

International Journal of Research and Reviews in Pharmacy and Applied science

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## AN UPDATED REVIEW ON OTITIS MEDIA

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### ABSTRACT

The history and clinical assessment of children with symptoms, which may be associated with otitis media, are used to differentiate between AOM, OME and non-otological pathology. Almost half of these children will have three or more ear infections during their first 3 years. It is estimated that medical costs and lost wages because of otitis media amount to \$5 billion a year in the United States. Although otitis media is primarily a disease of infants and young children, it can also affect adults.

**Key words** Introduction, sign and symptoms, causes, diagnosis ,treatment.

## 1 INTRODUCTION

Otitis media is the medical term for middle ear infection or inflammation of the middle ear. Although several subtypes of otitis media are distinguished, the term is often used synonymously with acute otitis media. It is very common in childhood but may occur at any age[4].

This inflammation often begins when infections that cause sore throats, colds, or other respiratory or breathing problems spread to the middle ear. These can be viral or bacterial infections. Seventy-five percent of children experience at least one episode of otitis media by their third birthday. Almost half of these children will have three or more ear infections during their first 3 years. It is estimated that medical costs and lost wages because of otitis media amount to \$5 billion a year in the United States. Although otitis media is primarily a disease of infants and young children, it can also affect adults[5].

- Acute otitis media (AOM) is defined as the presence of inflammation in the middle ear accompanied by the rapid onset of signs and symptoms of an ear infection.
- Otitis media with effusion (OME) is defined as the presence of fluid in the middle ear without signs and symptoms of an ear infection[6]. The prevalence of otitis media with effusion (OME), commonly referred to as glue ear, is very high. In one study, around 80% of children had OME at least once before the age of four[7].
- Chronic suppurative otitis media (CSOM) is defined as a chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharges or otorrhoea through a tympanic perforation. It persists typically for a minimum of a month. This is in distinction to an acute ear infection (acute otitis media) that usually lasts only several weeks. Chronic otitis media can cause ongoing damage to the middle ear and eardrum, and there may be continuing drainage through a hole in the eardrum. Chronic otitis media often starts painlessly without fever. Sometimes a subtle loss of hearing can be due to chronic otitis media[8].

The history and clinical assessment of children with symptoms, which may be associated with otitis media, are used to differentiate between AOM, OME and non-otological pathology. The symptoms most associated with acute otitis media are fever, earache, irritability, otorrhoea, lethargy, anorexia and vomiting. These lack sensitivity or specificity for diagnosis particularly in children under two in which group the symptoms of earache, conjunctival symptoms and rhinorrhoea are associated with AOM.

In the case of OME, there may be no history to indicate the presence of the disease. A relevant element to be elicited in the history includes information about disability in terms of hearing difficulty, together with information on social interaction, behaviour, function in the educational setting and speech and language development. Clumsiness and poor balance may also be relevant[9].

## **2 SIGNS AND SYMPTOMS**

Acute OM (AOM) implies rapid onset of disease associated with one or more of the following symptoms:

- Otolgia
- Fever
- Otorrhea
- Irritability
- Vomiting
- Diarrhea

These symptoms are accompanied by abnormal otoscopic findings of the tympanic membrane (TM), which may include the following:

- Opacity
- Bulging
- Erythema
- Middle ear effusion (MEE)
- Decreased mobility with pneumatic otoscopy

Other signs to look for in younger children include:

- pulling, tugging or rubbing their ear
- poor feeding
- restlessness at night
- coughing
- a runny nose
- unresponsiveness to quiet sounds or other signs of difficulty hearing, such as sitting too close to the television or inattentiveness
- loss of balance

Sometimes, in cases of middle ear infection, the eardrum will become perforated (a hole will form in it) and pus may run out of the ear. This can help to relieve the pain by releasing the pressure on the eardrum, but it may also lead to re-infection[10].

### 3 CAUSES

A multitude of host, infectious, allergic, and environmental factors contribute to OM development:

#### 1. Host factors

- **Immune system:** The immature immune systems of infants or the impaired immune systems of patients with congenital immune deficiencies, HIV infection, or diabetes may be involved in the development of OM. OM is an infectious disease that prospers in an environment of decreased immune defenses. The interplay between pathogens and host immune defense plays a role in disease progression.
- **Familial (genetic) predisposition:** Although familial clustering of OM has been demonstrated in studies that examined genetic associations of OM, separating genetic factors from environmental influences has been difficult. No specific genes have been linked to OM susceptibility. As with most disease processes, effects of environmental exposures on genetic expression probably play an important role in OM pathogenesis.
- **Mucins:** The role of mucins in OME has been described. Mucins are responsible for gel-like properties of mucus secretions. The middle ear mucin gene expression is unique compared with the nasopharynx. Abnormalities of this gene expression may have a predominant role in OME.
- **Anatomic abnormality:** Children with anatomic abnormalities of the palate and associated musculature have higher risk for OM. Specific anomalies that correlate with high prevalence of OM include cleft palate, Down syndrome.
- **Physiologic dysfunction:** Abnormalities in the physiologic function of the ET mucosa, including ciliary dysfunction and edema, increase the risk of bacterial invasion of the middle ear and the resultant OME. Children with cochlear implants have a high incidence of OM especially chronic OM.

