CONTINUING MEDICAL EDUCATION

Acute Otitis Media—a Structured Approach

Jan Peter Thomas, Reinhard Berner, Thomas Zahnert, Stefan Dazert

SUMMARY

Background: Two-thirds of all children have an episode of acute otitis media (AOM) before their third birthday. Antibiotic treatment is often given immediately, even though adequate scientific evidence for this practice is lacking.

Methods: This review is based on a selective literature search including previously published evidence-based recommendations, particularly those of the current American guidelines.

Results: A purulent tympanic effusion, possibly associated with inflammation of the tympanic membrane, is indicative of AOM. Only some patients with AOM need immediate antibiotic treatment: children with severe otalgia and/or fever of 39.0°C or above, infants under 6 months of age, and children with certain specific risk factors, including immune deficiency and Down syndrome. In other cases, symptomatic treatment is appropriate. Antibiotic therapy (preferably with amoxicillin) should be initiated only if the symptoms and signs do not improve within two to three days.

Conclusion: As the currently available data are not fully consistent, there is still a need for controlled trials with well-defined endpoints to determine the relative benefits of immediate antibiotic treatment versus two to three days of watchful waiting.

► Cite this as:

Thomas JP, Berner R, Zahnert T, Dazert S: Acute otitis media: a structured approach. *Dtsch Arztebl Int* 2014; 111(9): 151–60. DOI: 10.3238/arztebl.2014.0151

Acute otitis media (AOM) is one of the most commonly occurring inflammatory diseases of infancy and childhood and the third most frequent reason for prescription of antibiotics in this age group (1).

The introduction of antibiotics in the first half of the 20th century was followed by a dramatic decrease in occurrence of the previously severe complications of this disease (e1). Up to the 1980s no-one doubted the necessity of immediate antibiotic treatment as soon as AOM was diagnosed (e2). In 1981, motivated by the increasingly evident resistance to antibiotics, van Buchem et al. were the first to demonstrate that children over the age of 2 years with uncomplicated AOM could tenably be managed by observation with purely symptomatic treatment (2). Although this paradigm shift has become embodied in various countries' guidelines (3, 4, e3–e5) in the intervening years, some studies have questioned this practice (5, 6).

An S2 guideline for the treatment of AOM is currently being prepared under the aegis of the German Society of Oto-Rhino-Laryngology, Head and Neck Surgery. The German College of General Practitioners and Family Physicians issued an S3 guideline on “Ear-ache” that was initially valid until December 2011 and is currently under revision (e6).

Learning goals

After studying this article, the reader should be in a position to:

- Accurately diagnose AOM
- Differentiate uncomplicated AOM from cases where complications may arise
- Initiate and monitor appropriate treatment of AOM.

Department of Otorhinolaryngology and Head and Neck Surgery, Ruhr University of Bochum: Thomas, M.D.; Prof. Dazert

Department of Child and Adolescent Medicine, Technical University of Dresden (Carl Gustav Carus University Hospital Dresden): Prof. Berner

Department of Otorhinolaryngology, Technical University of Dresden (Carl Gustav Carus University Hospital Dresden): Prof. Zahnert

Incidence

Acute otitis media (AOM) is one of the most commonly occurring inflammatory diseases of infancy and childhood and the third most frequent reason for prescription of antibiotics in this age group.

Figure 1:
Typical appearance of AOM
(reproduced by
kind permission of
C.A. von Illberg)

Nomenclature

“Acute otitis media” is the general term embracing all inflammatory diseases of the middle ear with particular involvement of the tympanic cavity. In Germany, acute purulent otitis media is distinguished from viral otitis media; this differs from the nomenclature in the English-speaking countries, where “otitis media” includes otitis media with (serous or mucous) tympanic effusion (e7).

Epidemiology

The incidence of AOM is highest in the first 2 years of life and decreases to 2% by the age of 8 years (7). More than two thirds of children have suffered at least one attack of AOM by their third birthday, and around half have experienced three or more episodes (8).

Some of these patients develop tympanic effusion, which may result in middle ear hearing impairment persisting into later childhood (e8).

In Germany, the mean 12-month prevalence of AOM in children and adolescents between 0 and 17 years of age was 11% during the observation period 2003 to 2006 (e9).

An increase in the prevalence of AOM up to the mid-1990s was followed by a reduction of around 19%. Besides the introduction of vaccination against pneumococcal infection and influenza, this decrease has been attributed to the establishment of less ambiguous diagnostic criteria, the recommendation of an attitude of watchful observation together with the growing

acceptance of this policy by parents (9), and decreasing exposure to cigarette smoke (10).

Microbiology

Depending on the method used and how stringently the diagnostic criteria are applied, bacteria can be demonstrated in 70% to as many as 90% of patients with AOM (e10).

