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The impact of otitis media on hearing ability in children

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Abstract

Otitis media (OM) is the inflammation in the middle ear. Hearing impairment is frequently associated with OME. Pure tone audiometry and speech audiometry are two of the most commonly used auditory tests, both of which offer useful behavioural and functional information on hearing loss. A mild hearing loss affects about half of children who have an episode of OME, while a severe hearing loss affects about 5-10% of children. One of the most common reasons for children receiving antibiotics is acute otitis media. However, it is notoriously difficult to diagnose in infants and young children with accuracy, and treatment, especially when antibiotics are used, has been difficult. Updated guidance may be able to guide in the resolution of these issues.

AIM OF THE STUDY

This study aimed to detect the effect of otitis media on hearing ability in children

INTRODUCTION

Ear infections including otitis media (OM) and hearing loss are usually neglected problems in developing countries [1]. Infants and children are most commonly affected by OM, however, adults are not exempted. The countries are paid too much money for the treatment of this disease, for example, in the USA, the medical cost per year for this disease 5 billion $[2]. OM can result in various morbidity and even mortality if it is not treated promptly and in time. There are two problems in most of developing countries, including Iraq, firstly, there are no guidelines for treating OM and upper respiratory tract infection, and secondly, the patient or their relative are buying directly from the pharmacies without an official mandatory prescription from a doctor[3].

Otitis media is the inflammation of the mucous membrane of the middle ear cleft which includes the middle ear cavity (tympanic cavity), mastoid antrum, mastoid air cells and the Eustachian tube, When the inflammation is associated with a discharge from the ear through a perforation in the tympanic membrane, suppurative (or discharging) otitis media occurs. It may be acute (<6 weeks) or chronic (>6 weeks) [4]. It is one of the most common infectious diseases of childhood worldwide. Between 60 and 80 percent of children have at least one episode of AOM by one year of age, and 80 to 90 percent by two to three years. AOM is slightly more common in boys than girls. AOM is infrequent in school-age children, adolescents, and adults. It is particularly prevalent among children with cleft palate and other craniofacial defects, and those from lower socio-economic status[5]. Bacteria have remained the most important etiological agents in suppurative or discharging otitis media . Resistance to multiple antibiotics is not uncommon, further predisposing to complications among affected children. Universal immunization of infants with the 7-valent pneumococcal conjugate vaccine (PCV7) has decreased the incidence of AOM. In clinical trials, PCV7 reduced the overall incidence of AOM by 6 to 7 percent [6-7]. Acute otitis media is diagnosed in patients with acute onset, presence of middle ear effusion, physical evidence of middle ear inflammation, and symptoms such as pain, irritability, or fever. Acute otitis media is usually a complication of eustachian tube dysfunction caused by a viral upper respiratory tract infection. Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella catarrhalis are the most common organisms isolated from middle ear fluid. Management of acute otitis media should begin with adequate analgesia. Antibiotic therapy can be deferred in children two years or older with mild symptoms. High-dose amoxicillin (80 to 90 mg per kg per day) is the antibiotic of choice for treating acute otitis media in patients who are not allergic to penicillin. Children with persistent symptoms despite 48 to 72 hours

of antibiotic therapy should be reexamined, and a second-line agent, such as amoxicillin/clavulanate, should be used if appropriate. In the absence of acute symptoms, otitis media with effusion is known as middle ear effusion. Antibiotics, decongestants, and nasal steroids are not recommended because they do not speed up the clearance of middle ear fluid. [8]

Conductive hearing loss is the most frequent complication of OME, typically owing to the increased stiffness and mass of the tympanum caused by middle ear effusion .[9] For children with moderate to profound bilateral sensorineural hearing loss, there is a consensus that significant developmental defects of speech and language may occur as sequelae .[10] However, for mild to moderate OME related conductive hearing loss, there is no consensus on the level of hearing impairment which may trigger speech and language developmental disorders and warrant active intervention. In the United Kingdom's NICE guideline, persistent bilateral OME and no less than 25–30 dB HL in the better ear are considered criteria for surgery.[11] In the AAO-HNSF guidelines, no specific hearing threshold level is suggested. Moreover, hearing loss related with OME is often persistent or recurrent and occurs in the ''sensitive'' period for child speech and language development. [12] The ability to determine the hearing status of children with OME is essential for disease monitoring and management. During regularly recommended observational times known as "watchful waiting," advice may be given to children with hearing loss to minimize the impact of reduced auditory input, such as using preferential seating. [13] Type and severity of hearing loss may also be considered in determining surgical candidacy since ventilation tube placement has shown superiority for promoting quick recovery of pure tone hearing [14]. A number of national guidelines have recommended that pure tone hearing be evaluated when OME has persisted for three months, or before surgical intervention, however, a

US study showed that hearing assessment was only carried out for less than one third of children with OME for longer than three months or with risks for speech, language and academic problems [15].

