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Assessment of clinical and pathogenic aspects of Otitis media

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Abstract

Background: Otitis media (OM) is a group of complex infective and inflammatory conditions affecting the middle ear, with a variety of subtypes differing in presentation, associated complications, and treatment. A number of diseases of the middle ear are summed up under the term otitis media: acute otitis media, recurrent acute otitis media, otitis media with effusion, chronic suppurative otitis media and chronic otitis media epitympanalis (= cholesteatoma).

Objectives: Hence; under the light of above mentioned data, the present study was undertaken for assessing the clinical and pathogenic aspects of chronic otitis media.

Methods: A total of 25 patients with confirmed diagnosis of otitis media were enrolled in the present study. Middle-ear discharge was taken from each subject and were placed on thioglycollate broth media and immediately sent to the pathogenic analysis. The swab samples were cultured on 5 per cent sheep blood agar, and chocolate agar for isolation of aerobic bacteria, and incubated aerobically at 37°C for 24–48 hours. Identification of the isolates grown was done by using different microbiological methods. All the results were analyzed by SPSS software.

Results: Earache and ear discharge were found to be the prominent clinical manifestation. Deafness and pain were found to be the other presenting symptoms. While assessing the pathogenic profile, it was observed that coagulase-negative staphylococci, *S aureus*, *P aeruginosa*, *Klebsiella* spp. and *Proteus* spp. were present in 80 percent, 60 percent, 64 percent, 48 percent and 40 percent of the cases. Non-significant results were obtained while assessing the distribution of patients with different clinical profile according to gender. Coagulase-negative staphylococci were seen in 12 males and 8 females. *S aureus* was found to be present in 10 males and 5 females. *P aeruginosa* was found to be present in 11 males and 5 females. *Klebsiella* spp. were found to be present in 8 males and 4 females. Non-significant results were obtained while assessing the microbial growth among patients divided on the basis of gender.

Conclusion: Earache and ear discharge are the most common presenting symptom of chronic otitis media with coagulase-negative staphylococci and *S. aureus* being the prominent micro-organism responsible for it.

Keywords: Chronic suppurative otitis media (CSOM), otitis media, culture, swab, tympanic membrane (TM)

Introduction

Otitis media (OM) is a group of complex infective and inflammatory conditions affecting the middle ear, with a variety of subtypes differing in presentation, associated complications, and treatment. OM is a leading cause of health care visits worldwide, and its complications are important causes of preventable hearing loss, particularly in the developing world [1-3].

A number of diseases of the middle ear are summed up under the term otitis media: acute otitis media, recurrent acute otitis media, otitis media with effusion, chronic suppurative otitis media and chronic otitis media epitympanalis (= cholesteatoma). Acute otitis media belongs to the most common pediatric diseases and is often caused by bacterial infection. Since the advent of pneumococcal vaccines the quantity of AOM caused by pneumococci has declined; vaccination against NTHi and *Moraxella catarrhalis* are being developed. Dysfunction of the Eustachian tube often underlies OM. Manometric measurement of Eustachian tube function may be useful for indication of balloon Eustachian tuboplasty. Several theories explain pathogenesis of cholesteatoma and multiple pro-inflammatory processes promote its progress in the course of the disease [4-6].

The most common cause of OM is bacterial infection of the middle ear. AOM is predominantly caused by *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis*.

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However, *Pseudomonas aeruginosa* and *Staphylococcus aureus* are the most common aerobic microbial isolates in patients with CSOM, followed by *Proteus vulgaris* and *Klebsiella pneumoniae*. A number of studies from different countries including India, Nepal, Singapore and Nigeria have reported that *P. aeruginosa* is the most common pathogen that causes CSOM, followed by *S. aureus*. However, studies from gulf countries reported *S. aureus* as the most predominant pathogen, followed by *P. aeruginosa*. The difference in the various studies could be due to the differences in the patient population studied and geographical variation^[7].

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 (TM). Tubotympanic is called as a safe type or benign type as there is no serious complication whereas, attico-antral is called as the unsafe or dangerous type because of associated complication and may be life threatening at times. 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 associated with chronic ear discharge is nearly always significant, reported in 50% of cases and tending to be more severe than those reported in other types of otitis media^[8, 9].

