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Present scenario of microbiological pattern in chronic suppurative otitis media and its management guidelines

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Abstract:

AIMS: Chronic suppurative otitis media (CSOM) is a common infectious chronic ear disease in India resulting in serious complications, especially hearing impairment. Irrational use of antibiotics for its management has led to the emergence of multidrug-resistant bacterial strains. Considering this, this study was conducted to know the pattern of causative organisms associated with CSOM and their antimicrobial sensitivity.

MATERIALS AND METHODS: Ear discharge from 200 clinically diagnosed cases of CSOM was collected by suction using sterile techniques in a sterilised test tube on wash bottle principle consisting of a glass tube made air tight with the help of a cork with an inlet and outlet facility. All samples were processed in the department of microbiology for the identification of bacterial and fungal isolates and their antimicrobial sensitivity testing.

RESULTS: Among the 200 samples of ear discharge, 127 were from ear having tubotympanic (mucosal or safe) type of CSOM while 73 were from ear with attico-antral (squamosal or unsafe) CSOM. Among aerobic isolates, *Pseudomonas aeruginosa* (35%) was most common followed by *Staphylococcus aureus*. Other aerobes isolated were Klebsiella spp., coagulase-negative Staphylococcus, Proteus spp. and *Escherichia coli.* Fungus was isolated in tubotympanic (9.45%) CSOM only. Among anaerobic isolates, Peptostreptococcus (1%) was most common.

CONCLUSION: Monomicrobial isolates, especially *P. aeruginosa* and Staphylococcus species, were found to be most common in our study. Therefore, evaluation of microbiological pattern and their antibiotic sensitivity pattern in local area becomes helpful in prescribing empirical antibiotics for successful treatment of CSOM.

Keywords:

Antibiotic sensitivity, attico-antral (squamosal), chronic suppurative otitis media, ear discharge, tubotympanic (mucosal)

Introduction

Chronic suppurative otitis media (CSOM) is defined as a chronic inflammation of middle ear and mastoid cavity that may present with recurrent ear discharge or otorrhoea through a tympanic perforation.[1] Incidence of this disease is higher in developing countries, especially among low socioeconomic society because of malnutrition, overcrowding, poor hygiene, inadequate healthcare and recurrent upper respiratory tract infections (URTIs).[2] Prevalence of CSOM in India according to the WHO reports is 7.8% which puts India amongst the group with highest prevalence and hence demands urgent attention to deal with a massive public health problem.[1]

CSOM is usually classified into two types, tubotympanic and attico-antral, depending on whether the disease process affects the pars tensa or pars flaccida of the tympanic membrane.[2] Tubotympanic CSOM is also known as mucosal (safe)

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disease. The infection is limited to the mucosa and the anteroinferior part of the middle ear cleft, hence the name.[3,4] Attico-antral type of CSOM is termed as squamosal (unsafe) disease because dangerous intra- and extra-cranial complications such as mastoiditis, facial nerve paralysis, labyrinthitis, lateral sinus thrombosis, meningitis and brain abscess[5,6] can occur, proving fatal to the patient.

CSOM typically produces a mild-to-moderate conductive hearing loss.[7] In India, 77% of cases of CSOM were reported to have hearing impairment.[1] Of all the complications, hearing loss associated with chronic ear discharge is nearly always significant and tending to be more severe than those reported in other types of otitis media.[8]

Various microorganisms found in ear discharge from CSOM include *Pseudomonas aeruginosa*, Proteus, *Staphylococcus aureus* and *Escherichia coli*, but fungi and anaerobes can also be a cause of CSOM. The microbiological flora of CSOM varies from place to place depending on the type of otitis media, use of antibiotics in that area and many other factors. The irrational and injudicious use of antibiotics has led to the emergence of multidrug-resistant bacterial strains and disease complications in return.[9]

The study of bacteriology and drug sensitivity is thus necessary 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.[10] Considering the emergence of bacterial resistance and the availability of a wide spectrum of newer antimicrobial agents, this study was conducted to know the pattern of microbes causing CSOM and the antimicrobial sensitivity of the isolates and thus have an insight into a more rational management of the disease and forming a protocol in this part of the country.