In almost all cases, AOM is preceded by viral infection of the upper respiratory tract. The most frequent pathogen is respiratory syncytial virus. Other commonly occurring viruses are influenza and parainfluenza viruses, rhinoviruses, adenoviruses, and enteroviruses.

The most frequently occurring bacterial pathogens are *Streptococcus pneumoniae* and *Haemophilus influenzae*, followed by *Moraxella catarrhalis*. *Streptococcus pyogenes* and *Staphylococcus aureus* are found in smaller numbers of cases (e11). Prior to introduction of the heptavalent pneumococcal conjugate vaccine (PCV-7) the majority of cases of bacterial AOM were caused by pneumococci, but the bacterial spectrum changed thereafter. Studies in the USA showed a relative reduction in pneumococcal AOM from 33–48% to 23–31%, while the proportion of *H. influenzae* infections rose from 41–43% to 56–57% (11, e12). It is unknown whether the same is true for Germany. However, this shift may possibly be reversed by an increase in serotypes not contained in PCV-7. The consequences of the introduction of tridecavalent pneumococcal conjugate vaccine (PCV-13), which could potentially reduce the incidence of AOM caused by resistant pneumococcal serotypes, remain to be seen (12). Because influenza viruses are among the viruses most commonly demonstrated in middle ear fluid from patients with AOM and are also known to be precursors of pneumococcal infections, it may seem self-evident that influenza vaccination will reduce the incidence and severity of both viral and bacterial AOM, but to date only partial proof of this has been provided. A recent meta-analysis has shown that nasal administration of live attenuated influenza vaccine (LAIV) to children aged between 6 and 71 months lowers the incidence of AOM by 12.4% (13). However, these findings do not currently justify an obligatory recommendation to administer LAIV.

Clinical symptoms

AOM often occurs in patients with an upper respiratory tract infection. In isolation, symptoms such as earache and, in infants, compulsive grasping of the ear are not

Nomenclature

“Acute otitis media” is the general term embracing all inflammatory diseases of the middle ear with particular involvement of the tympanic cavity; in Germany, acute purulent otitis media is distinguished from viral otitis media.

Microbiology

Depending on the method used and how stringently the diagnostic criteria are applied, bacteria can be demonstrated in 70% to as many as 90% of patients with AOM.

FIGURE

Algorithm for treatment of acute otitis media (AOM)

specific (11). Only 10% of children with compulsive ear grasping have AOM (14). Fever, general malaise, and, in smaller children, diarrhea and vomiting are variable symptoms (e13).

In adolescents and adults, earache, headache, and impairment of hearing are usually less ambiguous. If

there is spontaneous perforation of the tympanic membrane, the earache disappears abruptly.

Diagnosis

Examination of the tympanic membrane by otomicroscopy or otoscopy is the keystone of correct diagnosis.

Clinical findings

AOM often occurs in patients with an upper respiratory tract infection.

Variable symptoms

Fever, general malaise, and, in smaller children, diarrhea and vomiting, are variable symptoms.

TABLE

Indications for antibacterial treatment versus observation in children with uncomplicated acute otitis media (AOM)*

Age	Moderate to severe earache Temperature $\geq 39.0^{\circ}\text{C}$ or otorrhea	Mild earache Temperature $<39.0^{\circ}\text{C}$
< 6 months	Antibacterial treatment	Antibacterial treatment
6 months < x < 2 years	Antibacterial treatment	Antibacterial treatment in bilateral AOM Observation in unilateral AOM
≥ 2 years	Antibacterial treatment	Observation

*Modified from (3)

While previously inflammatory changes of the tympanic membrane and simultaneous demonstration of an inflammatory effusion led to the diagnosis of AOM, the new guidelines of the American Academy of Pediatrics (AAP) recommend that the following criteria be met (3):

- Demonstration of moderate to severe bulging of the tympanic membrane or newly occurring otorrhea not caused by acute otitis externa.
- Demonstration of mild bulging of the tympanic membrane with occurrence of earache or pronounced reddening of the tympanic membrane in the previous 48 h.

Absence of fluid accumulation in the tympanic cavity is considered to exclude the presence of AOM.

The first of the two AAP recommendations for diagnosis is controversial. If severe bulging of the tympanic membrane suffices as sole criterion for AOM, differentiation from simple tympanic effusion becomes difficult. The transparency of the tympanic membrane should also be a criterion.

A history of acute occurrence of clinical symptoms such as earache, otorrhea, and/or fever supports the diagnosis of AOM but is not specific in isolation; it has a merely moderate predictive relationship with correct diagnosis (sensitivity 54%, specificity 82%) (11).