Types of hearing loss

There are 3 types of hearing loss:

- **Conductive**: This type of hearing loss occurs when there is a problem with the sound getting through the outer or middle ear. This can be caused by:
    - Wax buildup.
    - Fluid in the ear.
    - Damage to the eardrum or middle ear bones birth defects, or a hereditary condition (passed down from the parents).

Conductive hearing loss may not be permanent, and can often be treated with medicine or surgery.[16]

- **Sensorineural**: This is a problem with the inner ear, especially the vestibular cochlear nerve. Causes of sensorineural hearing loss include:
    - Abnormal development in the womb.
    - Injury from certain diseases and infections.
    - Certain medicines.
    - Heredity.
    - Fluid backup.
    - Tumors.
    - Aging.
    - Overexposure to loud noise (which kills the hair cells).

This type of hearing loss is permanent. In many cases, sensorineural hearing loss can be treated with hearing aids.

- **Mixed**: This is a combination of conductive and sensorineural hearing loss.[16]

What are the risk factors for hearing loss?

- ✓ Otitis media (most common in children)
- ✓ Craniofacial abnormalities
- ✓ Family history of hearing loss.
- ✓ Exposure to infection in the womb.
- ✓ Ototoxic medicines (damaging to the auditory system).
- ✓ Down syndrome
- ✓ Certain diseases, such as syphilis, rubella, and bacterial meningitis.
- ✓ Head trauma (injury).

Diagnosis

Diagnosis requires a detailed history, local examination of the ear, nose, throat and neck, and detailed hearing tests. In children a more detailed examination may be required if the hearing loss is congenital. A full otolaryngology examination is mandatory for patients with hearing loss. Both ears must be examined with an otoscope or microscope. The examiner can see an obstruction of the ear canal with cerumen, debris, or a foreign body. Stenosis of the canal, which may be congenital or the consequence of repeated infections, can be seen. The tympanic membranes must be visualized to exclude acute infections, effusions, perforations, hemotympanum, or the presence of a cholesteatoma. Approximately 90% of patients with otosclerosis have normal tympanic membranes, while 10% have a pink tinge called Schwartz's sign.[17] If an adult is noted to have an effusion, then a flexible nasoendoscopy should be performed in the clinic to view the postnasal space.[18] Weber and Rinne tuning fork tests are useful screening tests for determining whether hearing loss is conductive or sensorineural. They may be performed in the clinic. [19] a They are best suited to unilateral hearing loss and

hearing loss that is not mixed in nature. Pure tone audiometry, rather than tuning fork assessments, is a safer way to diagnose cases of bilateral or mixed hearing loss.[19] A 512Hz tuning fork is struck on the clinician's knee or elbow, and the vibrating fork is positioned in the vertex of the patient's head near the midline of the forehead to perform the Weber examination. A tuning fork can be heard similarly in both ears as a natural consequence. The tuning fork can be heard better in the affected ear if you have conductive hearing loss. In a sensorineural hearing loss, the tuning fork will be heard louder in the unaffected ear. This is used in conjunction with the Rinne test, where again a vibrating 512Hz tuning fork is placed, this time on the mastoid process until the patient can no longer hear it, and then 1cm away from the external acoustic meatus. A normal result is when air conduction is heard better than bone conduction (paradoxically called Rinne positive). If bone conduction is superior to air conduction (Rinne negative), a conductive hearing loss is present. [20] Pure tone audiometry is the gold standard in hearing loss research, It can confirm the presence of hearing loss, quantify the severity, and determine the nature of the hearing loss.[21] Headphones deliver sounds in varying loudness over 250 to 8000 Hz. The patient notifies the audiologist when they hear the sounds 50% of the time. This is a measure of the air conduction threshold and is recorded in decibels (dB). The bone conduction threshold is determined by placing a transducer on the mastoid process. An air-bone gap exists when bone conduction is superior to air conduction.[22] This is significant when the gap is over 10dB and marks a conductive hearing loss. Usually, an air-bone gap over 40dB indicates pathology within the ossicular chain rather than solely a tympanic membrane pathology. Pure tone audiometry is appropriate for patients over the age of four. Alternative assessments for younger children include play and visual reinforcement audiometry. Both of these hearing