Age appropriate audiometry and tympanometry should be tested in patients with otitis media with effusion. A 'flat' tympanogram will support a diagnosis of otitis media with effusion. Hearing can be tested in infants with the use of auditory brainstem responses (ABR). This exam tests the electrical activity of the brainstem to acoustic stimuli. The test detects both the frequency range and sound intensity levels in which the patient's brain responds. Patients do not need to be able to speak and do not even need to be awake to perform the test. Therefore, it is ideal for children from birth to 5 years of age. With older children and adults, although ABR testing can still be performed, it is more common to do a classic audiology exam. This exam consists of playing sounds to the patient's left and right ears at different tones and intensities. Patients are requested to raise either the right or left hand when they hear a sound in the right or left ears, respectively. Individuals with normal hearing can detect lower frequencies at a lower decibel (i.e., intensity) than higher frequencies, meaning that a normal individual needs a sound to be louder to perceive high frequencies than lower frequencies. During an audiology exam, the range of frequencies that an individual can perceive is plotted on an audiograph. The decibel (dB) range of individuals with OME is decreased in the audiograph^[10]. Many previous studies have investigated the prevalence and risk factors of COM. Its reported prevalence in Southeast Asia, Africa, and Western Pacific countries is 2–4%, and that in North America and European countries is < 2%. Risk factors of COM include low socioeconomic status, malnutrition, high number of children in the household, family history, and passive exposure to smoking. However, most studies have involved children, and have confined the study of otitis media to chronic suppurative otitis media, acute otitis media, or otitis media with effusion. Moreover, the effects of various host and environmental factors have not been well defined. Information on the risk factors of COM would contribute to effective treatment and control of this disease^[8-10]. Hence; under the light of above mentioned data, the present study was undertaken for assessing the clinical and pathogenic aspects of chronic otitis media.

Materials and Methods

The present study was conducted on 25 patients of either sex, in the department of ENT, Government Mohan Kumarmangalam Medical College, Salem, Tamil Nadu, in the time period of one year from August 2018 to August 2019. The study was performed with the aim of assessing the clinical and pathogenic profile of otitis media patients. Ethical approval was obtained from institutional ethical committee and written consent was obtained from all the patients after explaining in detail the entire research protocol.

A total of 25 patients with confirmed diagnosis of otitis media were enrolled in the present study. Exclusion criteria for the present study included:

Patients with history of any other systemic illness,

- Patients with any known drug allergy,
- Diabetic and hypertensive patients,
- Patients who refused to give informed consent

A pretested questionnaire was used containing open questions and the patients were assessed clinically. Middle-ear discharge was taken from each subject and were placed on thioglycollate broth media and immediately sent to the pathogenic analysis. The swab samples were cultured on 5 per cent sheep blood agar, and chocolate agar for isolation of aerobic bacteria, and incubated aerobically at 37 °C for 24–48 hours. Identification of the isolates grown was done by suing different microbiological methods. All the results were analyzed by SPSS software. Chi-square test was used for assessment of level of significance. P-value of less than 0.05 was taken as significant.

Results

In the present study, a total of 25 patients with chronic otitis media were enrolled. Mean age of the patients was found to be 20.8 years. 48 percent of the patients belonged to the age group of less than 30 years. 60 percent of the patients were males while the remaining were females. 72 percent of the patients had rural residence while the remaining had urban residence. In the present study, earache and ear discharge were found to be the prominent clinical manifestation. Deafness and pain were found to be the other presenting symptoms. While assessing the pathogenic profile, it was observed that coagulase-negative staphylococci, *S. aureus*, *P. aeruginosa*, *Klebsiella* spp. and *Proteus* spp. were present in 80 percent, 60 percent, 64 percent, 48 percent and 40 percent of the cases. Earache was present in 14 males and 9 females. Ear discharge was present in 15 males and 10 females. Deafness was present in 9 males and 6 females. Pain was present in 6 males and 4 females. Non-significant results were obtained while assessing the distribution of patients with different clinical profile according to gender. In the present study, Coagulase-negative staphylococci were seen in 12 males and 8 females. *S. aureus* was found to be present in 10 males and 5 females. *P. aeruginosa* was found to be present in 11 males and 5 females. *Klebsiella* spp. were found to be present in 8 males and 4 females. Non-significant results were obtained while assessing the microbial growth among patients divided on the basis of gender.

