

# A prospective study on aetiological agents of acute and chronic suppurative otitis media

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## ABSTRACT

Otitis media is a persistent, insidious, and dangerous disease because of multiple aetiology and serious complications. Hence, a study was conducted to find out the bacterial and fungal aetiology of suppurative otitis media. **Aim:** The aim was to find the prevalence of bacterial and fungal pathogens in acute and chronic otitis media. **Materials and Methods:** A total of 260 patients having otitis media belonging to all age groups and both sexes who attended the ENT outpatient department were selected for study for a period of 1-year. Ear discharge was collected under aseptic precautions using sterile cotton swabs. Both bacterial and fungal culture were done. The antimicrobial susceptibility of bacterial isolates was done including detection of extended-spectrum  $\beta$ -lactamase and detection of metallo  $\beta$ -lactamase for resistant strains. **Results:** In acute suppurative otitis media, Gram-positive organisms 48 (55.18%) were predominant compared to Gram-negative organisms 37 (42.52%). No fungal isolates were obtained in the present study. In the case of chronic suppurative otitis media (CSOM), bacteria were isolated in 129 (74.57%) cases and fungus in 41 (23.7%) cases. Polymicrobial infection was found only in 14 (10.85%) cases. Among the bacterial isolates in CSOM, Gram-negative organisms (65.35%) were more compared to Gram-positive organisms (35.65%).

**Key words:** Extended spectrum  $\beta$ -lactamase, metallo  $\beta$ -lactamase, otitis media

## INTRODUCTION

Otitis media occurs in both children and adults without any age limits. It is a cause of conductive deafness, which may lead to the delayed development of speech and language in children. Early detection of the disease is necessary for better treatment and management. The prompt management of infection based on culture and sensitivity also help in preventing further complications like mastoiditis and brain abscess.<sup>[1]</sup>

## MATERIALS AND METHODS

### Aim

The aim was to find the prevalence of bacterial and fungal pathogens in acute and chronic otitis media.

### Objectives

1. To find the prevalence of bacterial and fungal pathogens in acute and chronic otitis media in the

ENT outpatient department of Government Medical College, Thiruvananthapuram.

2. Identification and characterisation of the pathogens and their antibiogram.

### Setting and period of study

The study was done by the Department of Microbiology in collaboration with the Department of ENT, Government Medical College, Thiruvananthapuram. The study was done for a period of 1-year starting from April 2009 to March 2010.

### Inclusion criteria

All cases of acute suppurative otitis media (ASOM) and active chronic suppurative otitis media (CSOM).

### Exclusion criteria

All cases of otitis media who were on antibiotic therapy at any time during the past 1-week.

Clinical information such as duration of symptoms, predisposing factors, history of recurrent infection, and the treatment taken.

Ear discharge was collected under aseptic precautions using sterile cotton swabs. The swabs were processed

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immediately in the laboratory.<sup>[2,3]</sup> Microscopic examination (both Gram's staining and KOH wet mount) and culture were done. Specimen was inoculated on blood agar, MacConkey agar, salt agar, and Sabouraud's dextrose agar (SDA) and incubated at 37°C. Another SDA tube inoculated with the specimen was incubated at room temperature.

The identification of the bacterial pathogen was done based on Gram stain, growth on culture, and biochemical properties using standard laboratory procedures.<sup>[4,5]</sup> Antibiotic sensitivity testing was done according to Clinical and Laboratory Standards Institute guideline using disc diffusion method (Himedia disc). Detection of extended-spectrum  $\beta$ -lactamase (ESBL) and metallo  $\beta$ -lactamase (MBL) for resistant Gram-negative strains<sup>[6,7]</sup> were done by the double disc diffusion method.

Fungal growth obtained on SDA was examined for characteristics such as the rate of growth, colony morphology, and pigmentation.<sup>[8]</sup> Fungal growth was examined by a lactophenol cotton blue tease mount preparation and slide culture. A negative fungal culture report was given after 4 weeks.