Materials and Methods

A prospective observational study was carried out in the Department of ENT, RL Eye and ENT Hospital, Amritsar, in collaboration with the Department of Microbiology, Government Medical College, Amritsar. From March 2014 to August 2015, a total of 200 patients of all age groups and both genders, clinically diagnosed as CSOM, were included in the study and categorised into tubotympanic and attico-antral types of CSOM on the basis of history and clinical findings. Patients on antibiotics or antifungal drugs for more than 7 days before presenting to the ENT outpatient department and patients who had otomycosis, otitis externa, acute suppurative otitis media, diabetes mellitus and other immunocompromised states were excluded from the study.

After obtaining informed consent from the patients, relevant information regarding age, sex, nature of discharge, duration of ear discharge and any antibiotic treatment taken was noted in a structured pro forma.

Two days before the collection of the discharge, aural toilet and cleaning of external auditory canal was done with spirit. Introitus of the external auditory canal was plugged with a sterilised cotton ball. The discharge was collected in a sterilised test tube (without contamination) on wash bottle principle consisting of a glass tube made air-tight with the help of a cork with an inlet and outlet facility plugged and connected with two rubber tubes. One tube was longer while the other was shorter. The latter was attached to the tube of a suction apparatus while the former was attached to a suction tip [Figures 1 and 2]. Specimens so collected were sent for culture and sensitivity to the department of microbiology, without any delay.

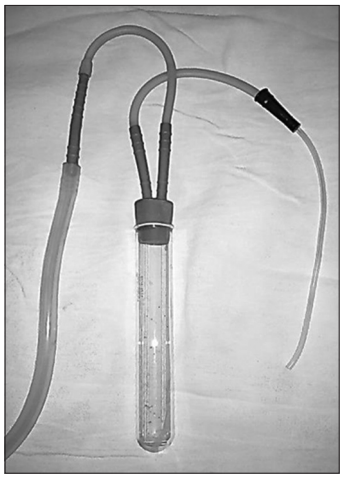

Figure 1: Sterilised test tube with its attachments for sample collection

Figure 2: Suction apparatus with attached sterilised test tube

All specimens were processed for the identification of aerobes, anaerobes and fungal isolates. One part of specimen was inoculated onto 5% sheep blood agar, chocolate agar and MacConkey agar plates for the growth of aerobic and facultative organisms. The plates were incubated at 37°C aerobically (MacConkey) and under 5% carbon dioxide (5% sheep blood and chocolate agar) and examined at 24 and 48 h. For anaerobes, the material was inoculated onto blood agar plate from thioglycolate broth and incubated at 37°C in anaerobic jars (GasPak jar) and examined at 48 and 96 h. Culture isolates were identified and characterised by standard microbiological methods.[11] Antimicrobial susceptibility testing of the isolates was performed on Mueller Hinton agar by Kirby-Bauer disc diffusion method [Figure 3] as per the Clinical and Laboratory Standards Institute (CLSI) guidelines.[11]

The following antimicrobial discs were used (Hi-Media).

- For Gram-positive organisms: Ampicillin, Amoxicillin/Clavulanic acid, Cotrimoxazole, Gentamicin, Erythromycin, Cephalexin, Linezolid and Vancomycin
- For Gram-negative organisms: Amikacin, Gentamicin, Ciprofloxacin, Piperacillin, Piperacillin + Tazobactam, Cefotaxime, Cefotaxime + Sulbactam, Imipenem and Meropenem
- For methicillin-resistant *S. aureus* (MRSA)/methicillin-sensitive *S. aureus*: Cefoxitin disc diffusion method was used as per the CLSI guidelines.[11]

Fungal growth obtained was processed by direct microscopic examination with potassium hydroxide preparation followed by inoculation on two tubes of modified Sabouraud's dextrose agar. Lactophenol cotton blue mount was made from growth on culture media to study morphological features of fungal isolates.

Antifungal susceptibility testing of yeast isolates was performed by disc diffusion method using Fluconazole (25 µg/Ml), Itraconazole (10 µg/Ml) and Amphotericin B as per the CLSI guidelines.

The patients were given treatment based on clinical diagnosis initially and followed up 1 week later with culture and sensitivity reports. The treatment was reviewed then and changed if needed according to the reports of culture. Follow-up was done weekly up to 4 weeks, and patients not improving despite accurate treatment were taken up for surgery.

