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A study on microbial pattern & drug therapy of mucosal type of Chronic Suppurative Otitis Media in a Tertiary Care Hospital in Tamil Nadu, India

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Abstract

Background: Chronic suppurative otitis media (CSOM) is one of the most common infections and a major health issue in developing countries causing serious complications. Early and effective treatment based on the microbial pattern and appropriate antimicrobial agents ensures prompt recovery and prevents dreaded complications. The present study aims to isolate the organisms associated with mucosal type of CSOM and to detect the antibiogram of the isolates.

Materials & Methods: Samples were taken from 202 patients over a period of one year from mucosal type of CSOM patients. Gram staining, KOH mount, biochemical tests & culture sensitivity by modified Kirby Bauer disc diffusion method were carried out for identification and antibiotic susceptibility.

Results: The most common organisms isolated were Staphylococcus aureus (49.6%) and Pseudomonas aeruginosa (19.7%). Fungi accounted for 20.3% while 10.4% were anerobes. Antibiotic susceptibility revealed maximum sensitivity to Amikacin (83.3%), gentamicin (80%) and ceftriaxone (71%).

Conclusion: Proper knowledge of the causative organisms and their antibiotic susceptibility is of utmost importance in the effective treatment, thereby preventing complications and antibiotic resistance and reducing the economic burden on the care seekers.

Keywords: CSOM, microbes, antibiotic sensitivity

1. Introduction

Chronic suppurative otitis media (CSOM) is defined as "infection of middle ear and mastoid cavity that lasts more than 3 months and may present with recurrent ear discharges or otorrhoea through a tympanic perforation" [1]. Incidence of CSOM is higher in developing countries where malnutrition, poor hygiene, overcrowding, inadequate health care, and recurrent upper respiratory tract infection are prevalent [2]. The rural to urban ratio of the disease is 2:1 and the poorer rural communities have highest prevalence [3]. This infection has profound impact on the society in terms of resources utilized for treatment and direct impact the infection has on the hearing of the patient.

CSOM is classified into two types, tubotympanic and attico-antral depending on the part of tympanic membrane affected by the disease process. Tubotympanic also called as mucosal type and affect the pars tensa of the TM and there is no serious complication whereas, attico-antral also called as squamous type which affects the pars flaccida and is associated with cholesteatoma [4]. The infection can spread from middle-ear to important 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 [5, 6].

Hearing loss associated with CSOM is reported to be 50% which seems to be more severe than those reported in other types of otitis media [7].

Though complications associated with CSOM were frequent in the pre-antibiotic era, the irrational use of antibiotics led to the emergence of a number of multi-drug resistant bacterial strains and serious complications as well [8]. Hence a clear knowledge about the pathogens causing the CSOM can assist in choosing the appropriate antibiotic regimen, preventing the emergence of drug resistant strains and complications associated with it.

2. Materials & Methods

This was a prospective study conducted for a period of one year in a Tertiary Care Hospital in Tamil Nadu, India. Institutional Ethical Committee clearance obtained.

A total of 202 patients of all ages and either gender with safe type of CSOM diagnosed by otoscopic examination, who had not received antimicrobial therapy (topical or systemic) over the prior 14 days were included in the study. Patients with ear discharge due to cholesteatoma / attico antral disease were excluded from the study. Ear discharges from the diseased ear of the patient, using three separate sterilized swabs were obtained. One of the swabs was used for aerobic culture and was plated on 5% sheep blood agar (BA), MacConkey's agar and chocolate agar (CA). The plates were incubated at 37°C for 48 h. Second swab used for anaerobic culture was inoculated in Robertson's cooked meat (RCM) broth and incubated at 37°C for 72 h. Third swab was used for fungal culture and was inoculated on two slants of Sabouraud Dextrose Agar with chloramphenicol (0.05%) and then incubated at 28°C and 37°C. The slants were later examined for gross and the microscopic morphology of the fungi.

Organisms were identified using standard procedures [9]. Antimicrobial sensitivity testing for aerobic isolates was carried out by modified Kirby Bauer disc diffusion method on Muller Hinton agar.

Table 1: Age wise distribution of various morphotypes in CSOM

Age (years)	Microbial growth			Total
	Mono microbial	Poly microbial	Sterile	
0-10	30	22	2	54
11-20	25	23	4	52
21-30	23	9	1	33
31-40	19	3	2	24
41-50	9	5	1	15
51-60	7	1	1	9
61 & above	8	6	1	15
Total	121	69	12	202

3. Results

Out of the total 202 ear swabs processed microbial growth was seen in 190 (94.06%) while 12 (5.94%) samples showed no growth. In 121 (59.9%) samples mono-microbial growth was seen whereas 69 (34.16%) samples showed poly-microbial growth. The overall high incidence of CSOM was observed in the age group between 0 and 10 years (26.7%). Females (52.48%) were more commonly affected than males (47.52%) and the sex ratio male: female was 1:1.1.