## RESULTS

Of 260 otitis media patients 173 (66.54%) had active CSOM and 87 (33.46%) had ASOM. Incidence of ASOM was highest in children <10 years, that is, 46/87 (52.87%). In ASOM, 48 (55.18%) Gram-positive organisms were isolated, being slightly more than 37 (42.52%) Gram-negative organisms [Table 1]. *Staphylococcus aureus* was the predominant organism isolated, that is, 44 (50.58%) followed by *Pseudomonas aeruginosa*, 28 (32.18%). *Haemophilus influenzae* was isolated from two cases. No fungal isolates were obtained in ASOM in the present study.

The highest incidence of CSOM of 71 (41.04%) was in the age group of 21-30 years, In the case of CSOM, bacteria were isolated in 129 (74.57%) cases and fungus in 41 (23.7%) cases. There was polymicrobial infection in 14 (10.85%) cases and concomitant bacterial and fungal infection in 9 (6.98%) cases. Of 143 isolates, Gram-negative organisms accounted for 92 (53.18%) while 51 (42.52%) were Gram-positive organisms.

Among the bacterial isolates in CSOM, *P. aeruginosa* was the predominant organism that accounted for 62 (43.36%) cases. *S. aureus* was the only Gram-positive bacterial pathogen isolated in CSOM accounting for 51 (33.65%) cases [Table 2].

**Table 1: Profile of isolates from ASOM**

Pathogen isolated	Number of isolates (%)
<i>Staphylococcus aureus</i>	44 (50.58)
<i>Streptococcus pyogenes</i>	2 (2.30)
<i>Enterococcus faecalis</i>	2 (2.30)
<i>Pseudomonas aeruginosa</i>	28 (32.18)
<i>Klebsiella pneumoniae</i>	7 (8.04)
<i>Haemophilus influenzae</i>	2 (2.30)
Fungi	0
Sterile	2 (2.30)
Total	87

ASOM: Acute suppurative otitis media

**Table 2: Profile of bacterial isolates from CSOM**

Bacteria isolated	Number of isolates (%)
<i>Staphylococcus aureus</i>	51 (33.65)
<i>Pseudomonas aeruginosa</i>	62 (43.36)
<i>Klebsiella pneumoniae</i>	11 (7.69)
<i>Klebsiella oxytoca</i>	2 (1.40)
<i>Proteus mirabilis</i>	7 (4.90)
<i>Proteus vulgaris</i>	4 (2.80)
<i>Acinetobacter baumannii</i>	3 (2.10)
<i>Escherichia coli</i>	3 (2.10)
Total	143

CSOM: Chronic suppurative otitis media

## Antibiotic sensitivity pattern

### Acute suppurative otitis media

Of the 44 *S. aureus* strains, 14 (31.82%) were sensitive to Penicillin and all (100%) were methicillin-sensitive. Table 3 shows sensitivity pattern of the isolates.

Among the isolates of *P. aeruginosa*, 25 (89.28%) were sensitive to third generation cephalosporins (Ceftazidime) and Piperacillin + Tazobactam. All (100%) the isolates were sensitive to Imipenem. However, only 19 (67.86%) were sensitive to Amikacin and Ciprofloxacin [Table 4].

### Chronic suppurative otitis media

Among *P. aeruginosa*, 59 (93.16%) were sensitive to Imipenem and Ceftazidime, 58 (93.16%) were sensitive to Piperacillin + Tazobactam, 49 (79.03%) were sensitive to Ciprofloxacin and 36 (58.06%) were sensitive to Amikacin [Table 5].

Among the isolates, 3 (21.43%) *Klebsiella pneumoniae* and 1 (33.37%) *Escherichia coli* were ESBL producers and 3 (4.73%) *P. aeruginosa* were MBL producers.

Most common polymicrobial infection was by *P. aeruginosa* and *S. aureus* followed by *P. aeruginosa* and *Klebsiella* spp. Among the fungal pathogens, Aspergillus species formed the major isolate, that is, 25/41 (60.98%) followed by Candida with 13 (31.71%) isolates [Table 6]. *Aspergillus* species was also the major fungal pathogen obtained along with bacteria.

