Management of otitis media

Acute otitis media, recurrent acute otitis media, chronic otitis media with effusion – when are antibiotics, ventilation tubes and other treatments appropriate?

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Otitis media – inflammation of the middle ear – is a very common condition of childhood, and is generally self-limiting. In acute otitis media (AOM), the inflammation is accompanied by systemic signs of acute infection, such as high temperature, and is seen as acute injection of the tympanic membrane with bulging pus behind it (Table 1). In otitis media with effusion (OME), which is also known as glue ear, the inflammation is accompanied by fluid behind the tympanic membrane but there are no signs or symptoms of acute infection. Confusingly, the term OME has been used for both chronic OME (more than three months' duration) and acute episodes (for example, after a cold). The term recurrent AOM is used when there are at least three episodes of AOM within a six-month period. Continuing inflammation of the middle ear can lead to perforation of the tympanic membrane and chronic otorrhoea, and is then termed chronic suppurative otitis media.

AOM and OME are common conditions in children, but they can occur at any age. About 50% of children will have had three or more episodes of AOM by the age of 3 years, and OME affects up to 80% of preschool children at some time. OME is the most common cause of deafness in children in the western world. Both OME and AOM have a peak in incidence in babies aged under 1 year and a second peak in incidence around 5 years of age. It is reassuring to note that most cases of AOM and OME resolve without intervention, and that most children outgrow all their ear problems between the ages of 6 and 8 years.

The management of otitis media is determined by the duration of the middle ear effusion and the accompanying complications, and it is therefore important to determine the duration of the effusion when considering the disease. Generally, otitis media should be treated when there is:

- AOM with complications
- recurrent AOM
- persistent bilateral otitis media with effusion of more than 12 weeks' duration and accompanying bilateral hearing loss of more than 20 dB HL (decibel hearing level) or damage to the tympanic membrane or ossicles.

Acute otitis media (AOM)

AOM usually arises as a complication of an upper respiratory tract infection and may be due to viruses and/or bacteria. The common viral pathogens include respiratory syncytial virus,

IN SUMMARY

- **Acute otitis media (AOM) often does not need antibiotic treatment in the first 24 hours of symptoms. Analgesia should be provided.**
- **Recurrent AOM (three or more episodes of AOM within a six-month period) should be treated.**
- **Otitis media with effusion (OME) present for at least three months and associated with conductive hearing loss should be treated.**
- **Otitis media associated with damage to the drum or ossicles needs to be treated.**
- **Biofilm is thought to be an aetiological factor in chronic OME.**

Table 1. Otitis media subcategories[1]

Otitis media: inflammation of the middle ear

- **Acute otitis media (AOM):** infection of the middle ear with acute onset, middle ear effusion (i.e. fluid in the middle ear) and signs of middle ear inflammation
- **Recurrent AOM:** at least three episodes of AOM in six months
- **Otitis media with effusion (OME; also known as glue ear):** middle ear effusion without signs or symptoms of acute infection. When OME persists beyond three months, it should be termed chronic
- **Chronic suppurative otitis media:** continuing inflammation in the middle ear giving rise to otorrhoea and perforation of the tympanic membrane

adenovirus and influenza virus type A and B, and the common bacterial pathogens include *Streptococcus pneumoniae, Haemophilus influenzae* and *Moraxella catarrhalis*.

Possible complications of AOM are listed in Table 2. The more common complications include chronic OME, tympanic membrane perforation, secondary otitis externa, granulation tissue, middle ear polyps and myringitis.

AOM may present with a history of earache, raised temperature, pulling at the ear and possible discharge if a perforation has occurred. Otoscopy will reveal a red bulging tympanic membrane. Depending on the stage of AOM, however, the tympanic membrane may be bulging with white pus and injected, or there may be a localised area of redness or just a localised area of pus behind it.

For most patients with AOM, no investigation is required. Patients should, however, be reviewed if symptoms do not settle within a few days, and should be followed up longer term to check that chronic OME does not ensue a few months later.

Treatment options for AOM

Analgesics

Paracetamol or ibuprofen can be used to relieve the pain of AOM in children.[1] The children's formulations of these drugs allow accurate dosing in young children (paracetamol: Children's Panadol Chewable Tablets, Children's Tylenol, Dymadon Drops, Dymadon Suspension, Panadol (Children); ibuprofen: Ibuprofen Suspension For Children, Nurofen For Children). Titchen and colleagues warn of significant drug reactions with NSAIDs in children.[2] Pain will settle within 24 hours in about

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About half of all children will have had three or more episodes of acute otitis media by the age of 3 years, and otitis media with effusion affects up to 80% of preschool children. However, most cases of otitis media resolve without intervention, and most children will not have ear problems beyond the ages of 6 to 8 years.

