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Full Length Research Paper

Bacterial etiology of acute middle ear infections

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To determine the bacterial etiology of acute middle ear infections in preschool age children. This prospective descriptive clinical study was implemented in Marmaris town between November, 2008 and May, 2009 with 80 cases. Their age ranged from 2 - 6. One fourth of the cases were preschoolers. The diagnosis of acute middle ear infection was confirmed by an otolaryngologist following a pediatrician and paracentesis that was performed. Bacterial culture was done in regular conditions and antibacterial resistance was assessed with disk diffusion method. *Streptococcus pneumoniae* was the most frequent etiologic agent. It was followed by *Haemophilus influenzae* (15%) and *Staphylococcus aureus* (6%) in order of frequency. The penicillin resistance rate of pneumococci was 24%.

Key words: Child, infection, middle ear infection.

INTRODUCTION

Acute otitis media (AOM) is the most frequent bacterial infection and the most frequent cause of antibiotic use in children. Despite of the use of appropriate antibiotic, middle ear fluid occurring after AOM may persist for weeks or months. That may lead to repeated use of antibiotics and eventually surgical intervention. For this reason, AOM causes to an important cost besides it disturbs the patient and his/her family (Niemelä et al., 1999; Shurin et al., 1979). The leading risk factors are male gender, attending to a daycare center, lack of breastfeeding, the number of the persons living in the house, smoking in the house, living in a region of air pollution, missing vaccination, nutritional mistakes (Rovers et al., 2006; Daly et al., 2005). Although etiology varies in different geographic regions of the world, bacterial agents are the leading causes and followed by viral agents and mixed infections (Kleemola et al., 2006; Winther et al., 2006). *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis* are the leading bacterial agents (Güven et al., 2006). Leading viral etiologic agents are rhinoviruses and respiratory syncytial viruses. Determining its etiology contributes to make an accurate therapeutic plan as it is a leading infectious disease among the diseases treated with antibiotics. In this study, it was aimed to determine the bacterial etiology in the children applied to our hospital and diagnosed with AOM.

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MATERIALS AND METHODS

The research was started after having received the approval of the consent from the parents of the patients. This study was carried out with the cases applied to Ahu Hetman Hospital Pediatrics Out-patients Clinic between November, 2008-May, 2009 and diagnosed with AOM.

The criteria to being included in the study

Accordance between pediatrician and confirmatory otolaryngologist with the diagnosis of AOM, the presence of clinical signs onsetting recently and suggesting AOM, the cases having the disease in the past 7 days, not having a known predisposing chronic diseases, no use of antibiotics within the last 2 weeks or long-acting penicillin within the last 1 month, the parents consent to collect middle ear material.

AOM case definition

Following three features were asked for definitive diagnosis of AOM: 1) The acute onset of the diseases, 2) Middle ear effusion (MEE), 3) The signs or findings of acute inflammation and the presence of dullness, hyperemia and suppurative signs of eardrum and the signs of fluid accumulation in middle ear space on examina - tion of the patient who had clinical findings suggesting AOM, made

Table 1. General characteristics of the patients and some factors influencing the isolation of bacteria.

	Bacterial izolations of middle ear fluid (n: 26; 65%)	None bacterial izolations of middle ear fluid (n: 14; 35%)
Age (average)	4.1	4.5
H. influenzae type b conjugates vaccine (%)	25%	75%
Attending to a daycare center (%)	34.6%	65.4%
The history of middle ear infection within the last 6 months (%)	60%	40%

