Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2014; 2(5B):1606-1612 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com **DOI:** 10.36347/sjams.2014.v02i05.021

Research Article

A Study of Bacterial Profile and Antibiotic Susceptibility Pattern of Chronic Suppurative Otitis Media among Patients attending a Tertiary Care Centre, Davangere

KG Raghu Kumar[1*], S Navya[2], KG Basavarajappa[3]
[1]Associate Professor, [3]Professor and Head, Department of Microbiology, [2]Under Graduate Student, MBBS Phase-III;
S S Institute of Medical Sciences and Research Centre, Jnana shankara, NH-4 Bypass Road, Davangere-577005, India

***Corresponding author**
Dr. Raghu Kumar. K.G
Email: drraghukumarkg@yahoo.in

Abstract: Chronic Suppurative Otitis Media (CSOM) is a potentially serious disease because of its complications. The incidence of CSOM is increasing in the developing countries because of the poor hygiene practices and lack of health education. Knowledge of bacterial etiolgy of CSOM and their antibiotic susceptibility pattern prevalent in a community is very important for the clinicians for appropriate management of the cases and to prevent or minimise the occurrence of complications. The aim of this study was to determine the bacterial pathogens associated with CSOM and to study their antimicrobial susceptibility pattern from Davangere and its surrounding region. The study was carried out in a tertiary care centre in Davangere from June 2013 to November 2013 for a period of six months. The ear discharges from 118 patients with a clinical diagnosis of CSOM were collected and were subjected to aerobic culture & sensitivity. Out of 118 ear discharge samples cultured, 90(76.27%) samples yielded pure cultures, 16(13.56%) yielded mixed cultures while 12 samples (10.17 %) yielded no growth. From 90 pure isolates, the most common was Pseudomonas species (spp)(42.22%) followed by Staphylococcus aureus(34.44%). Drug sensitivities pattern among pure isolates showed that Cefoperazone was active against majority 89.47%. Pseudomonas isolates followed by Piperacillin 86.84% and Amikacin and Gentamicin in 84.21% cases, while Ofloxacin and Ciprofloxacin were effective against 50.0% and 47.37% isolates respectively. Staphylococcus aureus were sensitive to Amikacin in 90.32% of cases, Gentamicin, Cefoperazone and Piperacillin 83.87%, Ofloxacin 80.65%, and Erythromicin and Ciprofloxacin in 67.74% isolates, whereas only 12.90% and 16.13% isolates showed sensitivity to Ampicillin and Amoxyclav respectively. Pseudomonas spp is the most commonly isolated bacteria followed by Staphylococcus aureus in CSOM from our region. Majority of the isolates of Pseudomonas spp and Staphylococcus aureus isolates are sensitive to Amikacin, Gentamicin, Piperacillin, and Cefoperazone .Pseudomonas spp is becoming gradually resistant to Fluoroquinolones, while majority of the Staphylococcus aureus isolates are resistant to Penicillin drugs.
Keywords: Pure culture, Mixed culture, Antibiotic susceptibility, Chronic Suppurative Otitis media (CSOM), Davangere

INTRODUCTION

Chronic Suppurative Otitis Media (CSOM) is a chronic inflammation of middle ear and mastoid cavity that may present with recurrent ear discharges or otorrhoea through a tympanic perforation [1]. It is a disease of multiple etiology and is well known for its persistence and recurrence inspite of treatment [2]. Although the development of CSOM may follow an acute infection,the type of organisms found in chronic discharge differs from those in acute infections. The commonest organisms isolated from CSOM are *Pseudomonas aeruginosa*, Proteus species (spp) and *Staphylococcus aureus*. Other organisms found less commonly are *Escherichia coli* (E coli), Diphtheroid, Klebsiella spp and anaerobic bacteroides [3] .