Discussion

OM is pathology of the middle ear and middle ear mucosa, behind the ear drum (tympanic membrane). The middle ear is a cavity containing the ear ossicles (malleus, incus, and stapes), with the eustachian tube placed anteriorly (leading to the nasopharynx), the mastoid air cells posteriorly, tympanic membrane laterally, and the inner ear medially. Other important

nearby structures are the brain and meninges superiorly and the sigmoid sinus posteriorly, and any infection of the middle ear can spread to surrounding structures with serious results. The middle ear is lined by modified respiratory epithelium, including ciliated cells and goblet cells; the epithelium produces mucins that are normally transported down the eustachian tube [5, 6].

Different types of OM present in different ways. Acute OM (AOM) usually affects children aged under 2 years, and presents with acute onset symptoms and signs of otalgia and fever, in a child that is systemically unwell. It is acute inflammation, and may be caused by bacteria or viruses. A particular subtype of AOM is acute suppurative OM, which is characterized by the presence of pus in the middle ear. If the ear drum perforates (this occurs in approximately 5%, although higher rates have been reported) then ear discharge will be present also; the perforation usually heals spontaneously. AOM is one of the commonest childhood infectious diseases; in the majority of cases the disease is self-limiting, but it has high morbidity, although mortality rates are generally low [7].

Many environmental, anatomical, and other factors contribute to both the prevalence of middle ear infections in children and the chronicity or recurrent nature of OM. These factors include the immaturity of the pediatric immune system, existence of other ongoing infections, the anatomic positioning of the Eustachian tube in childhood, genetic predisposition, methods of feeding, smoking in the household, existence of allergies, and attendance at day care, among others. In addition, while children do mount an immune response both systemically as well as locally to the organism(s) present in their middle ears, due to the vast heterogeneity of the microorganisms that cause OM, this immune response does not confer protection against subsequent bouts of OM. Whereas the multifactorial nature of middle ear infections is well acknowledged, it has only recently become fully appreciated that OM, both acute and chronic, is also a truly polymicrobial infection involving any of several URT viruses and one or more of three primary bacterial pathogens of the middle ear. This delayed understanding was partly due to difficulty in obtaining sequential samples from the middle ear for assay by culture and the fact that many middle ear fluids (or effusions) that were retrieved, in particular, from cases of chronic OM, were culture negative [8-11]. Hence; under the light of above mentioned data, the present study was undertaken for assessing the clinical and pathogenic aspects of chronic otitis media.

In the present study, mean age of the patients was found to be 20.8 years. 48 percent of the patients belonged to the age group of less than 30 years. 60 percent of the patients were males while the remaining were females. 72 percent of the patients had rural residence while the remaining had urban residence. Neogi R *et al.* assessed the clinico-epidemiological profile, perceptions and clinical profile of the chronic suppurative otitis media (CSOM) patients in a tertiary care hospital. A pretested questionnaire was used containing open questions and the patients were assessed clinically. Most patients (31.2%) were from 0-10 years age group and were males (58.8%). Majority of them (96%) lived in "kuccha" houses/slums, 76.8% practised unhygienic ear pricking, 36.8% poured oil in their ears, 70.8% bathed in ponds/rivers, 52.8% had ear discharge for more than 1 year. Among the respondents, 17.2% knew that CSOM was contagious, 24% thought CSOM ran in family, 20% knew CSOM is preventable. There was low threat perception and long time to seek care. Patients mostly presented with earache, deafness and discharge, most had deafness and safe variety of CSOM. More than half had comorbidities. Most of the previous

study findings corroborated with the present study. Here was a substantial delay between the onset and treatment seeking due to lack of awareness and low threat perception. Pain and complications were the triggers for care-seeking [12].