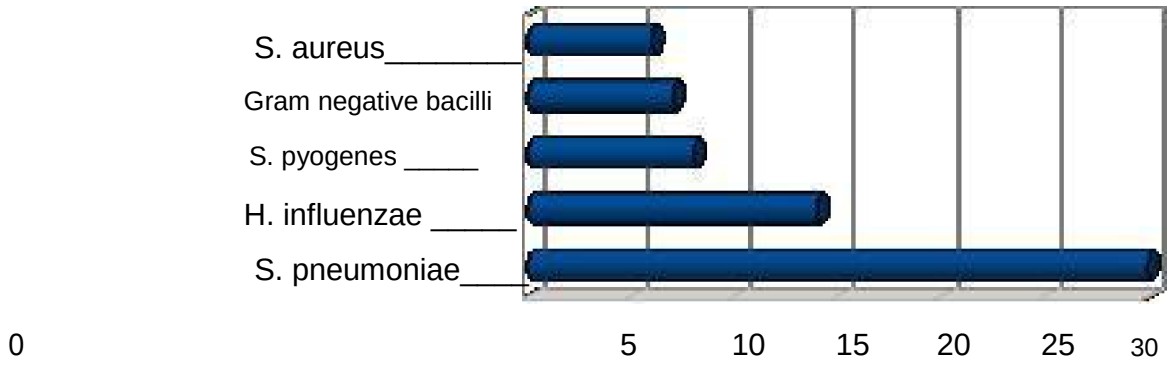

Figure 1. Bacterial agents isolated from middle ear.

made the diagnosis of AOM (Rovers et al., 2004). The cases with chronic diseases, no signs of AOM on otolaryngological examination, perforated eardrum, who were recently treated with antibiotics and whose parents didn't give consent were excluded.

Collecting of middle ear fluid

After otoscopic examination, the cerumen in the external auditory canal was cleaned. Without applying any antiseptic material to external auditory canal, tympanocentesis was performed with a sterile paracentesis blade and purulent middle ear fluid was collected into transport medium with a sterile collector using “John Tymp-Top” middle ear aspirator and sent to microbiology laboratory.

Microbiologic examination

The samples were cultured aerobically on 5% sheep blood agar, chocolate agar, MacConkey agar, Sabouraud dextrose agar and thioglycolate broth. All media were incubated in an incubator at 35 - 37°C for 24 - 48 h. The slides prepared from culture media were evaluated with Gram staining. The bacteria with alpha hemolysis on blood agar and susceptible to optochin were identified as *S. pneumoniae*. The bacteria with beta hemolysis on blood agar, susceptible to bacitracin, positive PYRse (Pyrrolidine peptidase enzyme) reaction were classified with latex agglutination and positive ones were classified to be group A beta hemolytic streptococci. The colonies multiplied on chocolate agar with the appearance of Gram negative coccobacilli were identified as Haemophilus due to their need for X and V factors and the bacteria with the appearance of Gram negative cocci, oxidase and DNAse positive were identified to be *M. catarrhalis* . Antibiotic susceptibility was assessed with disk diffusion method according to NCCLS (1). Serotyping was done with appropriate antiserum.

FINDINGS

The study was carried out with 80 cases. The rates of the middle ear infection in the right, the left and bilaterally were determined as 41.8, 24.2 and 34% respectively. Of the cases included in the study, 55% (44) were male and 45% (36) were female. The mean age was calculated as 4.3 years (2 years old: 10 cases; 3 years old: 14 cases; 4 years old: 18 cases; 5 years old: 16 cases and 6 years old: 22 cases). The rate of the attendance to a daycare center was 25%. It was the first middle ear infection episode in 42.3% of the cases, while 57.7% of the cases have had previous middle ear infections. Of the cases that had previous middle ear infections, 60% have had the infection within the last 6 months. Of the patients, 30% were vaccinated with *H. influenzae* type b conjugate vaccine (Table 1).

The rate of bacterial isolation from middle ear fluid was 65%. Among the bacteria isolated, *S. pneumoniae* was in the first place (30%). It was followed by in order of frequency *H. influenzae* (14%), *S. pyogenes* (8%), Gram negative bacilli (7%) and *S. aureus* (6%). Penicillin resistance rate of all bacteria isolated was 18%. Three isolates of *S. pneumoniae* (21.4%) were found to be penicillin resistant. Two of them (14.2%) were highly resistant to penicillin and one of them (7.1%) showed intermediate penicillin resistance. In three of the patients vaccinated with Hib vaccine, *S. pneumoniae* was isolated. Only one of them was penicillin resistant.

When the factors influencing bacterial isolation from

middle ear fluid were evaluated, male gender may increase the isolation rate while attending a daycare center and the history of middle ear infection within the last 6 months diminished the chance of isolation (Figure 1).