Infection can spread from middle- ear to vital structures such as mastoid, facial nerve, labyrinth, lateral sinus, meninges and brain leading to mastoid abscess, facial nerve paralysis, deafness, lateral sinus thrombosis, meningitis and intracranial abscess. Of all the complications, hearing loss but preventable type is nearly always significant particularly in the developing world and a reason of serious concern, particularly in children, because it may have long- term effects on early communication, language development, auditory processing, educational process and physiological and cognitive development [4]. The study of bacteriology and drug sensitivity is necessary to enable the treating family physician to plan the general management of CSOM and it is almost essential for the ENT surgeon to make the discharging ear dry for better results of

myringoplasty and ossiculoplasty. However, the antibiogram of these organisms causing CSOM has been reported to vary with time and geographical area as well as continent to continent probably due to indiscriminate use of the antibiotics [5, 6].

To the best of our knowledge, no information is available on the type of bacteria associated with CSOM and their antibiotic susceptibility pattern from Davangere and its surrounding region. Therefore, this study was conducted to know the trend of prevalence and antibiogram profile of bacterial agents of CSOM from Davangere and its surrounding region.

MATERIALS AND METHODS

This hospital based prospective study was conducted for a period of six months from June 2013 to November 2013 in the Department of Microbiology, S S Institute of Medical Sciences & Research Centre (SSIMS&RC), Davangere, which is a dedicated tertiary care centre located in central Karnataka ,India.

A total of 118 patients belonging to age groups 0 to 70 years and of both sex who were clinically diagnosed of CSOM were included in the study [7]. Patients using topical or systemic antibiotics for the last 7 days were excluded from the study [4]. Well informed consent was taken from patients/parents explaining the procedure, its risks and benefits and the study was approved by the Institutional Ethics Committee. Ear discharges were collected using sterile swab sticks which were properly labelled for each patient. The swab sticks were taken to Microbiology Laboratory for analysis.

The swabs were plated on MacConkey agar, Blood agar and Chocolate agar and incubated aerobically at 37^0C for 24 hours. The organisms were identified according to standard microbiological procedures [8]. All isolated strains were tested for susceptibility to antibiotics on Mueller Hinton Agar using Kirby Bauer disc diffusion method. Results were interpreted using Clinical Laboratory Standards Institute (CLSI) guidelines [9]. All dehydrated media, reagents and antibiotic discs were procured from Microxpress, Tulip Diagnostics (P) Ltd., Goa, India.

RESULTS

Out of 118 ear swabs processed, 90(76.27%) samples showed pure culture, 16(13.56%) samples showed mixed culture .No growth was reported in 12(10.17%) samples. The mean age of the patients with bacteriological growth was 28.14 and the peak incidence of growth was observed in the age group between 11 years and 30 years (46.23%) (Table 1). Sex-wise distribution of the patients with bacteriological growth were 66(62.26%) males and 40(37.74%) females and the sex ratio male: female was 1.65:1. A total of 122 bacterial isolates identified out of which 70(57.38%) were Gram negative and 52(42.62%) of Gram positive bacteria (Table 2).

Bacteria isolated from pure cultures were Pseudomonas spp (38/90) in 42.22%, *Staphylococcus aureus* in 34.44% (31/90), Klebsiella spp in 6.67% (06/90), Proteus spp in 4.44% (04/90), Acinetobacter spp in 4.44% (04/90), Coagulase Negative Staphylococci (CONS) in 3.33% (03/90), *E. coli* in 2.22% (02/90), Enterococci in 1.11% (01/90) and Diphtheroids in 1.11% (01/90).

Mixed cultures were isolated in 16(13.56%) of 118 ear samples. Combinations included Pseudomonas spp and *Staphylococcus aureus* in 50% (8/16), *Staphylococcus aureus* and Acinetobacter spp in 18.75% (3/16), *Staphylococcus aureus* and Klebsiella spp in 12.5% (2/16), Klebsiella spp and Diphtheroids in 6.25% (1/16), Proteus spp and CONS in 6.25% (1/16) and Klebsiella spp with CONS in 6.25%(1/16)(Table 3).

The antimicrobial sensitivity testing was carried out for 89 pure isolates as 01 isolate was identified as Diphtheroid. Results of sensitivity testing were shown in Table 4. Majority of these isolates showed sensitivity to Amikacin (87.64%). Gentamicin, Cefoperazone and Piperacillin were equally effective (86.52%). Majority of the isolates showed resistance to Ampicillin (13.48%) and Amoxyclav(16.85%).