Table 2. Complications of otitis media

AOM

- Chronic OME
- Chronic perforation
- Secondary otitis externa
- Granulation tissue
- Middle ear polyps
- Myringitis
- Rarely: facial nerve palsy, mastoiditis, intracranial suppuration (meningitis and brain abscess), chronic suppurative otitis media, labyrinthitis

Recurrent AOM

AOM complications listed above plus:

- High frequency sensorineural hearing loss
- Persistent conductive hearing loss due to adhesions or tympanosclerosis

Chronic OME

- Conductive hearing loss, and consequent speech and language development delays and behavioural problems
- Adhesions
- Inflammation
- Cholesteatoma
- Atelectasis
- Necrosis of incus
- Tympanosclerosis

60% of patients without the use of antibiotics.[3]

Antibiotics

Patients aged 3 years and over should be treated with pain relief initially, and reviewed two to three days later if the pain has not settled.[4] At that stage, antibiotics can be used.

Antibiotics do reduce the rate of contralateral AOM.[3] Short courses (five or fewer days) lead to more treatment failures, relapses and reinfections than longer courses (eight to 10 days).[1,5]

In clinical practice, patients may be self-selecting, only seeing their GP when symptoms have not resolved after a day or two. In the light of Del Mar and colleagues' meta-analysis, carefully assessing how long the patient has had AOM symptoms will help determine whether to treat or to adopt a 'wait and watch' approach.[3]

Children aged 2 years and under should be treated with antibiotics at their initial presentation rather than using the wait and watch approach. Persistent infection or the onset of complications are harder to detect in children of this age because of their inability to communicate effectively. It can also be argued that if the patient is unlikely to return for follow up it is worth treating with antibiotics at the initial consultation. Del Mar and colleagues stated 'their [antibiotics] use should be discretionary rather than either prohibited or mandatory'.[6]

Amoxycillin is suggested as first line treatment, and the broader spectrum antibiotics amoxycillin–clavulanate (Augmentin, Clamohexal, Clamoxyl, Clavulin) and cefaclor (Aclor, Ceclor, Karlor, Keflor) as second line treatments. Amoxycillin is generally available in formulations given three times daily but a twice daily formulation is also available (Maxamox Suspension).

Vaccination

Vaccination against *S. pneumoniae* can, in theory, help reduce episodes of AOM. This may be especially useful if the child attends day care and is experiencing multiple AOM episodes. Two pneumococcal vaccines are available: Prevenar and Pneumovax 23. Prevenar can be given to children aged 2 years and under.

Follow up

Follow up should occur in a day or two if symptoms do not settle or there are complications. Even when symptoms seem to settle and there are no complications, follow up a week after the initial consultation is warranted for young patients in whom communication of persistent symptoms is unreliable.

Further follow up to check for chronic OME is worthwhile since in about 50% of cases of chronic OME there is a preceding episode of AOM.[7] This follow up timing should be months rather than weeks later, as most cases of OME will clear by three months and the aim is to detect only chronic cases.

Recurrent AOM

If ear infection recurs within one month, it is likely that the original infection had not completely settled. If antibiotics were not used initially then a course of seven to 10 days of amoxycillin may be useful. If antibiotics were previously used, a longer course (10 days rather than five days) may be effective. If antibiotic resistance is suspected, changing to a broader spectrum antibiotic can be of benefit. A child who has had three or more episodes of AOM within a six-month period (thereby fulfilling the definition of having recurrent AOM) should be treated. .

Taking an ear swab can be useful if there is a perforation with discharge. In recurrent cases of AOM, the swab may show a resistant pathogen, and hence guide the choice of subsequent antibiotic.

Recurrent AOM can cause high frequency sensorineural hearing loss and long term conductive hearing loss, the latter caused by adhesions or tympanosclerosis in the middle ear (Table 2).

Investigations for immunoglobulin subclass deficiencies are appropriate in some children with recurrent AOM, especially if AOM started very young in life or has often been accompanied by multiple other infections. These investigations are particularly warranted in children with frequent (monthly or so) recurrent infections, especially from an early age. Having said that, it is rare to need to determine immunoglobulin subclass levels in children.