DISCUSSION

Of the children, 80 - 90% has at least one episode of AOM by 10 years. The disease has not being limited in the middle ear cavity; inflammatory process comprises Eustachian tube and mastoid cells. It is suitable to classify the etiologic factors of acute suppurative otitis media under two headings as risk factors and microbiological factors. Additionally, it is required to evaluate the risk factors in two groups.

Environmental risk factors

Seasons

The disease gets increased in winter and fall seasons. In winter, it is encountered 4 times higher than in the other seasons. Living in a crowded environment; AOM attacks are common in children in a crowded environment such as daycare center and preschool. It has been shown in various studies that the child is at risk of AOM if parents are tobacco smokers, namely the child is subjected to passive smoking. Middle ear is generally affected during some childhood diseases epidemics, especially in the course of scarlet fever, measles and mumps. A poor socioeconomical situation is accepted to be a risk factor.

The risk factors related to the patient

Age

AOM is common between 0 - 7 years, the disease peaks in 2 - 4 years. The leading one among the risk factors is repetitive upper respiratory tract infections. Low birth weight. Ethnicity; the disease is common in white people. Gender; male patients are in majority. Heredity; in the recent studies it has been emphasized that some families are more prone to infections, although it cannot be certain. The fact that the children who are not nor cannot breastfed are susceptible to the infections is generally accepted. Allergic rhinitis and adenoidal hypertrophy.

As microbiological factors, the bacteria such as *S. pneumoniae*, *H. influenzae*, *B. catarrhalis*, *S. pyogenes*, *S. aureus* and *S. epidermidis* are the most frequently isolated bacteria in AOM.

In the etiology of acute middle ear infections, causing agents are reported in the literature to be bacteria in the rate of 62%, viruses with bacterial agents in the rate of 45% and viruses in the rate of 75%. The order of frequency of the bacteria can vary according to the geographic region and has being changed over years with increased use of antibiotics and has a dynamic character (Sener and Günalp, 1998; Casey and Pinchichero, 2004). The most common agent in the bacterial etiology of AOM is reported to be *S. pneumoniae*, untyped *H. influenzae* and *M. catarrhalis* are reported in the second and third places, respectively (Siegel and Bien, 2004; Rovers et al., 2004). In our study, the order of frequency of the bacteria out of *S. pneumoniae* and *H. influenzae* was different from that reported in the literature. *S. aureus*, which is reported among rare agents, was determined to be in the 3rd place; *M. catarrhalis* which is reported to be 3rd agent and group A beta hemolytic streptococci which is among rare agents were determined to be in the 4th place. Evaluating in terms of the level of development of the countries, S. aureus has been reported in lower rates (1 - 2%) in developed countries and in slightly higher rates (4%) in developing countries in etiology of AOM according to the studies (6). But, in our study it was determined to be higher (6%) . In a study by Jacobs (7), *H. influenzae* was determined to be in the first place.

In *S. pneumoniae*, the most common bacterial agent of AOM, penicillin resistance has been reported in increasing rates, up to a mean of 40%, varying by country (Kanra et al., 1998; Yalçin et al., 2006). In this study, the rate of penicillin resistant pneumococci was determined to be 28.3%. Of the cases, 28% were vaccinated with H influenzae type b conjugate vaccine. But, it was evaluated that AOM encountered in vaccinated cases was normal and it was concluded that vaccination was still useful, because of the mild course of disease. In two distinct studies, it was showed that influenza vaccination before flu season decreased AOM incidence by 32 and 36% (Heikkinen et al., 1991; Clements et al., 1995). With another influenza vaccine given intranasally, influenza proved by culture was prevented by 93% and AOM incidence was decreased by 30% (Belshe et al., 1998). For this reason, influenza vaccine can be recommended to the children over six months old, prone to otitis and attending a daycare center.

In conclusion, bacteria were responsible in more than half of the AOM cases in childhood in our study and *S. pneumoniae*, *H. influenzae* and *S. aureus* were placed in the first three. Penicillin resistance rate among all the bacteria isolated was 18% and amoxicillin resistance was 37.2%. We believe that our research about bacterial etiology of acute middle ear infections must support with more crowded groups.

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