

Chronic Suppurative Otitis Media : A Comparative Microbiological Review of India with other Developing Countries.

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Abstract

Chronic infection of the middle ear cleft for at least 2 weeks or more is known as Chronic Suppurative otitis media. It usually manifests as a complication of acute otitis media. It is more prevalent in developing countries due to various predisposing factors like malnutrition, overcrowding, poor hygiene, inadequate health care, and recurrent upper respiratory tract infection. Due to advancement in medical facility, India still falls under high prevalence zone. In India, average prevalence of chronic Suppurative otitis media is 5.2%. *Pseudomonas aeruginosa* and *Staphylococcus aureus* are the predominant isolates in most of the studies conducted in India as well as in other developing countries of the world. In case of fungal aetiology *Candida spp* and *Aspergillus spp* were the predominant isolates.

Keywords: Chronic Suppurative otitis media; Aerobic isolates; Developing countries.

Introduction

“Chronic suppurative otitis media (CSOM) as stage of disease in which there is chronic infection of the middle ear cleft, in which a nonintact tympanic membrane (e.g, perforation or tympanostomy tube) and discharge (otorrhoea) are present for at least 2 weeks or more”.¹ It is also known as chronic active mucosal otitis media, chronic otomastoiditis or chronic tympanomastoiditis. This is usually a disease of childhood occurring as a sequel of acute otitis media presenting most commonly with hearing loss and suppurative drainage.² It is more prevalent in developing countries due to malnutrition, overcrowding, poor hygiene, inadequate health care, and recurrent upper respiratory tract infection.³ It can lead to

irreversible complications like persistent otorrhoea, mastoiditis, labyrinthitis, and facial palsy to more serious intracranial abscesses or thromboses.⁴ Hence an early diagnosis of the causative agent and prompt effective treatment are necessary to avoid such complications.

The most common aerobic bacterial isolates found in CSOM are *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus pyogenes*, *Proteus mirabilis*, *Klebsiella spp* and *Candida spp*. are the common fungal isolates. However, this may vary according to geographical areas and other factors.⁵

Topical antibiotics in combination with aural toilet are the mainstay of therapy for uncomplicated CSOM.⁶ However, widespread irrational use

of antibiotics has led to multidrug resistance organisms which in turn pose complications making treatment of CSOM more difficult. In developing countries, multidrug resistance organisms are rapidly increasing due to indiscriminate use of antibiotics, overcrowding, poor hospital hygiene and lack of resources and personnel trained in infection control.⁴ Thus, there is urgent need of speciation of isolates along with their antibiotic resistance pattern.

This systemic review aims to compare the aetiology of CSOM of India with that of other developing countries. We also investigated for any changing trends of CSOM aetiology in our country.

Materials and Methods

Data sources and searches

Published original articles and abstracts in English were searched through google, scholar and PubMed search engine. Data sources were included from all parts of India and other developing countries from 2009 to 2019 and included studies on CSOM. Exclusion criteria were:

- i) Study of CSOM with complications and
- ii) Case reports, letter to editors and intervention articles.

We have searched original articles from all parts of India and 10 from other neighboring developing countries ranging from 2009 to 2019 through various search engine. We had 32 Indian studies and 9 studies from 8 countries related to prevalence and microbiological profile of CSOM.

Results

Demographic profile

We found 13 studies which discussed prevalence of CSOM (Table 1) in school going children. The prevalence ranged from 1.4% to 6.6%. Males outnumbered in most of the studies

Microbiological profile

A wide range of aerobic bacteria were isolated in different studies of India (Table 2 and 3). *Pseudomonas aeruginosa* and *Staphyococcus aureus* were the predominant isolates (19.9%–67.5% and 11.3%–51.9% respectively), others were *Klebsiella*

spp, *Proteus spp*, *Escherichia coli* and few studies also isolated *Serratia marcescens* and *Shewanella spp*.^{14–16}

Candida spp and *Aspergillus spp* were the common fungal isolates in most of the studies (Table 4). Only Juyal et al. reported *Penicillium spp* and *Mucor* in their study.¹⁷

In other developing countries, *Pseudomonas aeruginosa* and *Staphyococcus aureus* were the predominant isolates. However, some studies isolated *Proteus vulgaris* and *Proteus mirabilis* as predominant isolates.^{18,19} *Aspergillus spp* and *Candida spp* were the common fungal isolates (Table 5).