Table1: Age-wise distribution of culture pattern in CSOM among patients attending a Tertiary Care Centre, Davangere

Age (yrs)	Culture Pattern			Total
	Pure	Mixed	Sterile	
0-10	15	0	2	17
11-20	20	2	3	25
21-30	21	6	3	30
31-40	16	4	2	22
41-50	4	2	2	8
51-60	11	0	0	11
61-70	3	2	0	5
Total	90 (76.27%)	16(13.56%)	12(10.17%)	118(100%)

Table 2: Gram Reactivity of bacterial isolates in CSOM among patients attending a Tertiary Care Centre, Davangere

Gram reactivity	No .of isolates	Percent
Gram positive bacteria	52	42.62%
Gram negative bacteria	70	57.38%
Total	122	100%

Table 3: Bacteriology of ear discharge samples (n=89) in CSOM among patients attending a Tertiary Care Centre, Davangere

Cultures	Isolated bacterial pathogens	Total	Percent
Pure	Pseudomonas spp	38	42.22
	Staphylococcus aureus	31	34.44
	Klebsella spp	06	6.67
	Proteus spp	04	4.44
	Acinetobacter spp	04	4.44
	Coagulase-Negative Staphylococci	03	3.33
	Escherichia coli	02	2.22
	Enterococci	01	1.11
	Diphtheroids	01	1.11
	Total	90	76.27%
Mixed	Pseudomonas spp and *Staphylococcus aureus*	08	50
	Staphylococcus aureus and Acinetobacter spp	03	18.75
	Staphylococcus aureus and Klebsiella spp	02	12.5
	Klebsiella spp and Diphtheroids	01	6.25
	Proteus spp and Coagulase Negative Staphylococci	01	6.25
	Klebsiella spp and Coagulase Negative Staphylococci	01	6.25
	Total	16	13.56%
No growth		12	10.17 %
Total		118	100%

DISCUSSION

CSOM takes a lot of time in the hospital outdoors and a considerable amount of O.T. timings [10]. It is a destructive disease with irreversible sequelae and its importance lies in its chronicity and its serious intracranial and or extracranial complications [11]. Both Gram positive and negative organisms are responsible for infection of the middle ear [5]. It is common in infants and children especially among low socio-econimic society and is more prevalent in the rural community [4, 12]. Topical antibiotics and aural toilet are the mainstays of medical management of CSOM, which is essential in attaining a dry ear [13].

In the present study, Pure culture was obtained in 90(76.27%) samples, 16(13.56%) samples yielded mixed culture, whereas 12(10.17%) showed no growth. Similar studies by other investigators showed the corresponding figures to vary significantly [3, 4, 7, 13]. Loy *et al*. [14] from Singapore in their study on 90 ear discharge samples revealed that 63.3% of them were pure and 34.44% were mixed cultures and 2.2% no growth where as Kumar *et al*., [15] from India in their study on 70 ear samples found pure growth from 60, mixed growth from 06 and no growth in 04 samples. It could be due to the complex relationship between pathogen and host in the middle ear which cannot be detected by traditional culture techniques [7].

Analysis of the bacteriology culture results from our study found pure culture to be more common (76.27%) and this observation is supported by many other investigators [11, 16-18]. However, some investigators found mixed culture more prominently associated with CSOM [19, 20].

Age-wise distribution of prevalence of culture positive cases of CSOM revealed that it was more common in young populations. Most developing countries have predominantly young populations in whom CSOM is most prevalent. CSOM can affect paediatric and adult groups [7]. This is in agreement with study reported by Prakash *et al*. [4]. In this study, Culture positive results were more common in males (62.26%) than in females (37.74%) and the male: female ratio was found to be 1.65:1. As per literature search, no data is available on the sex distribution in association with bacteriological growth in CSOM, although many reports have been published showing the relation of sex variable with clinically diagnosed CSOM cases. Patients trend showed male predominance in our study. This may be related to their more exposed way of life [21] .It is seen that Gram negative bacteria(57.38%) are responsible more than Gram positive bacteria(42.62%) for infection of the middle ear in the present study. The findings of predominant Gram negative bacilli is in tandem with many previous investigators [11, 13, 22] .The predominance of Gram negative aerobes indicate that the nasopharynx is not the source of infection, as it does not contain these organisms [23].