**Table 3: Antibiotic sensitivity pattern of Gram-positive isolates**

Organism	Penicillin (%)	Ampicillin (%)	Gentamicin (%)	Erythromycin (%)	Cephalosporin first generation (%)	Cefoxitin (%)	Vancomycin (%)	Amikacin (%)	Bacitracin (%)
<i>Staphylococcus aureus</i> (44)	14 (31.8)	NT	32 (72.73)	30 (68.18)	44 (100)	44 (100)	NT	40 (90.91)	NT
<i>Streptococcus pyogenes</i> (2)	2 (100)	2 (100)	2 (100)	1 (50)	2 (100)	NT	NT	2 (100)	2 (100)
<i>Enterococcus faecalis</i> (2)	0	2 (100)	2 (100)	0	0	NT	2 (100)	2 (100)	NT

NT: Not tested

**Table 4: Antibiotic sensitivity pattern of Gram-negative isolates**

Organism	Ampicillin (%)	Gentamicin (%)	Cephalosporin first generation (%)	Cephalosporin third generation (%)	Amikacin (%)	Ciprofloxacin (%)	Imipenem (%)	Piperacillin + tazobactam (%)	Chloramphenicol (%)
<i>Pseudomonas aeruginosa</i> (28)	NT	13 (46.43)	NT	25 (89.28)	19 (67.86)	19 (67.86)	28 (100)	25 (89.28)	NT
<i>Klebsiella pneumoniae</i> (7)	0	5 (71.43)	5 (71.43)	6 (83.71)	6 (83.71)	6 (83.71)	7 (100)	6 (83.71)	NT
<i>Haemophilus influenzae</i> (2)	1 (50)	NT	NT	1 (50)	NT	NT	NT	NT	1 (50)

NT: Not tested

**Table 5: Antibiotic sensitivity pattern of Gram-negative isolates**

Organisms	Ampicillin (%)	Gentamicin (%)	Cephalosporin first generation (%)	Cephalosporin third generation (%)	Amikacin (%)	Ciprofloxacin (%)	Imipenem (%)	Piperacillin + tazobactam (%)
<i>Pseudomonas aeruginosa</i> (62)	NT	28 (43.16)	NT	59 (93.16)	36 (58.06)	49 (79.03)	59 (93.16)	58 (93.55)
<i>Klebsiella</i> spp. (13)	0	7 (53.85)	8 (61.54)	10 (76.92)	9 (69.23)	11 (84.62)	10 (76.92)	11 (84.62)
<i>Proteus</i> spp. (11)	6 (54.55)	5 (43.45)	7 (63.64)	11 (100)	10 (90.91)	11 (100)	11 (100)	10 (90.91)
<i>Acinetobacter baumannii</i> (3)	2 (66.67)	3 (100)	1 (32.3)	3 (100)	3 (100)	2 (66.67)	3 (100)	3 (100)
<i>Escherichia coli</i> (3)	1 (33.3)	2 (66.67)	2 (66.67)	2 (66.67)	2 (66.67)	3 (100)	2 (66.67)	2 (66.67)

NT: Not tested

**Table 6: Fungal isolates obtained as single pathogen in CSOM**

Fungal isolate	Number of cases (%)
<i>Aspergillus niger</i>	14 (34.5)
<i>Aspergillus fumigatus</i>	10 (24.4)
<i>Aspergillus terreus</i>	1 (2.44)
<i>Candida albicans</i>	8 (19.51)
<i>Candida</i> species	5 (12.20)
<i>Penicillium</i> spp.	2 (4.9)
<i>Mucor</i> spp.	1 (2.44)
Total	41

CSOM: Chronic suppurative otitis media

## DISCUSSION

This study was done to know the bacterial and fungal aetiological agents of otitis media, with antimicrobial susceptibility testing of the bacterial isolates. The results are compared and correlated with the studies conducted by other researchers.