Discussion

Prevalence

According to WHO/CIBA workshop of otitis media experts in 1996, countries having prevalence rate of 1–2% were considered under low prevalence zone while countries having 3–6% prevalence rate were considered as high prevalence zone.¹³ In India, since average prevalence of CSOM is 5.2%, it falls under high prevalence zone. In most of the other developing countries, prevalence of CSOM falls more than 3% as like in India which is indicative of high prevalence zone. Only Latin America Andean region shows less than 2% of prevalence rate (Figure 1).⁴⁴ In this systemic review a study from 1961 showed a high prevalence of 14.7%⁴⁵, whereas in the last decade⁷ studies taken from different parts of India found prevalence to have decreased to 6.6%.⁸ Based on these studies, it may be concluded that prevalence of CSOM has changed in past many years probably due to improved health care seeking behavior and more awareness. There are many other factors which determine prevalence of CSOM like- younger age, male sex, parental or sibling history of otitis media, early onset of otitis media, low socioeconomic strata, reduced duration of breast feeding, over crowding, day-care attendance, recurrent upper respiratory infections, allergic rhinitis, ignorance regarding ear diseases, lack of medical facility, passive smoking and different geographical location.^{7,11} In India, as like other developing countries (Nepal, Bangladesh, Pakistan etc.), low socioeconomic condition is associated with progression of CSOM. Lower socioeconomic class people generally live in congested room and maintain poor personal hygiene which favor transmission of infectious agents. Poor living condition is also associated with malnutrition resulting in depressed immune system which causes increased risk of disease.⁴⁶

Table 1 Showing prevalence of CSOM in India.

Author	Study year	Place of study	Prevalence
<i>Sophia et al. 2010</i> ⁷	July 2006–April 2007	Tamil Nadu	1.4%
<i>Abhinav et al. 2014</i> ⁸	1 yr. period	Maharashtra	6.6%
<i>Chadha et al. 2015</i> ⁹	2010 – 2011	Delhi	3.6%
<i>Parvez et al. 2016</i> ¹⁰	Aug 2010 – July 2011	Aligarh	6.1%
<i>Garud et al. 2016</i> ¹¹	Jan 2012 – Jan 2013	Maharashtra	6.4%
<i>Ray et al. 2017</i> ¹²	2011	Delhi	3.6%
<i>Singhal et al. 2018</i> ¹³	July 2016 – Sep 2016	Uttar Pradesh	6.5%

Table 2 Aerobic isolates in CSOM in India (data are expressed in percentage).

Reference No/year	20 2009	21 2010	22 2010	23 2011	24 2012	25 2012	26 2013	27 2013	28 2013
Isolates									
<i>P aeruginosa</i>	32.4	67.5	28.3	45.5	32.2	45.2	33	19.9	54
<i>S aureus</i>	21.2	-	29.2	37.7	17.4	22.2	25.8	48.7	11.3
CONS	-	-	-	-	-	-	-	-	8.1
<i>P vulgaris</i>	5.2	-	-	-	0.9	4.8	-	2.1	6.5
<i>P mirabilis</i>	-	-	7.5	1.3	2.6	6.4	20.6	-	8.1
<i>E coli</i>	7.6	17.5	-	1.3	1.7	4.8	-	7.3	3.3
<i>E aerogenes</i>	-	-	2.8	-	0.9	-	4.1	-	-
<i>Klebsiella spp</i>	10	-	3.7	9.1	6.9	6.4	4.1	9.4	8.1
<i>β hemolytic Streptococcus</i>	-	-	3.7	2.9	-	-	4.1	-	1.6
<i>S pneumoniae</i>	-	-	-	-	1.7	-	-	1.1	-
<i>Acinetobacter spp</i>	3.2	-	1.9	-	1.7	2.4	1	3.1	-

Table 3: Aerobic isolates in CSOM in India (data are expressed in percentage).

