

Pathogenesis and Microbiology of Otitis Media with Effusion in Children

Essam A. Abo Elmagd^{1*}, Tahia Hashem Saleem², Mahmoud E. Khalefa¹, Bahaa Elhawary¹

¹Faculty of Medicine, Aswan University, Aswan, Egypt

²Faculty of Medicine, Assiut University, Assiut, Egypt

Email: *esamali801@yahoo.com

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Abstract

Objective: To detect different etiological factors of otitis media with effusion (OME) and different types of microorganisms in middle ear fluids. **Methods:** This prospective study included 60 patients with otitis media with effusion diagnosed at the otorhinolaryngology (ENT) outpatient clinic with age ranged from 2 to 16 years, 36 males and 24 females. **Results:** Predisposing factors of OME were rhinosinusitis in 58.3% of cases, adenoid in 20% of cases, adenotonsillitis in 16.7% of cases and tonsillitis in 5% of cases. Microorganisms in middle ear fluids were negative in 70% of cases, isolation of streptococcus pneumonia in 16.7% of cases, *Haemophilus influenzae* 6.7% and *Moraxella catarrhalis* 6.7%. **Conclusion:** Rhinosinusitis was the most frequent predisposing factor of cases of OME. Positive bacterial culture was found in 30% of cases.

Keywords

Otitis Media with Effusion, Microbiology, Pathogenesis

1. Introduction

OME is characterized by a non-purulent effusion of the middle ear that may be either mucoid or serous without acute symptoms. It is one of the common causes of deafness among children. When inadequately treated, it may lead to major functional limitations like hearing loss and impairment in development of speech and language [1]. The reason for treatment failure is probably due to partial knowledge of etiopathological mechanisms responsible for the beginning and the course of the disease in the mucous membrane of the middle ear [2]. OME includes inflammation of the tubotympanum and an accumulation of fluid

within the middle ear. The disturbance of the excretory function is due to mechanical obstruction of the Eustachian tube (ET) and/or mucociliary dysfunction of the tubotympanum. Mechanical obstruction has been emphasized for a long time, but recent laboratory investigations have established the critical importance of mucociliary function in the tubotympanum. However, the pathogenesis is not fully understood. It is unclear whether the cilia functions normally throughout the full length of the ET in the chronic phase of OME [3]. OME was previously considered to be bacteriologically sterile. However positive bacterial cultures have been demonstrated in 40% of middle ear fluid; *Streptococcus pneumoniae* and *Haemophilus influenza* account for the majority of cases [4] [5] [6].

2. Patients and Methods

This prospective study included 60 patients with otitis media with effusion diagnosed at ENT outpatient clinic, South Valley university hospital during the period from December 2015 to December 2016. All patients gave written informed consent before entering the study and the study protocol was approved by the ethical committee of the faculty of Medicine, South Valley University.

The diagnosis of otitis media with effusion was made in our study group on the basis of the following clinical findings in the form of dull tympanic membrane, loss of con light, loss of landmarks of the eardrum, blue drum, and/or alteration in the mobility of tympanic membrane. Every patient had complete ear, nose and throat examination. All cases had detailed assessments aided by X-ray of soft tissue neck (lateral view) for adenoidal enlargement and an audiological assessment. All patients were subjected to tympanometric screening (Immittancemeter-Interacoustics-Automatic AZ26, Denmark).

3. For All Patients Included in the Study

Patients subjected to surgical management in the form of myringotomy and ventilation tube insertion (grommet), myringotomy and adenoidectomy or myringotomy and adenotonsillectomy according to the predisposing factor. Samples of middle ear effusions were collected using sterile syringe during the puncture of tympanum or tympanostomy tube placement Sample was sent for culture and sensitivity. For all samples, culture done using CLED media, incubation at 37 for 48 hours, for the negative results the time extended 24 hours more. Sensitivity for the positive results applied on neutral agar using the antibiotic discs and according to the diameter of inhibition, the results were recorded.

4. Statistical Analysis

Date entry and data analysis were done using SPSS version 19 (Statistical Package for Social Science). Data were presented as number, percentage, mean, standard deviation and median. Chi-square test was used to compare between qualitative variables. Mann-Whitney test was used to compare quantitative variables between groups in case of non-parametric data. P-value considered statistically

significant when $P < 0.05$.

5. Results

A total of included 60 patients with otitis media with effusion with age ranged from 2 to 16 years, 60% were less 5 years (**Table 1**), 36 males and 24 females (**Table 2**). Bilateral OME with rhinosinusitis diagnosed in 58.3%, with adenoid enlargement in 20%, with adenotonsillitis in 16.7% and with tonsillitis in 5% (**Figure 1**). Bilateral myringotomy and grommet tube insertion only was done in 58.3% of cases, with adenoidectomy in 20% of cases, with adenotonsillectomy in 16.7% and with tonsillectomy in 5% of cases (**Table 3**). Culture sensitivity results were negative in 70% of cases while positive culture in 30% of cases (Streptococcus pneumonia 16.7%, Haemophilus influenzae 6.7, Moraxellacatarrhalis 6.7%) (**Table 4**).