Table 2: characterization of aerobic, anaerobic, and fungal isolates among CSOM patients showing monomicrobial growth

Type	Organism	Total Isolates	Percentage
Aerobic	Staph. Aureus	60	49.6
	Pseudomonas aeurogenosaa	24	19.8
	CONS	5	4.1
	Klebsiella species	5	4.1
	Proteus species	2	1.6
	E. coli	4	3.3
	Enterococcus	1	0.8
Fungal	Aspergillus niger	5	4.1
	Aspergillus fumigatous	3	2.5
	Candida albicans	5	4.1
Anaerobic	Clostridium species	5	4.1
	Peptococcus species	1	0.8
	bacteriodes	1	0.8

Aerobes accounted for 83.47% of the total isolates, followed by fungi (10.74%) and then anerobes (5.79%). Among the aerobes isolated Staphylococcus aureus was the most common isolate followed by Pseudomonas aeruginosa, coagulase negative staph, Klebsiella sp, E coli and Proteus sp.

Antimicrobial sensitivity testing was carried out for all the isolates. The results of the sensitivity pattern of Staphylococcus aureus & Pseudomonas aeruginosa are given in table 3 & 4 respectively.

Table 3: Antibiotic sensitivity of Staph. aureus

S. No	Anti-microbial Agent	No. of sensitive strains	Percentage
1	Ampicillin	17	28.3
2	Amikacin	50	83.3
3	Gentamicin	48	80
4	Ciprofloxacin	31	51.6
5	Ceftrioxone	43	71
6	Cephalexin	38	63.3
7	Cefotaxime	41	68.3
8	Vancomicin	60	100

Table 4: Antibiotic sensitivity of Pseudomonas aerogenosa

S. No	Anti-microbial Agent	No. of sensitive strains	Percentage
1	Amikacin	20	83.3
2	Ceftazidime	13	54.2
3	Ciprofloxacin	11	45.8
4	Imipenum	21	87.5
5	Piperacillin	17	70.8
6	Tobramicin	12	50
7	Levofloxacin	13	54.2
8	Piperacillin + Tazobactum	22	91.6

4. Discussion

CSOM is a major public-health problem, and India is one of the countries with high-prevalence of this disease. CSOM is an important cause of preventable hearing loss particularly in the developing world like India. It's 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 [1]. Early, microbiological diagnosis ensures prompt and effective treatment to avoid such complications. A high prevalence of culture positive cases of CSOM (94.06%) was seen in the present study. CSOM was more prevalent in first and second decades of life and accounted for 52.47% of the cases. This positively corroborates with the observations made by other studies.[12-16] High-prevalence of CSOM in children may be attributed to the fact that they are more prone to get frequent upper respiratory tract infections (URTIs). And also additional factors like poor hygiene, inadvertent use of unconventional ear drops and natural remedies such as oil and honey into the middle-ear may initiate the proliferation of opportunistic pathogens leading to eustachian tube (ET) block [17].

The male is to female ratio was found to be 1:1.1. Cases of CSOM were slightly more common in females (110) than in males (94). This correlates with some studies[16, 18] and in contrast with some other studies [2, 14].

Analysis of the total 202 cases revealed that mono-microbial growth was obtained in 121 (59.9%) samples, 69 (34.16%) samples yielded polymicrobial growth, whereas, 12 (5.94%) samples showed no growth. Few other studies vary significantly, in this aspect. Aslam, *et al*. from Pakistan[19] in their study on 142 samples revealed that 76% of them were mono-microbial and 23.9% were mixed growth and only 2.1% fungi. Poorey and lyer from India [14] in their study on 100 samples found mono-mirobial growth from 82, mixed growth from 10, and no growth in 8 samples. Such a difference in results of various studies could have been due to the difference in the patient population studied and geographical variations. In the present study, mono-microbial etiology was found to be more common (59.9%) and this observation is supported by other studies [14, 15, 16, 18]. A study from Iran [20] reported mono-microbial etiology to be 100% in all 61 samples studied. In contrast, some researchers found polymicrobial etiology more prominent in otitis media [17, 21].

Staphylococcus aureus (49.6%) was the predominant aerobic bacterial etiology of CSOM in this study and this observation is similar to the studies by Ettehad, *et al*. [20] from Iran (31.15%) and Singh, *et al.* [22] from India (36%). In contrast, some other studies from India, [2, 15] Nigeria, [12] and Pakistan [16] showed different trends as Pseudomonas was the most prevalent organism and this could be due to the variation in micro-organisms in different regions. In our study, we could isolate Pseudomonas in 19.8% of cases. It does not usually inhabit the upper respiratory tract, its presence in the middle-ear may be considered as secondary invader, and gaining access to the middle-ear via defect in TM [8, 23].