#### 2. Infectious factors

##### 2.1 Bacterial pathogens:

- The most common bacterial pathogen in AOM is *Streptococcus pneumoniae*, followed by nontypeable *Haemophilus influenzae* and *Moraxella catarrhalis*. These 3 organisms are responsible for more than 95% of all AOM cases with a bacterial etiology.
- In infants younger than 6 weeks, gram-negative bacilli (eg, *Escherichia coli*, *Klebsiella* species, and *Pseudomonas aeruginosa*) play a much larger role in AOM, causing 20% of cases. *S pneumoniae* and *H influenzae* are also the most common pathogens in this age group. *Staphylococcus aureus* has also been found as a pathogen in this age group in some studies, but more recent studies suggest that the flora in these young infants may be that of usual AOM in children older than 6 weeks.

- *M catarrhalis* induced AOM differs from AOM caused by other bacterial pathogens in several ways. It is characterized by higher proportion of mixed infections.
- In chronic suppurative OM, the most frequently isolated organisms include *P aeruginosa*, *S aureus*, *Corynebacterium* species, and *Klebsiella pneumoniae*.
- The role of *Helicobacter pylori* in children with OME has been increasingly recognized.
- *Alloiococcus otitidis* is a newly recognized species of gram-positive bacterium that has been recently discovered as a pathogen associated with OME. This organism is the most frequent bacterium in AOM, as well as in OME.

## 2.2 Viral pathogens

- Certain respiratory viruses can cause inflammatory changes to the respiratory mucosa that lead to ETD, increased bacterial colonization and adherence, and, eventually, AOM. Studies have also shown that viruses can alter the host-immune response to AOM, thereby contributing to prolonged middle ear fluid production and development of chronic OME.
- The viruses most commonly associated with AOM are respiratory syncytial virus (RSV), influenza viruses, parainfluenza viruses, rhinovirus, and adenovirus.

## 3. Factors related to allergies

- The relationship between allergies and OM remains unclear. In children younger than 4 years, the immune system is still developing, and allergies are unlikely to play a role in recurrent AOM in this age group. Although much evidence suggests that allergies contribute to the pathogenesis of OM in older children, extensive evidence refutes the role of allergies in the etiology of middle ear disease.
- Many patients with OM have concomitant allergic respiratory disease (eg, allergic rhinitis, asthma).

## 4. Environmental factors

### 4.1 Infant feeding methods

- Many studies report that breastfeeding protects infants against OM. Breastfeeding reduces the incidence of OM by 13%.
- The protective effects of breastfeeding for the first 3-6 months persist 4-12 months after breastfeeding ceases, possibly because delaying onset of the first OM episode reduces recurrence of OM in these children.

#### 4.2 Passive smoke exposure:

- Many studies have shown a direct relationship between passive smoke exposure and risk of middle ear disease.

#### 5. Socioeconomic factors

Socioeconomic status encompasses many independent factors that affect both the risk of OM and the likelihood that OM will be diagnosed.

- In general, lower socioeconomic status confers higher risk for environmental exposure to parental smoking, bottle-feeding, crowded group daycare, crowded living conditions, and viruses and pathogens.
- Compared with children from middle-income and high-income families, children from lower socioeconomic groups use health care resources less frequently, which decreases the likelihood that OM cases will be diagnosed[11].

#### 4 PATHOPHYSIOLOGY

The ear consists of three major parts: the outer ear, the middle ear and the inner ear. The outer ear includes the pinna which is the visible part of the ear and the ear canal. The outer ear extends to the tympanic membrane or eardrum, which separates the outer ear from the middle ear. The middle ear is an air-filled space that is located behind the eardrum. The middle ear contains three tiny bones, the malleus, incus, and stapes, which transmit sound from the eardrum to the inner ear. The inner ear contains the hearing and balance organs. The cochlea contains the hearing organ which converts sound into electrical signals which are associated with the origin of impulses carried by nerves to the brain where their meanings are appreciated.