Table 1. Age distribution of the studied groups.

Age	Study (n = 60)		P. value
	No.	%	< 0.001
0 - 5 years	36	60.0	
5 - 10 years	18	30.0	
10 - 16 years	6	10.0	

Table 2. Sex distribution of the studied groups.

Sex	Study (n = 60)		P. value
	No.	%	0.121%
Male	36	60.0	
Female	24	40.0	

Table 3. Operations done.

Operations done	No. (n = 60)	%	P. value
Bilmyringotomy and grommet tube insertion and adenoidectomy	12	20.0	<0.001
Bilmyringotomy and grommet tube insertion and adenotonsillectomy	10	16.7	
Bilmyringotomy and grommet tube insertion and tonsillectomy	3	5.0	
Bilmyringotomy and grommet tube insertion	35	58.3	

Table 4. Culture.

Diagnosis	No. (n = 60)	%	P. value
<i>Streptococcus pneumonia</i>	10	16.7	<0.001
<i>Haemophilus influenzae</i>	4	6.7	
<i>Moraxella catarrhalis</i>	4	6.7	
Negative	42	70.0	

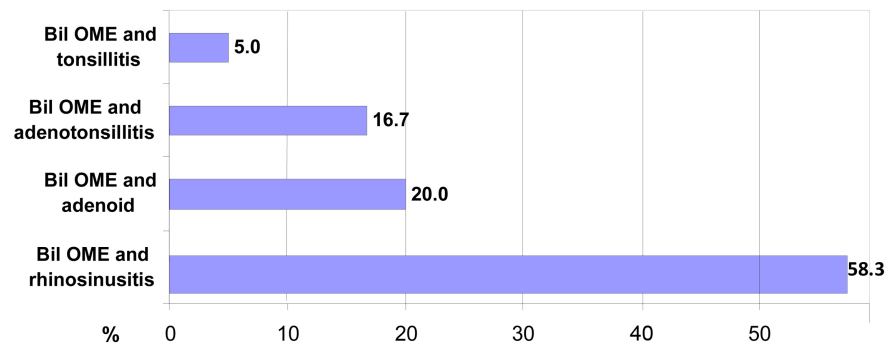


Figure 1. Predisposing factors of OME in study group.

6. Discussion

Otitis media with effusion (OME) is the presence of effusion within the middle ear cleft. It is one of the most common diseases of early childhood, 60% to 80% of children will have at least one episode during their first year of life [7] [8] 10 - 11. Microorganisms that locally colonize the adenoids and epithelium of the upper respiratory tract are the originator of inflammation process, which lead to mucous secretion in the middle ear. Identification of cytokines in secretion of the middle ear of the patients with OME indicates that the inflammatory mediators play a role in pathogenesis of OME [2].

In our prospective study, we included 60 patients with otitis media with effusion. patients subjected to surgery, suction of the effusion fluid was done and the sample sent for culture and sensitivity.

In our study, we found that the preschool age group (≤ 5 years) represented 60% of our patients which is in agreement with most of the published studies [2]. Li *et al.*, 2016 [9] reported that 60% to 80% of children will have at least one episode during their first year of life.

Clinical guidelines from a joint commission of specialties document that screening surveys of healthy children between infancy and age 5 years show a 15% - 40% point prevalence in middle ear effusion. Furthermore, among children examined at regular intervals for 1 year, 50% - 60% of childcare attendees were found to have OME [10]. On the other hand, Khan *et al.*, 2006 [6] in Pakistan reported that only 10.34% of his OME cases were below 5 years and 62% of his patients were 5 - 8 years. That difference may be due to sampling enrolment error in his study as there are no cases included below the age 2 year. Age is clearly an important predisposing factor in the development of OME. In infants, the Eustachian tube has a nearly horizontal orientation. In addition, the size and shape of the Eustachian tube at birth, unlike those in adults, are unfavorable for ventilation of the middle ear [11]. In our study, boys were more affected with OME than girls (60% vs. 40%). This is in agreement with Kubba *et al.*, 2000 [2], Khan *et al.*, 2006 [6] and Erdivanili *et al.*, 2012 [11] who reported that boys are more likely to have OME than girls but with no significant difference. In our study we found that rhinosinusitis, adenoid hypertrophy and chronic tonsillitis were the most common predisposing factors (58.3%, 20%, and