Results

In our study, age group of patients ranged from 0 to 90 years (mean age = 32.24 years). Maximum incidence of CSOM was observed in patients of 11–20 years' age group (27.5%) [Table 1]. Out of the 200 patients, 103 patients (51.5%) were from rural area and 97 (48.5%) were from urban area. Decreased hearing was the main associated symptom seen in 98 patients (49%). Other symptoms associated were pain and tinnitus [Table 2]. In this study, 90 patients (45%) had slight hearing loss of 26–40 dB and moderate hearing loss was observed in 74 patients (37%) [Table 3].

In our study of 200 patients, 127 patients (63.5%) had tubotympanic type of CSOM while 73 patients (36.5%) had attico-antral type of CSOM. Microbial growth was obtained in 170 (85%) samples, being monomicrobial in 162 (95.29%) while mixed growth was obtained in 8 (4.70%) samples.

Among 127 patients of tubotympanic CSOM, the most common isolates were *P. aeruginosa* (31.49%) and *S. aureus* (30.71%) followed by *E. coli* (3.15%), Proteus (3.15%) and coagulase-negative Staphylococci (CONS) (1.57%). No growth was observed in 17 (13.39%) samples. Among 73 patients of attico-antral-type CSOM, the major isolate was *P. aeruginosa* (41.09%) followed by

Table 1: Age distribution in samples from all patients of chronic suppurative otitis media

Age (years)	Number of patients (%)
0-10	4 (2)
11-20	55 (27.5)
21-30	48 (24)
31-40	43 (21.5)
41-50	22 (11)
51-60	8 (4)
61-70	16 (8)
71-80	0
81-90	4 (2)
91-100	0
Total	200 (100)

Table 2: Associated symptoms in all patients with ear discharge

Symptoms	Number of patients (%)
Decreased hearing	98 (49)
Tinnitus	56 (28)
Pain	13 (6.5)
None	33 (16.5)
Total	200 (100)

Table 3: Results of pure tone audiometry in all patients of chronic suppurative otitis media

Hearing loss in PTA	Number of patients (%)
Up to 25 dB: Normal	36 (18)
26-40 dB: Slight	90 (45)
41-60 dB: Moderate	74 (37)
61-80 dB: Severe	0
>80 dB: Profound	0
Total	200 (100)

PTA: Pure tone audiometry

S. aureus (20.54%), CONS (8.22%), *Proteus mirabilis* (5.48%) and *E. coli* (5.48%). In attico-antral type of CSOM, all cultures yielded pure isolates. Fungal positivity was observed in 12 (9.45%) cases of tubotympanic CSOM only. *Candida albicans* was predominantly isolated in ten cases while *Candida tropicalis* was isolated in two cases. No fungal growth was seen in attico-antral disease. Anaerobes were isolated in two samples (1%), one each in tubotympanic (0.078%) and attico-antral (0.13%) type of CSOM. In both the samples, the isolate was Peptostreptococcus [Table 4].

All the Gram-positive isolates showed maximum sensitivity to Vancomycin (100%), Linezolid (100%), Amoxycillin/Clavulanic acid, Erythromycin and Amikacin. Maximum resistance was seen to Ampicillin and Cotrimoxazole. No case of MRSA was observed. Majority of the Gram-negative bacilli showed maximum sensitivity to Imipenem (100%), Meropenem (100%), Piperacillin + Sulbactam, Cefotaxime + Sulbactam, Piperacillin and Amikacin. Gentamicin, Ciprofloxacin and Cefotaxime showed low sensitivity to isolates [Tables 5 and 6].

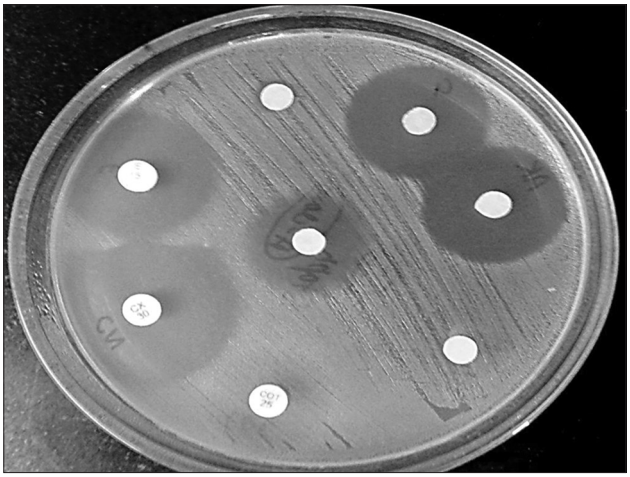

Figure 3: Antimicrobial sensitivity testing by disc diffusion method

Maximum sensitivity of *Candida* spp. was observed to Amphotericin B (100%), Nystatin (100%) and Itraconazole (83.3%). Fluconazole showed low sensitivity of 16.66%. In case of anaerobes, all Peptostreptococci were sensitive to Metronidazole [Table 7].