In the present study, earache and ear discharge were found to be the prominent clinical manifestation. Deafness and pain were found to be the other presenting symptoms. While assessing the pathogenic profile, it was observed that coagulase-negative staphylococci, *S aureus*, *P aeruginosa*, *Klebsiella* spp. and *Proteus* spp. were present in 80 percent, 60 percent, 64 percent, 48 percent and 40 percent of the cases. Vikram BK *et al.* compared the clinical and epidemiological profiles of cases of complicated and uncomplicated chronic suppurative otitis media, based on their prognostic factors. The study group comprised 187 ears, out of which 62 had complications while 125 did not. The two groups were compared with respect to nine prognostic variables: age distribution, sex, patient's domicile, literacy status, duration of ear discharge at presentation, ear pathology, predisposing disease focus in the nose or throat, ear swab microbiology, and hearing loss. Patients in the complicated chronic suppurative otitis media group had a higher male predominance and were younger. Rural and illiterate patients had a higher risk of developing complications. Cholesteatoma and granulation tissue were potential risk factors in the complicated chronic suppurative otitis media group. Ears with complications were more prone to develop sensorineural hearing loss. Age, sex, duration of ear discharge, predisposing disease focus in nose or throat, and ear swab microbiology were all less useful prognostic indicators of complications. Early detection and timely treatment of chronic suppurative otitis media in rural and illiterate patients may prevent life-threatening complications and reduce their incidence [13].

In the present study, earache was present in 14 males and 9 females. Ear discharge was present in 15 males and 10 males. Deafness was present in 9 males and 6 females. Pain was present in 6 males and 4 females. Non-significant results were obtained while assessing the distribution of patients with different clinical profile according to gender. With sensitive assays including culture, polymerase chain reaction and antigen detection, bacteria, viruses, or both, are detected in middle ear fluid in up to 96% of AOM cases. A study of middle ear fluid in 79 children with AOM and indwelling tympanostomy tubes found that 66% had bacteria and viruses, 27% had bacteria alone, and 4% had only viruses. The microbiology of AOM has changed over the last 2 decades with increasing penetration of pneumococcal vaccination programs. The most common bacterial species that cause AOM continue to be *Streptococcus pneumoniae*, nontypeable *Haemophilus influenzae*, and *Moraxella catarrhalis*. The heptavalent *S pneumoniae* vaccine (PCV) was introduced in 2000, shortly after which the frequency of *S pneumoniae* recovery in tympanocentesis studies of AOM decreased relative to that of the other microbes. The *S pneumoniae* serotypes contained in PCV continued to decline in AOM patients, and were in fact nearly absent by 2007 through 2009. However, they have been replaced by nonvaccine pneumococcal serotypes in both tympanocentesis and nasopharyngeal colonization studies, so that the incidence of *S pneumoniae* was approximately equal to that of *H influenzae*, with *M catarrhalis* less frequent. The new 13-valent *S pneumoniae* vaccine, PCV, was licensed in 2010 and will undoubtedly additionally shift the microbiological landscape of AOM [14-16]. Deb T *et al.* assessed the types of aerobic bacteria involved in CSOM. Aural swabs were collected from 100 ears, from 97 patients complaining of ear discharge, continuous or

intermittent, with a non- intact tympanic membrane for at least 12 weeks. Swabs were sent to the hospitals microbiology laboratory for culture and sensitivity tests. Bacteria could be isolated in 53 cases and 47 swabs were culture negative. The commonest bacteria isolated were pseudomonas (20) followed by *Staphylococcus aureus* (11), *E. coli* (11), proteus (9) and klebsiella (2). Three patients had bilateral ear discharge of which one had proteus in both ear swabs, one grew proteus in one ear and no growth in the other, and one patient showed no aerobic bacteria in any of his ear swabs. Among the culture positive cases ($n = 53$) gram negative bacteria were isolated in 79.24% ($n = 42$) and *S. aureus* in 11(20.75%) cases. Among 97 patients number of male and female patients was 50 and 47, respectively. Pseudomonas, *E. coli*, Bacilli proteus and *S. aureus* were the predominant bacteria involved in CSOM. Out of the 53 positive isolates ciprofloxacin could be tested against 35 i.e., 66%. Ciprofloxacin was sensitive in 26 isolates, intermediately sensitive in 4 and resistant in only five isolates. They concluded that, gram negative bacteria especially pseudomonas is the commonest bacteria involved in CSOM in this part of north east India [17].