5%; respectively). Khan *et al.*, 2006 also reported that rhinosinusitis, adenoid hypertrophy and chronic tonsillitis were the most common predisposing factors (36.8%, 34.5%, and 13.8%; respectively). Joshua, 2008 [12] reported that upper-respiratory tract infection was found to have a pronounced association with bilateral status of effusion at baseline. However, Balram and his colleague, 2001 reported that 95% of their patients had adenoid hypertrophy. That difference in results may be due to recording of small sized adenoids as Balram *et al.*, 2001 divided his patients with adenoids into large adenoids present in 45% and medium and small adenoids in 50% of his cases. Damoiseaux *et al.*, 2006 [13] reported that recurrent upper respiratory tract infection is a risk factor for persistence of acute otitis media and development of otitis media with effusion. In our study bilateral myringotomy and grommet tube application in combination to adenoidectomy were done to 20% and bilateral myringotomy with grommet tube application and adenotonsillectomy were done to 16.7%, bilateral myringotomy and grommet tube application were done in 58.3%, bilateral myringotomy and tonsillectomy were done in 5% of case. In other words myringotomy and grommet tube application was done in 86.7% of patients and adenoidectomy was done in 36.7% of patients. In a study in Pakistan [6] bilateral myringotomy and grommet tube application in combination to adenoidectomy were done to 17.5%, bilateral myringotomy and adenoidectomy were done to 14%, bilateral myringotomy and grommet tube application and adenotonsillectomy were done to 21%, bilateral myringotomy and grommet tube application were done in 29.8%, and bilateral myringotomy was done in 12.3% of cases. In other words in this study myringotomy and grommet tube application was done in 73.6% of patients and adenoidectomy was done in 52.5% of patients. The difference between both results is due to the lower frequency of hypertrophied adenoids among our patients. In our study suction of the effusion fluid was done and the sample send for culture and sensitivity. The results of culture and sensitivity were positive in 18 cases (30%). This is in agreement with Sedeek *et al.*, 2016 [14], who reported that bacterial culture of OME showed positive result for 20% - 30% of patients. *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis* are the three most common bacterial species, isolated by culture, in the middle ear effusion. Saafan *et al.*, 2013 [15] analyzed the adenoid biofilms for the most common middle ear pathogens (*S. pneumoniae*, *H. influenzae*, *M. catarrhalis*, and *S. aureus*) employing multiplex-PCR (polymerase chain reaction) in parallel with Scanning electron microscopy (SEM). They found that 96% of adenoid samples had middle ear pathogens present. As regards that point there are many controversies among different studies and literatures. OME was previously thought of as a sterile inflammatory process, as bacterial cultures were frequently negative. Later, nucleotide amplification techniques demonstrated that these effusions contain genomic material of pathogenic bacteria, which remains present up to 4 weeks after treatment with antibiotics. Furthermore, bacterial mRNA and proteins have also been found in the effusions, indicating that these bacteria remain metabolically active. These findings lead to the hypothesis that, in OME, otopa-

thogenic bacteria live in a specialized structure, called “biofilm” [16]. Regardless of the cause of acute otitis media, eustachian tube dysfunction is nearly universal in otitis media with effusion. As further evidence, ligation of the eustachian tube in animals invariably leads to the formation of a persistent middle ear effusion. Once the acute inflammation and bacterial infection have resolved, a failure of the middle ear clearance mechanism allows middle ear effusion to persist. Many factors have been implicated in the failure of the clearance mechanism, including ciliary dysfunction; mucosal edema; hyperviscosity of the effusion; and, possibly, an unfavorable pressure gradient [13]. Otitis media with effusion does not necessarily follow acute otitis media. Theories to explain the development of middle ear effusion in this case include the secretion of fluid from inflamed middle ear mucosa. This theory proposes that the middle ear mucosa is sensitized by previous exposure to bacteria, and continued antigenic challenge from occasional reflux induces the production of the effusion. On the contrary multiple studies have revealed that the same flora of bacteria is present in otitis media with effusion as in acute otitis media; these findings indicate that this effusion is not sterile [17]. Okomoto *et al.* 1993 [18] reported that adeno and rhinoviruses of upper respiratory tract may invade the middle ear mucosa and stimulate it to increase secretory activity. Tran 2005 [19] reported that inadequate antibiotic therapy in acute suppurative otitis media lead to low grade infection which act as stimulus for mucosa to secrete more fluid.

7. Conclusion

Of the whole patients of OME, 60% were under school age and only 10% of patients were above 10 years. Rhinosinusitis was the most frequent predisposing factor of cases (58.3%), followed by adenoids enlargement (20%) then adenotonsillitis (16.7%). Positive bacterial culture was found in 30% of cases.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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