Table 4: Antibiotic Sensitivity Pattern of bacterial isolates (n=89) CSOM among patients attending a Tertiary Care Centre, Davangere

Types and number of isolates	Antibiotics tested										
	AMP (%)	**AMC (%)**	**GEN (%)**	**AK (%)**	**OF (%)**	**E (%)**	**CTR (%)**	**COT (%)**	**CIP (%)**	**CPZ (%)**	**PI (%)**
Pseudomonas spp (n=38)	05 (13.16)	07 (18.42)	32 (84.21)	32 (84.21)	19 (50.0)	16 (42.11)	19 (50.0)	18 (47.37)	18 (47.37)	34 (89.47)	33 (86.84)
Staphylococcus aureus (n=31)	04 (12.90)	05 (16.13)	26 (83.87)	28 (90.32)	25 (80.65)	21 (67.74)	18 (58.07)	17 (54.84)	21 (67.74)	26 (83.87)	26 (83.87)
Klebsiella spp (n=06)	02 (33.3)	01 (16.67)	06 (100.0)	06 (100.0)	04 (66.67)	04 (66.67)	04 (66.67)	02 (33.33)	05 (83.33)	05 (83.33)	06 (100.0)
Proteus spp (n=04)	01 (25.0)	01 (25.0)	03 (75.0)	04 (100.0)	04 (100.0)	02 (50.0)	02 (50.0)	04 (100.0)	03 (75.0)	04 (100.0)	04 (100.0)
Acinetobacter spp(n=04)	00 (0)	01 (25.0)	04 (100.0)	03 (75.0)	02 (50.0)	02 (50.0)	02 (50.0)	03 (75.0)	03 (75.0)	02 (50.0)	02 (50.0)
CONS (n=03)	00 (0)	00 (0)	03 (100.0)	02 (66.67)	02 (66.67)	02 (66.67)	02 (66.67)	01 (33.3)	02 (66.67)	03 (100.0)	03 (100.0)
E. coli (n=02)	00 (0)	00 (0)	02 (100.0)	02 (100.0)	02 (100.0)	00 (0)	02 (100.0)	01 (50.0)	01 (50.0)	02 (100.0)	02 (100.0)
Enterococci (n=01)	00 (0)	00 (0)	01 (100.0)	01 (100.0)	01 (100.0)	00 (0)	00 (0)	00 (0)	01 (100.0)	01 (100.0)	01 (100.0)

AMP: Ampicillin; AMC: Amoxycillin/ Clavulanic acid; GEN: Gentamycin; AK: Amikacin; OF: Ofloxacin; E: Erythromycin; CTR: Ceftriaxone; COT: Co-Trimoxazole; CIP: Ciprofloxacin; CPZ: Cefoperazone; PI: Piperacillin

Pseudomonas spp was the most predominant organism causing CSOM in this region and this is in agreement with many previous investigators [3, 11, 16, 24]. In CSOM, the middle- ear environment is thought to be more tolerant to unusual organisms like Pseudomonas spp; therefore it is still uncertain whether this organism is a true pathogen in CSOM or might reflect secondary invaders or contamination from the external auditory canal [25]. In CSOM, intense Secretory Immunoglobulin A (SIgA) and Immunoglobulin G(IgG) coating of bacteria is common but when Pseudomonas spp is the causative agent of the infection, no bacterial coating is seen and thence difficult to eradicate [26, 27]. *Staphylococcus aureus* (34.44%) was found to be the next most common isolate in our study and is in accordance with earlier investigators [3, 5, 16, 24]. Several investigators reported Staphylococcus aureus as the most prevalent bacterial agent in CSOM [2, 4, 17, 28]. The frequency of Staphylococcus aureus in middle ear infections can be attributed to their ubiquitious nature and high carriage of resistant strains in the external auditory canal and upper respiratory tract [28].