In extremely rare cases, leukaemia can present with persistent ear infection,

often with discharge occurring despite ventilation tubes. A full blood count may, therefore, be warranted very occasionally. The diagnosis of leukaemia from recurrent or persistent ear infections alone is very rare.

Treatment options for recurrent AOM

Antibiotics

For acute recurrent infection, a broader spectrum antibiotic such as amoxycillin–clavulanate or cefaclor, which will cover resistant β-lactamase producing *H. influenzae* and *M. catarrhalis*, should be trialed. Alternatively, a longer course of the original antibiotic (seven to 10 days rather than five days) may be effective.

Long term antibiotics (for one month) can reduce the recurrence rate.[1] Intravenous antibiotics are needed only rarely.

Vaccination

Pneumococcal vaccination may be helpful for recurrent AOM, especially in the child day care setting.

Ventilation tubes (grommets)

Ventilation tubes can prevent recurrent AOM, and are indicated in children who have experienced at least three episodes of AOM in six months.

Ventilation tubes are thought to work in recurrent AOM by possibly affecting the oxygen tension and so altering the biofilm.

Chronic otitis media with effusion (OME)

As mentioned earlier, in about 50% of cases of chronic OME there is a preceding episode of AOM.[7] OME after AOM usually resolves spontaneously within three months. One meta-analysis showed that OME occurring after untreated AOM had 59% resolution by one month and 74% resolution by three months, and that OME of unknown duration had 28% resolution by three months and 42% resolution by six months.[8]

OME can be described as serous, mucoid or mucopurulent, depending on the consistency and appearance of the middle ear fluid.

It is now believed that a biofilm in the middle ear is a significant contributor to OME.[9] Biofilm is a blanket of bacteria existing in a very low metabolic state, enclosed in a self-produced polymeric matrix adhered to a surface such as mucosa. In this state, the bacteria have reduced requirements for oxygen and nutrients. The biofilm is often resistant to antibiotics as the several different bacterial species contained within it have varying levels of antibiotic resistance. The film may elicit an immune response that produces the mucin-rich effusion.[10]

Season is a risk factor for chronic OME, the condition being more likely to persist in autumn and winter than at other times of the year.[11] Child day care is another major risk factor; presumably this is related to repeated viral and bacterial illnesses and, possibly formation of a biofilm. Other risk factors include family history of OME and recurrent upper respiratory infections. It has also been observed that OME is more likely to persist if hearing levels in the best ear are worse than 30 dB HL.[11] Children with a cleft palate have a much greater incidence of OME, and the higher incidence continues despite palate repair.[10]

Chronic OME can have associated conductive hearing loss, which can lead to delays in speech and language development and behavioural problems (Table 2). It can cause damage of the tympanic membrane, with atelectasis and retraction leading to erosion of the ossicles (particularly the incus) and retraction pockets (Figure 1). Rarely, there may be subsequent cholesteatoma formation. Retraction of the membrane onto the incus or promontory occurs in 10% of chronic OME cases,[12] and affected patients should be followed

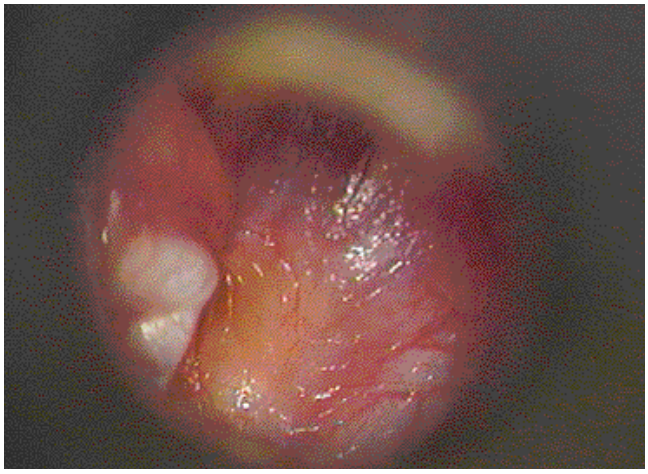

Figure 1. Chronic otitis media with effusion, showing retraction of the tympanic membrane onto the promontory, incus and stapes.

