77	73	74	76	82	81	22	56	59	56	89	88	59	89
E. coli	83	83	75	78	75	65	75	71	74	82	82	83	25	75	78	50	75	87	61	91
Proteus sp.	84	82	99	82	67	65	76	72	74	81	83	82	33	67	70	33	89	89	67	95
Enterobacter sp.	83	84	75	89	70	65	75	73	74	83	84	80	20	66	71	54	88	87	62	92
Citrobacter sp.	72	81	75	82	69	65	77	75	74	83	81	79	23	62	70	56	87	85	66	91
Serratia sp.	72	82	77	79	75	65	71	77	74	82	82	77	25	61	72	50	89	86	68	89

Table 5: Age wise distribution of CSOM cases

Age in years	Percentage of infected cases
1-10 years	4
11-20 years	32
21- 30 years	24
31-40 years	10
41-50 years	18
51-60 years	12

Table 6: Sex wise distribution of CSOM cases

Percentage of males infected	66
Percentage of males infected	34
Male: Female ratio	2:01

Table 7: Socio demograhic factors in CSOM

Social demographic factors	Percentage
Cases with single ear infected	94
Cases with both ears infected	6
Cases with white coloured ear discharge	89
Cases with yellow coloured ear discharge	10
Cases with amber coloured (bloody) ear discharge	1
Cases with low socioeconomic status	89

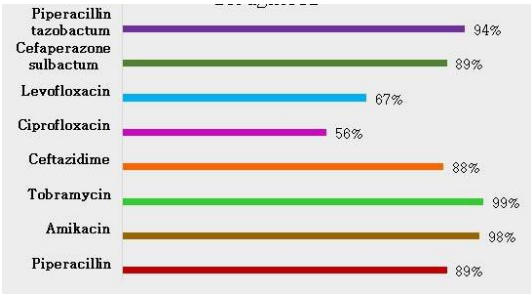

Figure 2: Antibiotic sensitivity pattern of *Pseudomonas aeruginosa*

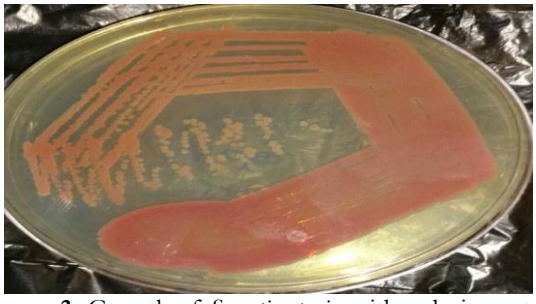

Figure 3: Growth of *Serratia species* with red pigment in Nutrient agar

Discussion

CSOM is chronic suppurative disease affecting the middle ear cleft with tympanic membrane perforation. This disease leads to complications like labyrinthitis, facial nerve paralysis, mastoiditis, meningitis, deafness, extradural and intradural abscesses due to inadequate or inappropriate antibiotic treatment. This is considered as a serious problem in our country due to increased risk of morbidity and mortality in affected individuals. Males and younger age groups, especially those less than 20 years are more susceptible to CSOM. Infections affecting single ear was found to be higher than bilateral ear infections which is similar to previous study by Prayaga N *et al.,* (2013).

Microbiological profile of CSOM cases as per our study showed 27% isolation of *Pseudomonas aeruginosa* followed by 16% of *Staphylococcus aureus*, 11% of *Coagulase negative Staphylococcus species*, 10% of *Klebiella species,* 5% of *Escherichia coli* almost similar to other studies by Osazuwa F *et al.,* (2011), and Shashidhar Vishwanath *et al.,* (2012).

One rare isolate in our study is *Serratia species* (1%) which produces red pigmentation as shown in Figure 3 which has not been isolated in any related study. Gram negative bacteria were isolated in high rate (48%) than gram positive bacteria (27%) in our hospital as defined by many other studies. 11% of *Coagulase negative Staphylococcus species* was isolated in our study. This finding was correlated clinically and pathogenicity of the same was assessed and considered as commensal. 2% showed mixed growth of bacteria with CONS and *Pseudomonas aeruginosa* in which CONS was considered as commensal. In 6% of cases no microorganism was isolated.