Of 260 otitis media patients, 87 (33.46%) had ASOM and 173 (66.54%) had active CSOM. This shows that the incidence of CSOM is more compared to ASOM. This

finding correlated with the study conducted by Oni *et al.* in Ibadan, Nigeria (1997). Of the 347 patients selected in their study, 67.1% cases were CSOM and 14.4% were ASOM. O.O. Olubanjo did a study on the epidemiology of ASOM in 2005 and observed the low incidence (1.01%) of ASOM.

In this study, it has been observed that in more than 50% of the cases, *S. aureus* was the etiological agent for ASOM. This finding correlated with studies conducted by the following researchers: Iseh and Adebite in 2004 who observed that *S. aureus* (46.2%) was the most common cause followed by *E. coli* (23.1%) in ASOM.<sup>[9]</sup> Das *et al.*, in 2005, reveals that the common microbes isolated from the culture from ASOM were *S. aureus* (69.2%), *Streptococcus* (7.7%), and *P. aeruginosa* (7.7%).<sup>[10]</sup>

In this study, it has been observed that in CSOM bacteria were more common than fungi. It was also observed that among the Gram-negative organisms *P. aeruginosa* was the predominant isolate accounting for 62 (43.36%) cases. *S. aureus* was the only Gram-positive bacterial pathogen isolated in CSOM. The above findings correlated with the following studies. A similar study was done for CSOM

in our institution in 2003 by Sinha, which also showed that in CSOM *P. aeruginosa* was the predominant isolate followed by *S. aureus*.<sup>[11]</sup> Loy *et al.* in 2002 conducted study on the microbiology of CSOM in Singapore and observed that *P. aeruginosa* was the predominant pathogen in CSOM followed by *S. aureus*.<sup>[12]</sup> Microbiological findings in patients with CSOM conducted by Nikakhlagh *et al.*, in 2008, reveals that the most common isolate was *S. aureus* (32.4%) followed by *P. aeruginosa* (21.6%).<sup>[13]</sup>

Of 173 CSOM cases in the study, *Aspergillus* forms the major fungal pathogen 25 (14.45%), followed by *Candida* 13 (7.51%). The study conducted by Sinha in 2003 showed that among the fungal pathogens causing CSOM, *Aspergillus* spp. was the major pathogen followed by *Candida albicans*.<sup>[11]</sup> A study conducted by Sreekumar *et al.* in the ENT Department, Medical College, Thiruvananthapuram (2007) observed that *Aspergillus niger* and *fumigatus* are the most common cause of otomycosis.<sup>[14]</sup> In the study conducted by Loy *et al.* on patients with CSOM<sup>[12]</sup> *Aspergillus niger*, *Aspergillus* spp. and *Candida* spp. were the main isolates.

Use of local and/or systemic antibiotics guided by culture and sensitivity is the effective treatment modality. This will prevent the development of drug resistance and use of unwanted antibiotics. For cases in which *S. aureus* was isolated, oral Cloxacillin and Gentamicin ear drops are used and in cases in which *P. aeruginosa* was isolated, oral Ciprofloxacin and Gentamicin ear drops were used. In the case of resistant *Pseudomonas* strains, local application of 1% acetic acid was very effective.

If the discharging ear does not respond to antibiotics, fungal infection should be suspected. For CSOM cases due to fungal infection insertion of gauze piece saturated with Clotrimazole, Neomycin, and Beclomethazone for 3-4 days was very effective.

In the present study, out of 173 CSOM patients, 23 had various complications. Totally, 17 had mastoiditis; four had temporal lobe abscess and one patient each had post-auricular abscess and meningitis. These cases were managed by parenteral antibiotics and surgical evacuation of pus.

## CONCLUSION

The study of micro-organisms commonly associated with suppurative otitis media and their antibiotic susceptibility

pattern is very useful for the physician to plan treatment. The aerobic bacteriological study of ASOM reveals that *S. aureus* is the most common causative agent followed by *P. aeruginosa*, *K. pneumoniae*, and *S. pyogenes*. No fungal aetiology has been identified for ASOM. The aerobic bacteriological study of CSOM reveals that *P. aeruginosa* is the most common causative agent followed by *S. aureus*, *K. pneumoniae*, and *Proteus* spp.

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