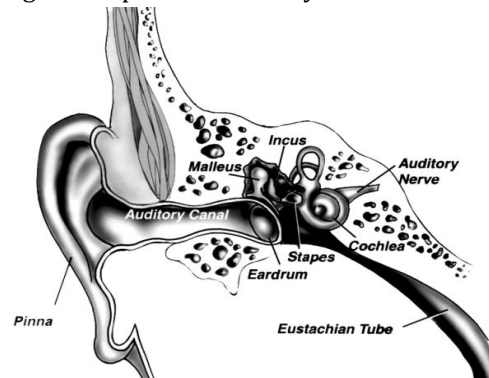


Figure:1

The pathogenesis of acute otitis media in most children usually follows this pattern:

The patient has an antecedent event (usually an upper respiratory viral infection) that results in congestion of the mucosa of the upper respiratory tract, including nasopharynx and eustachian tube. Congestion of the mucosa in the eustachian tube obstructs the eustachian tube and negative middle ear pressure develops; if prolonged, potential pathogens (viruses and bacteria) are aspirated from the nasopharynx into the middle ear. Because the eustachian tube is obstructed, the middle ear effusion, due to infection, accumulates in the middle ear, Microbial pathogens proliferates in the secretions, resulting in a suppurative and symptomatic otitis media[12].



**Figure:2 A view of the tympanic membrane showing acute otitis media**

## 5 DIAGNOSIS

A pneumatic otoscope is a small, hand-held device that has a magnifying glass and a light source at the end. It is used to study the inside of the ear. An otoscope can detect certain signs that would indicate fluid in the middle ear, which in turn may indicate an infection.

These include the ear drum:

- being pulled inwards
- being an unusual colour
- having a cloudy appearance, and bubbles and fluid inside the ear

The otoscope can also be used to blow a small puff of air into the ear. If the Eustachian tube (a tube that passes between your throat and middle ear) is clear, the eardrum will move slightly. If it is blocked, the eardrum will remain still. The examination will also show whether the eardrum is perforated (has a hole in it).

1) **Other tests:** Other tests are usually only required if treatment is not working or complications develop. These tests are described below.

**Tympanometry:** Tympanometry measures how the ear drum reacts to changes in air pressure. A healthy ear drum should move easily if there is a change in air pressure. During a tympanometry test, a probe placed into ear changes the air pressure at regular intervals while transmitting a sound into the ear. The probe measures how sound reflects back from the ear, and how changes in air pressure affect these measurements. If less sound is reflected back when the air pressure is high, it usually indicates an infection.

**Tympanocentesis:** Tympanocentesis involves draining fluid out of the middle ear using a small needle. The fluid can then be tested for bacteria or viruses that could be responsible for the infection.

**CT scans:** A computer tomography (CT) scan may be used if it is thought the infection may have spread out of the middle ear. A CT scan takes a series of X-rays and uses a computer to assemble the scans into a more detailed, '3D' image of the skull[13].

### 5.1 Diagnosis of AOM

Acute otitis media is a purulent middle ear process and, as such, otoscopic signs and symptoms consistent with a purulent middle ear effusion in association with systemic signs of illness are required. Ear related symptoms may include earache, tugging or rubbing of the ear, irritability, restless sleep and fever. Children may also have a history of cough and rhinorrhea, symptoms which are reported to increase the risk of AOM. Earache, however, is the single most important symptom[14].

Otoscopic appearances typical of AOM include bulging tympanic membrane with loss of the normal landmarks, change in colour, (typically red or yellow) and poor mobility.

Systemic signs of illness with a middle ear effusion are not sufficient to make the diagnosis, and similarly, neither is the finding of an incidental effusion in an otherwise well patient. It should be borne in mind that the typical symptoms and signs may have resolved by perforation of the tympanic membrane and discharge of pus[15].

### 5.2 Presentation patterns for children with OME

Most children have middle ear effusions at some time during childhood but these are transient in the majority and often asymptomatic. There is a minority in whom effusions persist over months or years causing hearing loss which in turn potentially impairs speech development and educational performance[16,17]. Boys are more susceptible to OME than girls, as are children in day care and those with older siblings. Rates of bilateral OME are



twice as high during winter than summer. Common cold and OME are the most frequent diseases of infancy, characterised by a multifactorial pathogenesis[18].

Healthcare professionals should have an increased awareness of the possibility of the presence of otitis media with effusion in asymptomatic children. The following groups of children are at particular risk:

- those in day care
- those with older siblings
- those with parents who smoke
- those who present with hearing or behavioural problems.