Discussion

CSOM is a major public health problem in developing countries causing serious local damage and life-threatening complications. It is a common cause of hearing impairment, disability and poor scholastic performance and can occasionally lead to fatal intracranial infections and other complications, especially in resource-poor countries.

In our study, maximum incidence of CSOM was observed in patients of 11–20 years' age group (27.5%) [Table 1]. The high-prevalence of CSOM in children may be attributed to the fact that they are more prone to URTIs. Furthermore, cold weather predisposes children to URTIs. Poor hygiene and unorthodox approach to treatment such as use of unconventional ear drops and concoctions such as oil and honey into the middle ear may initiate the proliferation of opportunistic pathogens leading to blockage of eustachian tube. A significant number of patients were from rural background. This is similar to a study done by Biswas *et al*. which shows higher rural incidence of the disease.[12] Poor socioeconomic condition, lack of education, lack of awareness about CSOM and inadequate knowledge about modes of treatment are also responsible for the occurrence and persistence of the disease in rural areas.

In 49% of patients, decreased hearing was the main associated symptom. This is in accordance with the study by Parry *et al*.[1,13] It also shows that CSOM affects hearing to a large extent.

Table 4: Different isolates in samples of ear discharge

Organism	Number of samples from tubotympanic (safe) type of CSOM	Percentage in (safe CSOM)	Number of samples from attico-antral (unsafe) type of CSOM	Percentage in (unsafe CSOM)
Pseudomonas aeruginosa	40	31.49	30	41.09
Staphylococcus aureus	39	30.71	15	20.54
Candida spp.	12	9.45	0	0
Klebsiella + Pseudomonas	5	3.94	0	0
Escherichia coli	4	3.15	4	5.48
Proteus spp.	4	3.15	4	5.48
Klebsiella + CONS	3	2.36	0	0
CONS	2	1.57	6	8.22
Anaerobes	1	0.78	1	1.37
No growth	17	13.39	13	17.80
Total	127	100	73	100

CONS: Coagulase-negative Staphylococci; CSOM: Chronic suppurative otitis media

Table 5: Antimicrobial susceptibility pattern of different Gram-positive and Gram-negative isolates from culture-positive cases of tubotympanic chronic suppurative otitis media

Gram-positive organisms	Sensitivity	A, *n* (%)	Ak, *n* (%)	G, *n* (%)	CF, *n* (%)	Cs, *n* (%)	CN, *n* (%)	COT, *n* (%)	E, *n* (%)	LZ, *n* (%)	Va, *n* (%)	A-CLAV, *n* (%)
Staphylococcus aureus (*n*=39)	S	14 (35.89)	36 (92.30)	27 (69.23)	28 (71.79)	28 (71.79)	39 (100)	14 (35.89)	32 (82.05)	39 (100)	39 (100)	37 (94.87)
	R	25 (64.11)	3 (7.7)	12 (30.77)	11 (28.21)	11 (28.21)	0	25 (64.11)	7 (17.95)	0	0	2 (5.13)
CONS (*n*=5)	S	2 (40)	5 (100)	4 (80)	3 (60)	3 (60)	5 (100)	2 (40)	4 (80)	5 (100)	5 (100)	5 (100)
	R	3 (60)	0	1 (20)	2 (40)	2 (40)	0	3 (60)	1 (20)	0	0	0