tests are subjective. Tympanometry, or acoustic impedance audiometry, provides objective evidence for the examination.[23]

CT scan Most causes of conductive hearing loss can be identified by examination but if it is important to image the bones of the middle ear or inner ear then a CT scan is required. CT scan is useful in cases of congenital conductive hearing loss, chronic suppurative otitis media or cholesteatoma, ossicular damage or discontinuity, otosclerosis and third window dehiscence. Specific MRI scans can be used to identify cholesteatoma. [24]

Management

Management of acute otitis media should begin with adequate analgesia. Antibiotic therapy can be deferred in children two years or older with mild symptoms. High-dose amoxicillin (80 to 90 mg per kg per day) is the antibiotic of choice for treating acute otitis media in patients who are not allergic to penicillin. Children with persistent symptoms despite 48 to 72 hours of antibiotic therapy should be reexamined, and a second-line agent, such as amoxicillin/clavulanate, should be used if appropriate.[25]

Analgesia

Analgesic dosing for the management of acute otitis media in children	
Paracetamol (oral)	**Age over three months: 15 mg/kg/dose (maximum 1 g) every four hours, maximum four doses in twenty-four hours**
Ibuprofen (oral)	**Age over three months: 10 mg/kg/dose (maximum 400 mg) every six to eight hours, maximum three doses in twenty-four-h**

Oxycodone (oral)	**0.1 mg/kg/dose (maximum 10 mg) orally every four hours when required**

Antibiotics

Bacterial resistance is a significant concern and an increasing clinical problem in AOM. Although some strains ofH. Influenzaeand M. catarrhalis are resistant to amoxicillin through their production of beta-lactamase, this can typically be overcome by including a beta-lactamase inhibitor such as clavulanic acid in the treatment regimen. The prevalence of antibiotic-resistant S. pneumonia and beta-lactamase producingH. Influenza is influenced by patient age, recent exposure to antibiotics, attendance at daycare and pneumococcal immunisation. A study reported penicillin resistance in nearly half of all nasopharyngeal isolates of these two bacteria. [26]

First-line antibiotics for AOM include:

• amoxycillin (50 to 60 mg/kg per day in two or three doses), unless the child has received this antibiotic in the previous month

• cefuroxime (30 mg/kg per day in two divided doses) as an alternative

• in the case of penicillin allergy, erythromycin (30 to 50 mg/kg per day in three divided doses) or clarithromycin (15 mg/kg per day in two divided doses). For treatment failure, second-line antibiotics include:

• amoxycillin plus clavulanic acid (22.5 + 3.2 mg/kg three times per day)

• clindamycin (30 to 40 mg/kg per day in three doses)

• a third-generation cephalosporin, such as ceftriaxone 50 mg/kg per day intramuscularly or intravenously, particularly if amoxycillin has been used in the previous 30 days.2 Adults are nearly 20 times less likely to develop AOM than children; their management should follow similar principles to those used in children.[26]

Conclusion

Otitis media is one of the most common childhood infectious diseases worldwide. By the age of one year, 60 to 80 percent of children have had at least one episode of AOM, and 80 to 90 percent by the age of two to three years. Although AOM typically presents with a set of distinct diagnostic features, diagnosis can be challenging in infants and young children because of poor compliance with examination, anatomical features and inconclusive signs. The most common cause of hearing loss was otitis media with effusion. The intensity and consequences of OME can be assessed using pure tone audiometric thresholds and speech perception in noise. Hearing loss caused by OME is usually 18–35 dB HL. The standard audiometric configuration of OME-related hearing loss is flat, with a slight peak at 2000 Hz and a drop at 8000 Hz. Speech comprehension is impaired in both quiet and noisy environments in children with OME-related hearing loss.

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