Reference No/ year	14 2015	29 2015	15 2016	30 2016	31 2016	16 2017	32 2018	33 2018	5 2018	34 2018	35 2018
Isolates											
<i>P aeruginosa</i>	37.9	33.1	30.8	34.3%	35	31.1	37.5	56.1	38.5	20	34.9
<i>S aureus</i>	32.6	21.6	29.8	28.6%	20.5	31.8	5	24.03	51.9	51.5	27.2
CONS	-	-	2.9	-	10.8	-	-	-	1.9	-	-
<i>P vulgaris</i>	6.3	-	-	-	-	2.2	10	4.1	-	3.1	12.6
<i>P mirabilis</i>	-	5.8	6.7	7.6%	4	0.7	-	-	-	-	-
<i>E coli</i>	4.2	3.6	1.9	-	3.6	7.4	5	6.01	-	7.7	7.8
<i>E aerogenes/spp</i>	-	2.2	-	-	-	-	-	-	-	-	-
<i>Klebsiella spp</i>	-	9.4	10.6	7.6%	8.4	2.2	5	6.01	3.8	8.5	9.7
<i>β hemolytic Streptococcus</i>	-	-	0.9	3.8%	-	-	-	-	-	-	-
<i>S pneumoniae</i>	2.1	-	-	-	5.6	0.7	-	-	3.8	0.8 (alpha)*	4.9
<i>Acinetobacter spp</i>	3.2	1.4	-	1.9%	-	6.75	-	1.7	-	3.4	-

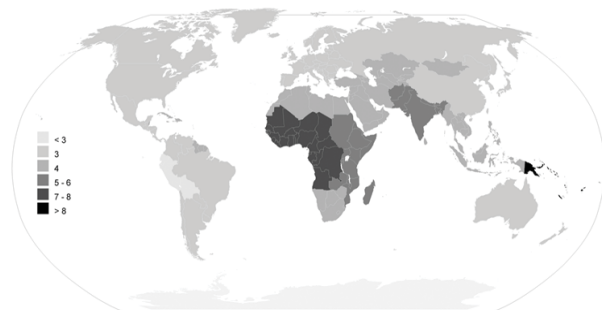
Table 4: Fungal isolates in CSOM in India (data are expressed in percentage).

Reference no/year Isolates	23 2013	24 2013	27 2016	26 2015	17 2014	29 2018	36 2013	5 2018	35 2017
<i>Candida spp</i>	-	-	2.6	-	-	-	2.3	-	-
<i>Candida albicans</i>	9.8	0.9	1.9	1.03	23	4.3	-	3.1	4.3
<i>Candida glabrata</i>	-	1.7	-	-	-	-	-	-	-
<i>Candida parapsilosis</i>	-	-	-	-	4.8	-	-	-	-
<i>Candida tropicalis</i>	-	-	-	-	10.8	-	-	-	-
<i>Candida krusei</i>	-	-	-	-	2.4	-	-	-	-
<i>Aspergillus spp</i>	-	-	-	-	-	-	5.4	-	-
<i>Aspergillus niger</i>	2.2	3.5	5.8	2.1	14.5	6.5	-	10.8	4.3
<i>Aspergillus flavus</i>	1.1	3.5	-	3.1	20.5	2.9	-	4.6	1.7
<i>Aspergillus fumigatus</i>	3.3	-	5.2	-	8.4	-	-	1.5	0.8
<i>Aspergillus terreus</i>	-	-	-	-	3.6	-	-	-	-
<i>Penicillium</i>	-	-	-	-	9.6	-	-	-	-
<i>Mucor</i>	-	-	-	-	2.4	-	-	-	-

Table 5: Aerobic isolates in CSOM in other developing countries (data are expressed in percentage).