Gram-negative organisms	Sensitivity	Ak, *n* (%)	G, *n* (%)	CF, *n* (%)	Cefotaxime, *n* (%)	Cefotaxime + SB, *n* (%)	PC, *n* (%)	PCTZ, *n* (%)	IMP, *n* (%)	MERO, *n* (%)
Pseudomonas aeruginosa (*n*=45)	S	36 (80)	32 (71.1)	29 (64.4)	31 (68.8)	42 (93.3)	37 (82.2)	44 (97.7)	45 (100)	45 (100)
	R	9 (20)	13 (28.9)	16 (35.6)	14 (31.2)	3 (6.7)	8 (17.8)	1 (2.3)	0	0
Klebsiella spp. (*n*=8)	S	7 (87.5)	5 (62.5)	6 (75.00)	4 (50.00)	8 (100)	5 (62.5)	8 (100)	8 (100)	8 (100)
	R	1 (12.5)	3 (37.5)	2 (25.00)	4 (50.00)	0	3 (37.5)	0	0	0
Proteus spp. (*n*=4)	S	3 (75)	3 (75)	2 (50)	3 (75)	3 (75)	2 (50)	4 (100)	4 (100)	4 (100)
	R	1 (25)	1 (25)	2 (50)	1 (25)	1 (25)	2 (50)	0	0	0
Escherichia coli (*n*=4)	S	4 (100)	2 (50)	2 (50)	3 (75)	4 (100)	3 (75)	4 (100)	4 (100)	4 (100)
	R	0	0	2 (50)	1 (25)	0	1 (25)	0	0	0

PC: Piperacillin; PCTZ: Piperacillin + Tazobactam; IMP: Imipenem; MERO:Meropenem; A: Ampicillin; Ak: Amikacin; G: Gentamicin; E: Erythromycin; LZ: Linezolid; Va: Vancomycin; A-CLAV: Clavulanic acid; CF: Ciprofloxacin; SB: Sulbactam; Cs: Cephalexin; CN: Cefoxitin; COT: Cotrimoxazole; S: Sensitive; R: Resistant; CONS: Coagulase-negative Staphylococci

Table 6: Antimicrobial susceptibility pattern of different Gram-positive and Gram-negative isolates from culture-positive cases of squamosal chronic suppurative otitis media

Gram-positive organisms	Sensitivity	A, *n* (%)	Ak, *n* (%)	G, *n* (%)	CF, *n* (%)	Cs, n (%)	CN, *n* (%)	COT, *n* (%)	E, *n* (%)	LZ, *n* (%)	Va, *n* (%)	A-CLAV, *n* (%)
Staphylococcus aureus (*n*=15)	S	5 (33.33)	13 (86.66)	12 (80)	7 (46.67)	9 (60)	15 (100)	2 (13.33)	10 (66.66)	15 (100)	15 (100)	14 (93.33)
	R	10 (66.67)	2 (13.34)	3 (20)	8 (53.34)	6 (40)	0	13 (86.67)	5 (33.34)	0	0	1 (6.67)
CONS (*n*=6)	S	2 (33.33)	5 (83.33)	4 (66.66)	4 (66.66)	3 (50)	6 (100)	1 (16.66)	4 (66.66)	6 (100)	6 (100)	6 (100)
	R	4 (66.67)	1 (16.67)	2 (33.37)	2 (33.37)	3 (50)	0	5 (83.37)	2 (33.37)	0	0	0

Gram-negative organisms	Sensitivity	Ak, *n* (%)	G, *n* (%)	CF, *n* (%)	Cefotaxime, *n* (%)	Cefotaxime + SB, *n* (%)	PC, *n* (%)	PCTZ, *n* (%)	IMP, *n* (%)	MERO, *n* (%)
Pseudomonas aeruginosa (*n*=30)	S	24 (80)	21 (70)	14 (46.66)	21 (70)	26 (86.66)	22 (73.33)	28 (93.33)	30 (100)	30 (1000)
	R	6 (20)	9 (30)	16 (53.34)	9 (30)	4 (13.34)	8 (26.67)	2 (6.67)	0 (100)	0 (100)
Proteus (*n*=4)	S	3 (75)	2 (50)	2 (50)	3 (75)	3 (75)	3 (75)	4 (100)	4 (100)	4 (100)
	R	1 (25)	2 (50)	2 (50)	1 (25)	1 (25)	1 (25)	0	0	0
Escherichia coli (*n*=4)	S	3 (75)	2 (50)	2 (50)	2 (50)	3 (75)	3 (75)	4 (100)	4 (100)	4 (100)
	R	1 (25)	2 (50)	2 (50)	2 (50)	1 (25)	1 (25)	0	0	0

PC: Piperacillin; PCTZ: Piperacillin+Tazobactam; IMP: Imipenem; MERO: Meropenem; A: Ampicillin; Ak: Amikacin; G: Gentamicin; E: Erythromycin; LZ: Linezolid; Va: Vancomycin; A-CLAV: Clavulanic acid; CF: Ciprofloxacin; SB: Sulbactam; Cs: Cephalexin; CN: Cefoxitin; COT: Cotrimoxazole; S: Sensitive; R: Resistant; CONS: Coagulase-negative Staphylococci