Coliforms including *Klebsiella pneumoniae* and *Escherichia coli* were isolated from 4.1% and 3.3% cases respectively, in this study. Mansoor, *et al*. [16] reported the same to be 8% and 4% whereas Poorey and lyer reported a high-incidence for klebsiella in their study (25.4%) [14]. A recent study by Shyamala and Reddy showed a little different trend where *E. coli* was reported in 12% and Klebsiella in 5% of cases [15]. More frequent isolation of fecal bacteria like *E. coli*, Klebsiella and water bacteria like Pseudomonas indicates that individuals are at high-risk of infection due to poor hygienic conditions. Our study revealed that both gram-positive and gram-negative organisms are responsible for infection of middle-ear. It is usually seen that gram-negative rods outnumber the gram-positive organisms in CSOM as reported by various authors [2, 15, 16]. However, in our study *S. aureus* was the predominant organism followed by Pseudomonas and other gram-negative rods and this observation corroborates well with reports by other researchers [22, 24].

Mostly anaerobes are detected in cases with extensive cholesteatoma or squamous type of CSOM. Still, it is advocated that while investigating pathogenic organisms in CSOM, requests for anaerobic culture should be included and the medical therapy should be directed against the pathogenic aerobic and anaerobic organisms [25, 26]. Out of total 202 samples anaerobic etiology was found in 7 (5.7%) samples. This is in contrast to Ibekwe, *et al*., Maji, *et al*. and Indudharan, *et al*. [25, 27, 28] who found negligible anaerobic isolates in their studies. However, a study by Srivastava, *et al*. [29] from India found anaerobic etiology in 10.2% of cases. Another study from Iran [30] reported the same to be 14.3%. Various anaerobic organisms isolated are shown in Table - 2. The most predominant were Clostridium species (5 isolates), Peptococcus species and Bacteroides species (1 isolate each). Growth of anaerobes showed that progression of infection from acute to chronic stage could have created anaerobiosis, which offered favourable micro environment for the growth and proliferation of anaerobic pathogens. There was strong evidence that mixed aerobic, anaerobic cultures characterized chronic infection suggesting a potential synergy between anaerobic and aerobic bacteria. It has been previously reported that polymicrobial infections are more pathogenic than mono-microbial infections [31].

Fungal infections of the middle-ear are common as fungi thrive well in moist pus. The most commonly found fungi in CSOM are Candida species and Aspergillus species [25]. In the present study, fungal etiology was found in 13 (10.7%) cases out of which 38.46% were Candida albicans and 61.54% were Aspergillus species (*Aspergillus niger*-5, *Aspergillus fumigatus*-3). In a study from Haryana, India, fungal etiology was found in 15% of cases, out of which 60% were Candida species and 40% were Aspergillus species [2]. In another study from Singapore on 90 patients of otitis media, fungi accounted for 8.8% of the total isolates out of which Aspergillus species was found in 33.3% followed by Candida species 22.2% [12]. These findings may be attributed to the environmental effects on the cases of otitis media, which were studied in this area.

Antimicrobial susceptibility test (AST) was carried out for all the aerobic isolates. These findings were parallel to the reports by other authors [2, 16, 32]. Regarding the topical ear drops, Gentamicin and Ciprofloxacin showed good activity for most of the commonly isolated organism and can be used as first line topical antibiotic in the treatment of mucosal type of CSOM. Studies have revealed that quinolones like Ciprofloxacin are safe and effective particularly against *S. aureus* and *Pseudomonas aeruginosa* [33, 34, 35]. Isolation of various aerobic, anaerobic, and fungal isolates shows that different conditions of CSOM could be differentiated on microbiological grounds. Thus, for better management of

CSOM, causative organism as well as drug sensitivity test of that organism is very important for prescribing proper antimicrobials that will effectively eradicate the pathogen.

When results of this study was analysed along with other studies, it is evident that there is changing pattern of microbial organisms and their antibiotic sensitivity in the due course of time. Geographical variation, difference in the study population and hygienic conditions, could be the possible reasons for this variability. Emergence of antimicrobial resistance is becoming more common, due to inappropriate and incomplete antibiotic usage. As the symptoms subside many patients stop taking antibiotics before the completion of therapy and allow the partly resistant microbes to flourish. Proper instructions should be given to the patients to avoid these kinds of practice.

5. Conclusion

CSOM like any other chronic disease can limit an individual's employability and quality of life. As the prevalence of CSOM is increasing, it must be targeted as a high-priority disease [1]. With the development and widespread use of antibiotics, the types of pathogenic micro-organisms and their resistance to antibiotics have changed. Continuous and periodic evaluation of microbiological pattern and antibiotic sensitivity of isolates is necessary to decrease the potential risk of complications by early institution of appropriate treatment. Proper knowledge of the causative organisms and their antibiotic susceptibility is of utmost importance in the effective treatment, thereby preventing complications and antibiotic resistance and reducing the economic burden not only on the patients, but also the nation. As higher incidence of disease was seen among children, educating parents and guardians on possible risk-factors of the disease may be a preventive strategy that might reduce disease occurrences.

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