In case of fungal isolates, 9 isolates were *Candida species* followed by 5 isolates of *Aspergillus niger* and 3 isolates of *Aspergillus flavus*. Among this, 5 isolates were *Candida species* along with CONS which is considered as a part of normal flora as per clinical correlation. *Aspergillus niger* was isolated along with *Pseudomonas aeruginosa* and this was defined as pathogen. *Pseudomonas aeruginosa* showed highest sensitivity to Amikacin (98%), Tobramycin (99%), Piperacillin (89%), Cefaperazone sulbactum (95%), Piperacillin tazobactum (96%), Ceftriaxone clavulanic acid (98%) and Ceftazidime (88%). Sensitivity against fluoroquinolones like Ciprofloxacin and Levofloxacin was only 56% and 67% respectively. All other significant gram negative bacteria like *Klebsiella species* and *Escherichia coli* also showed highest sensitivity to amikacin, tobramycin, cefaperazone sulbactum, Piperacillin tazobactum, ceftriaxone clavulanic acid, Cefotaxime, Ceftriaxone and Ceftazidime. All gram-negative bacteria showed least sensitivity to ciprofloxacin, ofloxacin, amoxicillin clavulanic acid and cotrimoxazole. In case of *Stapylococcus aureus* the second most common bacteria causing CSOM had highest sensitivity to amikacin (98%), Cefaperazone sulbactum (88%), Piperacillin tazobactum (83%), vancomycin (97%) and linezolid (98%) and least sensitivity to cotrimoxazole and ciprofloxacin.

10% of *Staphylococcus aureus* isolated in our study was found to be methicillin resistant. Increasing antibiotic resistance of gram negative bacteria to third generation cephalosporins was also observed. 21% Extended spectrum beta lactamases (ESBL) producing gram negative bacilli was also demonstrated in our study.

Comparison of sensitivity of amikacin and ciprofloxacin in most commonly isolated bacteria is as follows-The antibiotic sensitivity of *Pseudomonas aeruginosa* to Amikacin and Ciprofloxacin is 98% and 56% respectively. Similarly, the antibiotic sensitivity of *Staphylococcus aureus* to Amikacin and Ciprofloxacin is 98% and 23% respectively.

In our hospital, most commonly used antibiotic for local and systemic treatment of CSOM patients is ciprofloxacin and ofloxacin for which antibiotic resistance is found to be increasing. Based on the antibiotic sensitivity pattern for all gram-negative bacteria isolated in CSOM cases Amikacin is the most preferable antibiotic which shall be used widely in our hospital.

In chronic recurrent CSOM cases caused by gram negative bacteria with impending complications most preferable antibiotics would be third generation cephalosporins and combination of antibiotics like Cefaperazone sulbactum, Piperacillin tazobactum. As most of the gram negative bacterial isolates were resistant to fluoroquinolones, empirical use of the same is not advised.

In case of *Staphylococcus aureus* strains, Amikacin can be administered along with beta lactam antibiotics. In severe cases caused by Methicillin Resistant *Staphylococcus aureus* Vancomycin and linezolid were preferred. Gram positive bacteria also showed increasing resistance against ciprofloxacin.

The most sensitive antibiotic for all organisms is Amikacin and the least sensitive antibiotic is cotrimoxazole followed by ciprofloxacin. Ototoxicity of antibiotics administered is also an important issue in cases of CSOM. Tobramycin and Vancomycin have increased ototoxicity and associated with both vestibular and cochlear toxicity whereas Amikacin has less toxic effect and it is associated only with cochlear toxicity. Hence Amikacin is more preferable for treatment than other ototoxic antibiotics and is also cost effective.

The second most sensitive antibiotic is Cefoperazone - sulbactam combination followed by Piperacillin - tazobactam and Ceftriaxone clavulanic acid. In our region, gram positive organisms (*Staphylococcus aureus, coagulase negative staphylococcus species*) also play a major role in causing CSOM. It may be due to the seasonal variation. Mixed growth is also taken in to consideration in this study. The prescription of Amikacin is cheaper

and is the most sensitive antibiotic for all the bacteria isolated in our study.

Conclusion

The most commonly used topical antibiotics like Ofloxacin and Ciprofloxacin were showing increasing resistance for both gram positive and gram negative bacteria. The emergence of drug resistant strains like ESBL, MRSA and increasing resistance to gram negative bacilli and gram positive cocci were analysed and routine use of fluoroquinolones as most preferred antibiotic in our Institution for CSOM is not advised. Unhygienic practices and lack of sanitation measures play an important role in pathogenesis of CSOM. Proper health education on cleanliness and sanitation shall be provided to all cases.

Both gram positive and gram negative organisms play equal role in etiology of CSOM infection in our location. Amikacin which is active against all etiologic bacteria causing CSOM shall be prescribed. Combination of amikacin with beta lactam antibiotics in case of gram positive bacteria and in severe cases is emphasised. Proper appropriate use of antibiotics and the importance of completion of full course of antibiotic treatment shall be strictly emphasised. Continuous and periodic evaluation of Microbiological pattern and their antibiotic sensitivity are essential to decrease the impending risk of complications by early institution of appropriate treatment.

Abbreviations:

CSOM - Chronic Suppurative Otitis media
ENT OP- Ear, nose, throat out patients
SDA - Sabouraud's Dextrose Agar
WHO - World Health Organisation
CONS - Coagulase Negative *Staphylococcus aureus*
ESBL – Extended spectrum beta lactamases
MRSA – Methicillin resistant *Staphylococcus aureus*

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