Table 7: Antifungal susceptibility pattern of *Candida* spp. isolated

Antifungal	Sensitivity (%)
Amphotericin B	12 (100)
Fluconazole	2 (16.66)
Nystatin	12 (100)
Ketoconazole	3 (25)
Itraconazole	10 (83.33)

In our study of 200 patients, *Candida* spp. was observed in 12 (9.44%) out of 127 safe CSOM samples and none in 73 unsafe CSOM samples. Maximum sensitivity of *Candida* spp. was observed to Amphotericin B and Nystatin (100). CSOM: Chronic suppurative otitis media

In both types of CSOM, *P. aeruginosa* was the predominant microorganism isolated followed by *S. aureus.* A similar study by Raghu Kumar *et al*. in tubotympanic CSOM showed *P. aeruginosa* as the most common organism followed by Klebsiella spp. and *S. aureus*.[14] Other isolates in our study were *E. coli*, *Proteus mirabilis* and CONS. 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. Similar pattern of microbes was also seen in studies by Raghu Kumar *et al*.,[14] Khanna *et al*.[15] and Deb *et al*.[16]

C. albicans was the predominant fungal isolate in tubotympanic CSOM. Our study is in accordance with that of Harvinder *et al*.[17] which also showed predominant growth of *C. albicans*. Fungal culture positivity is most commonly seen in places where the weather conditions are hot and humid. In addition, prolonged use of topical antibiotics or antibiotic–steroid ear drops may cause suppression of bacterial flora and the subsequent emergence of fungal flora. Otologists should suspect mycotic otitis media in patients with continuous otorrhoea and who do not respond to the antibacterial treatment. Anaerobes were not significant pathogens in our study. Similar results were seen in studies done by Brook *et al*. and Shareef *et al*.[18,19]

Based on the antibiogram pattern in Gram-negative bacilli in both types of CSOM, *P. aeruginosa* showed 100% sensitivity to Imipenem and Meropenem followed by Piperacillin + Sulbactam (97.7%), Cefotaxime + Sulbactam (93.3%), Piperacillin (82.2%) and Amikacin (80%), but was found to be resistant to Ciprofloxacin (35.6%) and Cefotaxime (31.2%) and Gentamicin (28.9%). Other Gram-negative isolates showed similar pattern. Similar findings were reported by Madana and Tahir *et al*.[20,21] except for showing higher sensitivity for Ciprofloxacin of 90%–92%. Sensitivity for quinolones was 60%–70% in our study. Mirza *et al*.[22] found a sensitivity of 45% with Gentamicin and 48% for Amikacin. The declining sensitivity trend with quinolones in our study may be due to a number of factors including easy access, injudicious use such as inappropriate dose and duration and development of enzymatic resistance by organisms. *P. aeruginosa* is known to synthesise a biofilm which is responsible for its resistance to most commonly used antibiotics and thus it is an important organism in most chronic infections. It is becoming less sensitive against commonly used antimicrobials, namely Ciprofloxacin and Gentamicin.

S. aureus, the second most common isolate in both types of CSOM, showed maximum sensitivity to Vancomycin, Linezolid, Amikacin and Erythromycin. All the isolates of Staphylococci were sensitive to methicillin. No MRSA was isolated. Maximum resistance was seen to Ampicillin and Cotrimoxazole (60%–80%).

Conclusion

It can be concluded that CSOM is a major cause of acquired hearing impairment. Poorly treated or untreated CSOM can lead to many complications such as mastoiditis, meningitis and brain abscess. Our study showed a high prevalence of *P. aeruginosa* and *S. aureus* which were found to be resistant to quinolones, ß-lactams and other commonly used antimicrobials. The use of method of suction for collection of specimen of ear discharge helped to get a pure sample of middle ear discharge without contamination from external ear flora. As the microbial profile and antibiotic susceptibility pattern of the CSOM keep changing with the due course of time, evaluation of microbiological and antibiotic sensitivity pattern in local area is necessary in prescribing empirical antibiotics for successful treatment of chronic otitis media and thus minimising its complications and emergence of resistant strains.

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Conflicts of interest
There are no conflicts of interest.

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