CONS were isolated from 3.33% ears. This organism was also isolated frequently from CSOM cases by several investigators [14, 17, 28]. Although CONS are generally considered as non-pathogenic, their association in CSOM 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 [28]. In the present study, 50% CONS were isolated from mixed infection with Proteus spp and Klebsiella spp each. Diphtheroids were isolated from 1.11% of pure isolates. This organism may represent skin flora contamination and not be a true pathogen [29].

Coliforms including Klebsiella spp and E coli were isolated from 6.67% and 2.22% cases respectively. Rama Rao *et al*. [28], Shymala *et al*. [16] and Poorey *et al*. [11] reported fairly common occurrence of coliforms in CSOM. More frequent isolation of fecal bacteria like *E. coli*, Klebsiella spp and water bacteria like Pseudomonas spp indicates that individuals are at high-risk of infection due to poor hygiene conditions [4].

All the pathogenic isolates (Except for 01 isolate of Diphtheroid) from the pure cultures in the present study were tested against various antibiotics. Amikacin was found to be the most effective drug followed by Gentamicin, Cefoperazone and Piperacillin. The report is in close association with many investigators [3, 5, 30].

However, different investigators reported different sensitivity patterns in similar studies [7, 12, 28]. Majority 80-90% of CSOM isolates in the present study showed resistance to Ampicillin and Amoxyclav. This is in line with some investigators [15, 17]. Malkappa *et al*. [5] reported resistance to amoxicillin in 90% of cases where as Loy *et al* . [14] reported that Penicillin and Ampicillin was active only against 10% of Staphylococcus aureus isolates. Similarly Indudharan *et al*. [13] also reported that Pseudomonas spp and Staphylococcus aureus were highly resistant to Ampicillin. One reason for this could be the fact that most of these patients usually present in the ENT OPD after the previous treatments have failed .Another important factor is that the cultures are mostly requested when commonly used drugs have failed to eradicate infection [3].

While Pseudomonas spp,the most common pathogen is sensitive to Cefoperazone, Pipericillin, Amikacin, and Gentamicin and Staphylococcus aureus, the second most common pathogen is sensitive to Amikacin, Gentamicin, Piperacillin, Cefoperazone, Ofloxacin, Erythromycin, Ciprofloxacin. Only Ciprofloxacin, Gentamicin and Ofloxacin are commonly available as topical preparations for use in the ear. The majority of the remaining organisms were also highly sensitive to Gentamicin. However, Ofloxacin and Ciprofloxacin sensitivities are 50.0 % and 47.37% respectively for Pseudomonas spp, the major pathogen. .Hence of the commonly available ear drops, Ofloxacin and Ciprofloxacin are not effective in CSOM leaving only Gentamicin for routine use. Some investigators reported a high invitro activity of the fluorinated quinolones against Pseudomonas spp [4, 7, 13, 31].

Our study suggests that Amikacin, Cefoperazone, and Piperacillin are best choices in these cases associated with complications, where the situation demands the use of a systemic antibiotic. One important fact to be kept in mind is that the antibiotic susceptibility pattern of the CSOM causing organisms keep changing.

The present study has limitation in that the need for anaerobic culture methods and the role of anaerobes in CSOM were not investigated.

CONCLUSION

Pseudomonas spp and Staphylococcus aureus continue to be the major offending pathogens in CSOM. These organisms are increasingly becoming resistant to the common and routine antibiotics like fluoroquinolones and penicillin group drugs. Hence, where possible and available, antibiotic susceptibility tests should guide the management of CSOM in this region. Otherwise, Gentamicin if indicated, as ototopical drops as well as Amikacin, Cefoperazone and Piperacillin may provide rapid relief and delay emergence of drug resistant strains.

ACKNOWLEDGEMENT

We gratefully acknowledge the help from The Professor and Head, other Teaching staff and

PostGraduate students, Dept. of ENT, S S Institute of Medical Sciences and Research Centre, Davangere, India in the facilitation of this study.

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