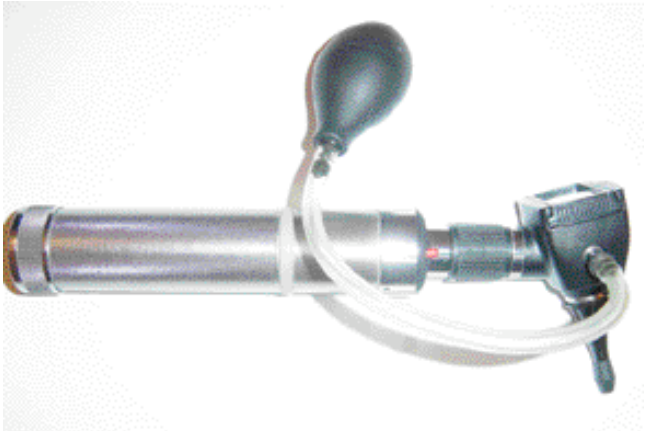

Figure 2. Pneumato-otoscopy using an otoscope with a pneumatic bulb enables investigation for middle ear effusion in the general practice setting.

up to check for resolution or referral to an ENT surgeon for management.

There is controversy about the link between OME and delays in speech and language development in young children. Paradise and collegues found in their meta-analysis that OME had no influence on hearing or speech and language development in children during the first three years of life.[13] However, Rosenfeld points out that most patients in Paradise and colleagues' meta-analysis had unilateral OME or discontinuous episodes, and that only 20% of the study group were children with bilateral continuous OME and hearing loss.[14] The important factors are the duration of OME and whether there is hearing loss associated with the chronic OME, as it is these factors that influence speech and language development.[15] Some children with chronic OME may still have hearing in the normal speech range even though they are hearing below their capability.

A UK-wide prospective study, the Trial of Alternative Regimens in Glue Ear Treatment (TARGET), found substantial benefit from ventilation tubes on hearing in children with bilateral persistent OME.[16] This study included only children with OME for more than three months and hearing outside the normal range preoperatively. These children had substantial benefit to their hearing and behaviour for up to two years after the ventilation tubes were inserted. Pre- and postoperative hearing test were performed.

More well designed studies that include preoperative hearing tests and look at outcomes of chronic OME with hearing loss should give further reliable assessments of the influence of hearing loss on speech and language.

Management of chronic OME

Most children with chronic OME do not have recurrent acute episodes of otitis media, and hence chronic OME is often insidious.

As the effects of OME and the subsequent management are influenced by the duration of the condition and most cases of OME will resolve within three months without treatment, generally only chronic OME (that is, over three months' duration) needs to be treated. From the history, the clinician may glean how long the TV has been turned up loudly, the child has been saying 'What?' frequently or the teacher has observed inattentiveness at school. Looking through the patient's file may reveal how long dull tympanic membranes have been observed at routine check ups. It is also important to ascertain whether the child has articulation problems or speech delay because investigation for hearing loss, and treatment of it, is generally started sooner in these cases.

The appearance of the tympanic membrane may be misleading in OME, and it may be difficult on otoscopy to be sure whether OME is present. In many cases, it may be obvious – for example, there may be amber fluid behind a bulging membrane or the membrane may be retracted and dull. Pneumato-otoscopy is possible in the general practice setting using a pneumatic bulb on the otoscope (Figure 2) and an olive tip speculum. This procedure shows whether the tympanic membrane moves with a puff of air, and is similar to performing a tympanogram. If there is air in the middle ear, the membrane will move with the change in pressure of the outer ear canal; if the middle ear is full of fluid, the membrane will not move with the puff of air. (Pneumato-otoscopy often works with a normal otoscope speculum – the important point is to get a seal so that any change in pressure in the canal will be transmitted to the tympanic membrane.)

Usual ENT practice is to wait for at least three months to see if spontaneous resolution of the middle ear effusion occurs. If, after three months, there is persistence of the effusion then treatment is started, particularly if there is associated hearing loss. Damage to the tympanic membrane (atelectasis) or the ossicles (due to retraction), or retraction that could cause cholesteatoma would necessitate earlier treatment. If an effusion persists but the hearing is normal and there is a normally positioned tympanic membrane then continued observation and follow up is a reasonable course of action.[17]

It is, therefore, important to explain to families that, while most cases of OME resolve spontaneously, follow up is needed three months after OME is thought to have started to check that it has resolved as its persistence is often insidious. If OME persists for more than three months then the hearing should be checked. Formal hearing tests can be a puppet test for children aged from 7 months to 3.5 years, or pure tone audiometry for older children. (In the puppet test, the child is taught to look towards a visual stimulus when he or she hears the sound.) The hearing test shows if the child's hearing is compromised by the presence of the fluid, and so determines whether active treatment is needed. A tympanogram can show if there is fluid in the middle ear, negative middle ear pressure or that the middle ear is normally aerated, and so is useful to confirm the presence or abscence of OME.