Country / Reference No	Sri Lanka 37	Bangladesh 38	Pakistan 39	Nepal 40	Malawi 41	Iran 42	Luanda 18	Ethiopia 43	Ethiopia 19
Isolates									
<i>S aureus</i>	20.5%	29.1%	65.2%	36.1%	20.1%	29.2%	2.6%	15.8%	16.2%
CoNS	-	-	-	8.8%	4%	35.7%	7.3%	-	16.2%
<i>S pyogenes</i>	-	14.9%	-	-	-	-	1.1%	7.9%	-
<i>S pneumoniae</i>	-	1.6%	-	-	-	-	-	8.9%	-
<i>Viridans Streptococci</i>	-	-	-	-	-	-	-	9.9%	-
<i>Streptococcus spp</i>	-	-	-	-	-	-	2.2%	-	-
<i>Enterococcus</i>	2.5%	-	-	-	-	-	8.8%	6.3%	-
<i>P aeruginosa</i>	29.5%	22.8%	15.2%	33.3%	20.8%	10.3%	13.2%	10.9%	-
<i>Pseudomonas spp</i>	-	-	-	-	-	-	1.9%	-	-
<i>Escherichia coli</i>	-	9.4%	0.65%	2.3%	8.4%	-	2%	7.4%	-
<i>K pneumoniae</i>	-	4.7%	-	6.01%	4%	12.9%	-	7.4%	-
<i>Klebsiella spp</i>	-	-	-	1.4%(oxytoca)	-	-	3%	-	13.5%
<i>P mirabilis</i>	-	6.3%	13.1%	4.2%	28.6%	-	-	7.9%	21.6%
<i>P vulgaris</i>	-	-	-	0.4%	4%	-	-	-	2.7%
<i>Proteus spp</i>	-	-	-	-	-	10.3%	14.7%	-	-
<i>E cloace/spp coliforms</i>	16.7%	-	-	-	0.6%	-	-	2.1%	-
<i>Citrobacter spp</i>	-	-	-	0.4%	-	-	3.4%	-	6.8%
<i>Acinetobacter spp</i>	-	-	-	3.2%	-	-	-	7.9%	-
<i>A fumigatus</i>	-	6.3%	-	-	-	-	-	-	-
<i>Candida</i>	7.7%	4.7%	-	-	-	-	-	-	-

Male dominance was seen in most studies which may be due to males reporting more than females in the hospital or because males are more exposed to outdoor activities.



CSOM incidence rate estimates for the year 2005 per thousand people, by the 21 WHO regions.⁴⁴doi: 10.1371/journal. Pone. 0036226.g004

Microbiological profile

Pseudomonas aeruginosa and *Staphylococcus aureus* are the most common isolates in most of the studies from different geographical regions of India as well as other developing countries. There are many favorable factors which help colonization of *Pseudomonas aeruginosa* over other bacteria like minimum nutritional requirement for survival, relative resistant to antibiotics and its antibacterial products i.e., pyocyanin and bacteriocin. One postulate by Vartiainen and Vartiainen that *Pseudomonas* is capable of maintaining a niche for itself in local infection through necrotising activities of its extracellular enzymes. The niche consists of damaged epithelium, interrupted circulation and devitalized tissue that protects the organism from normal host defence mechanisms and antibiotic agents. Besides these, the organism acts as an opportunistic pathogen, flourishes in the external auditory canal and may cause suppurative disease in contiguous sites.^{21,22} *Staphylococcus aureus* was the second most common organism in most of these studies where as few described *Staphylococcus aureus* as the most common isolate. Other bacterial isolates were *Klebsiella spp*, *Proteus spp*, *Escherichia coli*, *Enterobacter*, *Acinetobacter spp*, *Citrobacter spp*, *beta* hemolytic *Streptococci* and *Streptococcus pneumoniae*. The variations in bacteria isolation rates of different organisms reported by different workers may be as an effect of inappropriate antibiotic uses, climatic and other geographical factors.³³ Few studies also isolated *Serratia marcescens* and *Schewanella spp* which may be due to improved isolation/identification techniques.^{14,16,21}

Very few studies reported fungal isolates; Juyal

et al. found highest incidence of fungal infection in second and third decade of life.¹⁷ Jitendranath et al. also found in third and fourth decade of life. Probably, these age groups are more exposed to fungal spores as compare to extreme age groups. *Aspergillus spp* were common isolates in most of the studies. *Aspergillus* has capability of growing rapidly and produces a large number of small, dry, easily aerosolized conidia. These conidia can easily contaminate the air. Their growth is further facilitated by cerumen and the slightly acidic pH of the ear canal.²⁹ *Candida spp* were the second common isolates. Non albicans *Candida*, which are less pathogenic than *Candida albicans*, were also isolated. Jitendranath et al. found higher incidence of fungal infections during rainy season followed by summer season. Hot and humid climate and presence of dust in the environment facilitates the fungal growth.⁴⁷

Conclusion

Pseudomonas aeruginosa and *Staphylococcus aureus* are the common isolates in India. There is no significant change in prevalence for these two bacteria. Even outside India, these two bacteria are more common in most of the studies. There are some other isolates in different zones which may indicate local geographical or climatic variation or impact of inappropriate antibiotic use. *Candida spp* and *Aspergillus spp* are only fungal isolate in almost all studies.

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