### **5.3 Diagnosis of OME**

In many studies OME is diagnosed if there is middle ear effusion on pneumatic otoscopy with no signs of acute inflammation. In practice, pneumatic otoscopy is not used in primary care. No evidence based studies were identified concerning the most commonly used primary care diagnostic tool - otoscopy (with or without tuning fork testing).

Evidence of middle ear effusion consists of the presence of either:

- at least two tympanic membrane abnormalities (abnormal colour such as yellow, amber, or blue; opacification other than due to scarring; and decreased or absent mobility) and/or
- otoscopy typically showing a retracted/concave tympanic membrane with a colour change (typically yellow or amber). Air bubbles or an air/fluid level may be present and, while not typical, fullness or bulging may be visualised. Pneumo-otoscopy will demonstrate reduced or absent mobility.

The main symptom associated with OME is hearing loss. However this hearing loss is often not identified in infants and young children[19].

Type	Earache Fever Irritability	Middle ear effusion	Opaque drum	Bulging drum	Impaired drum mobility	Hearing loss
<b>AOM</b>	present	Present	Present	may be present	present	present
<b>OME</b>	usually absent	Present	may be absent	usually absent	present	usually present

**Table1: Diagnostic features of AOM and OME**

**6 TREATMENT**

Oral and topical pain killers are effective to treat the pain caused by otitis media. Oral agents include ibuprofen, paracetamol (acetaminophen), and opiates. Topical agents shown to be effective include antipyrine and benzocaine ear drops[20].

**6.1 Antibiotics**

It is important to weigh the benefits and harms before using antibiotics for acute otitis media. As over 80% of acute episodes settle without treatment, about 20 children must be treated to prevent one case of ear pain, 33 children to prevent one perforation, and 11 children to prevent one opposite side ear infection. The harms include, for every 14 children treated one child has an episode of either vomiting, diarrhea or a rash[21]. Deferring the start of antibiotics in acute otitis media for one to three days if pain is manageable with analgesics is currently recommended[22].

The first line antibiotic treatment, if warranted, is amoxicillin. If there is resistance or use of amoxicillin in the last 30 days then amoxicillin-clavulanate or another penicillin derivative plus beta lactamase inhibitor is recommended. While less than 7 days of antibiotics have less side effects more than seven days appear to be more effective. among short-course antibiotics, long-acting azithromycin was found more likely to be successful than short-acting alternatives. If there is no improvement after 2–3 days of treatment a change in therapy may be considered[23].

Another treatment option for chronic otitis media with discharge is topical antibiotics. Topical quinolone antibiotics can improve discharge better than oral antibiotics[24].

Other examples of antibiotics include: Cefixime, Clarithromycin, Erythromycin, Cefprozil, Cefaclor

## 6.2 Marketed drugs

- Augmentin (Amoxicillin-Clavulanate)
- Ceclor (Cefaclor)
- Cefzil (Cefprozil)
- Suprax (Cefixime)
- Zithromax (Azithromycin)
- Biaxin (Clarithromycin)

## 6.3 Other treatments:

### 6.3.1 Tympanostomy tube

In chronic cases with effusions, insertion of tympanostomy tube (also called a "grommet") into the eardrum reduces recurrence rates in the 6 months after placement but have little effect on long term hearing. Thus tubes are recommended in those who have more than 3 episodes of acute otitis media in 6 month or 4 in a year associated with an effusion[25].

A common complication of getting a tympanostomy tube is experiencing otorrhea, which is a discharge from the ear. Oral antibiotics should not be used to treat uncomplicated acute tympanostomy tube otorrhea. Oral antibiotics are not a sufficient response to bacteria which cause this condition and have significant side effects including increased risk of opportunistic infection. In contrast, topical antibiotic eardrops can treat this condition[26].

## 7 PREVENTION

Long term antibiotics, while they decrease rates of infection during treatment, have an unknown effect on long term outcomes such as hearing loss. They are thus not recommended. Pneumococcal conjugate vaccines when given during infancy decrease rates of acute otitis media by 6–7% and if implemented broadly would have a significant public health benefit. Certain factors such as season, allergy predisposition and presence of older siblings are known to be determinants of recurrent otitis media and persistent middle ear effusions (MEE). Previous history of recurrence, environmental exposure to tobacco smoke, use of daycare, and lack of breastfeeding have all been associated with increased risk of OM development, recurrence, and persistent MEE[27].

There is some evidence that breastfeeding for the first twelve months of life is associated with a reduction in the number and duration of OM infections. Pacifier use, on the other hand, has been associated with more frequent episodes of AOM. Evidence does not support zinc supplementation as an effort to reduce otitis rates except maybe in those with severe malnutrition such as marasmus[28].

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