Damage to the tympanic membrane may require earlier treatment, and patients with atelectasis or severe retraction of the membrane should be reviewed in a month and referred to an ENT surgeon if the condition has not resolved.

For children with delays in speech or language development, it may be appropriate to actively treat fluctuating hearing loss, as in many cases fluctuation in hearing is likely to compound the language difficulties.

The broad indications for referral to an ENT surgeon for patients with chronic OME are listed in Table 3. Those with persistent chronic OME need to have a hearing test. This can be done either before review by the ENT surgeon or, more often, at the time of review in the ENT surgeon's rooms, depending on the age of the patient.

Treatment options for chronic OME

The treatment regimen for chronic OME is often stepwise, more conservative options being used before proceeding to surgery.

Antibiotics

Antibiotics may be effective in the treatment of OME. It is possible that they may help destroy the biofilm.[9] Antibiotics for a month, either full dose or low dose (once a day) can be trialled.

Otovent

Children aged 6 years and older have sufficient co-ordination to use the Eustachian tube inflation device known as the Otovent, and I have seen children as young as age 4 years use it effectively. The device comprises a balloon on the end of a nozzle that fits tightly against one nostril. The child blows up the balloon through the nostril while holding the other nostril closed, thus increasing the pressure in the postnasal space and forcing air up the Eustachian tube. Children find the Otovent's valsalva effect fun and the balloon being blown up provides visual reinforcement. I ask children to use it three times a day, a few times on each nostril, for a month.

Ventilation tubes

Ventilation tubes are indicated if there is persistent chronic bilateral OME of more than three months' duration with associated hearing loss or if the tympanic membrane is being damaged. They are inserted into the tympanic membrane under general anaesthetic as a day surgery procedure, and generally stay there for six to 18 months before being expelled. Ventilation tubes are thought to work by Bluestone's bottle analogy ('an inverted bottle loses its contents once a further hole is made to release the vacuum').[9] The inflammatory cycle settles with the aeration that results after drainage of the retained liquid.

Ventilation tubes improve hearing levels in children with mild conductive hearing loss due to chronic OME by, on average, 20 dB HL.[18] They can provide substantial benefits to hearing for up to two years in children with bilateral persistent OME, and can also significantly reduce behaviour problems.[16,19]

About 20% of children will have recurrence of chronic OME when their ventilation tubes fall out; these children will often need subsequent sets of tubes.

Adenoidectomy

Research findings are mixed regarding the benefits of ventilation tubes and adenoidectomy for chronic OME. Adenoidectomy is generally not recommended with the first set of ventilation tubes, but if subsequent sets are needed it may be offered as it is thought it may have a marginal benefit.

Treatments that don't work for chronic OME

Oral corticosteroids have not been shown in studies to provide long term benefit (for example, at six weeks' post-use) in the treatment of OME. Also, no clinical benefit has been shown for the use of antihistamines and decongestants in this condition.

Table 3. Indications for referral of children with otitis media

- Persistent bilateral OME for more than three months, with hearing loss
- OME with speech and language delay or cognitive delay
- Recurrent AOM
- Chronic ear discharge, for exclusion of cholesteatoma
- Unusual otoscopic findings, such as atelectasis, or if a cholesteatoma is suspected
- Hearing loss with a possible sensorineural component

Conclusion

AOM and chronic OME are very common conditions of childhood, and are usually self-limiting. In most cases, no active management is needed, and a watchful waiting approach is taken. A minority of patients will need treatment because of persisting symptoms and associated problems such as hearing loss or damage to the tympanic membrane.

Chronic OME is insidious and its presence needs to be looked for. Complications of chronic OME include hearing loss, and if this is present then speech, language and behaviour may be affected.

The nonsurgical and surgical treatment options for the management of otitis media include analgesia, antibiotics, ventilation tubes, pneumococcal vaccination and the Otovent. MT

A list of references is available on request to the editorial office.

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