In the present study, Coagulase-negative staphylococci were seen in 12 males and 8 females. *S aureus* was found to be present in 10 males and 5 females. *P aeruginosa* was found to be present in 11 males and 5 females. Klebsiella spp. were found to be present in 8 males and 4 females. Non-significant results were obtained while assessing the microbial growth among patients divided on the basis of gender. Abraham ZS *et al.* determine the prevalence and etiological agents for chronic suppurative otitis media. A total of 5591 patients were recruited and only 79 (1.4%) had chronic suppurative otitis media. A male preponderance 43 (54.4%) was noted in this study and the left ear (58.2%) was more commonly affected compared to the right ear. Central perforation was the commonest pattern of presentation and was reported in 53% of cases though none had attic perforation. Of the 81 processed ear swabs, microbial growth was seen in majority 80 (98.8%) whilst one sample showed no microbial growth whereas 52.5% had polymicrobial growth. Among the isolates, most were gram negative species accounting for 59.7% while gram positive bacteria accounted for 25.6% and fungi accounted for 14.7%. Most of these isolates were facultative anaerobes. Klebsiella pneumoniae (20.2%) was the commonest isolates while Escherichia coli and Pseudomonas aeruginosa were equally least isolated (10.9%). Tested isolates were most sensitive to Ciprofloxacin, Gentamycin, Ceftriaxone and Amikacin and least sensitive to Amoxicillin/clavulanic acid and Ampicillin [18].

Table 1: Demographic data

Parameter	Number	Percentage
Age group (years)	Less than 30	12
	30 to 50	8
	More than 50	5
Gender	Male	15
	Female	10
Residence	Rural	18
	Urban	7

Table 2: Clinical profile

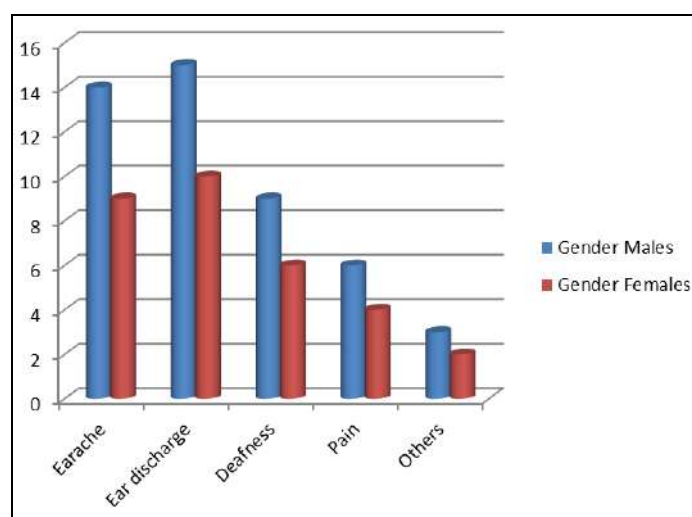
Clinical profile	Number	Percentage
Earache	23	90
Ear discharge	25	100
Deafness	15	60
Pain	10	40
Others	5	20

Table 3: Pathogenic profile

Pathogenic profile	Number	Percentage
Coagulase-negative staphylococci	20	80
<i>S aureus</i>	15	60
<i>P aeruginosa</i>	16	64
Klebsiella spp.	12	48
Proteus spp.	10	40
No growth	1	4

Table 4: Clinical profile among males and females

Clinical profile	Gender	
	Males	Females
Earache	14	9
Ear discharge	15	10
Deafness	9	6
Pain	6	4
Others	3	2
Chi-square value	1.45	
p- value	0.12	

**Graph 1:** Distribution of patients with Clinical profile according to gender**Table 5:** Pathogenic profile among patients divided on the basis of gender

Pathogenic profile	Gender	
	Males	Females
Coagulase-negative staphylococci	12	8
<i>S aureus</i>	10	5
<i>P aeruginosa</i>	11	5
Klebsiella spp.	8	4
Proteus spp.	7	3
No growth	0	1
Chi- square value	1.965	
p- value	0.33 (Non-significant)	

Conclusion

From the above results, the authors conclude that earache and ear discharge are the most common presenting symptom of chronic otitis media with coagulase-negative staphylococci and *S aureus* being the prominent micro-organism responsible for it.

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