Reddening of the tympanic membrane as sole symptom is also insufficient for diagnosis of AOM, because its positive predictive value is only 7% (e14). In the early stage of AOM, with reddening and vascular injection of the membrane and before development of a purulent effusion, differentiation between purulent and nonpurulent (viral) otitis media is impossible. Diagnosis of purulent AOM is not justified until the appearance of the scaly, yellowish bulging of the membrane

with vascular injection and in some cases pulsation of the membrane and flattening of the appearance of the manubrium mallei (Figure 1).

Particularly in infants and young children, assessment of the tympanic membrane may be hampered by lack of cooperation, the narrowness of the external auditory meatus, and increased amounts of cerumen. In such cases the diagnosis is not completely certain. Pneumatic otoscopy to confirm the restricted mobility of the tympanic membrane can be helpful, but may well also present problems in small children. Other potential diagnostic procedures are tympanometry and acoustic reflectometry—neither of which, however, can distinguish AOM from tympanic effusion. Therefore, both of these examinations can be used only to supplement insufficiently evaluable otomicroscopy/otoscopy, not to replace it (e15, e16).

Exclusion of an otogenic complication requires inspection and palpation of the mastoid together with assessment of the function of the facial nerve by means of specific grimaces. Older children, adolescents, and adults should undergo audiological examination by means of the Weber/Rinne tuning fork test to exclude toxic involvement of the inner ear.

If an otogenic complication is suspected, further diagnostic procedures are indicated. These include:

- Detailed cochleovestibular diagnosis
- Swab analysis
- Skull MRI or petrosal CT
- Laboratory testing.

Differential diagnosis

Not only do purulent and viral AOM have to be differentiated, AOM also has to be distinguished from myringitis in association with an inflammation of the external

Diagnosis

Examination of the tympanic membrane by otomicroscopy or otoscopy is the keystone of correct diagnosis.

Exclusion criterion

Absence of fluid accumulation in the tympanic cavity is considered to exclude the presence of AOM.

auditory meatus and from acute exacerbation of chronic otitis media. The most commonly occurring differential diagnosis is serous/mucous tympanic effusion, which usually does not involve pain, reddening of the tympanic membrane, or a purulent exudate in the tympanic cavity. Clinically, however, differentiation may be problematic in the early stages of AOM or in the recovery phase.

Treatment

The following recommendations relate to uncomplicated AOM with no signs of systemic disease in an otherwise healthy patient (*Figure 2*). In addition to otogenic complications, conditions that may complicate the natural course of AOM include cleft lip and palate, genetic aberrations as in Down syndrome, immune deficiencies, and the presence of a cochlear implant. Furthermore, patients who suffer recurrence of AOM within 30 days must be considered separately owing to the lower likelihood of spontaneous healing and the higher incidence of otogenic complications.

The level of evidence (I to IV) and the grade of recommendation (A to C, good clinical practice [GCP]) are given in parentheses.

Earache is often the most bothersome early symptom and must be treated immediately and adequately, independent of any subsequent causal treatment (3). Acetaminophen (paracetamol) and ibuprofen are considered the standard analgesics in AOM (15) (IIa, A). Administration of topical local anesthetics is not recommended (e17) (IV).

Although the use of decongestant nose drops is viewed critically (16), it may be expedient owing to the frequent underlying (accompanying) rhinosinusitis (IV, C) (e18).

Owing to the limited data there are no universally valid recommendations for complementary or alternative procedures in the treatment of AOM.

Historically, the immediate administration of antibiotics to patients with AOM was considered the principal reason for the sharp decline in acute mastoiditis from the 1950s onward (17). However, this initial assumption turned out not to be true for uncomplicated AOM. The rate of mastoiditis in older children who were given antibiotics straightaway did not differ significantly from that in those who were monitored and only treated with antibiotics if they did not improve (0.59% versus 0.17%) (e19). International studies comparing countries with different policies for treatment of

BOX 1

First-line antibiotics in acute otitis media (3)

- **Antibiotic of choice**
 - Amoxicillin 50 (–60) mg/kg BW/day, divided into two or three doses
- **Exceptions**
 - Treatment with amoxicillin in the previous 30 days, presence of accompanying purulent conjunctivitis, history of recurring episodes of acute otitis media that have not responded to amoxicillin, or suspected infection with a β -lactamase-positive pathogen:
amoxicillin + clavulanic acid
(50 mg/kg BW/day amoxicillin + 12.5 mg/kg BW/day clavulanic acid, divided into two or three doses)
- **Alternative substances**
 - Cefuroxime
(30 mg/kg BW/day divided into two doses)
 - Cefpodoxime
(5–12 mg/kg BW/day divided into two doses)
 - Ceftriaxone i.v. or i.m.
(50 mg/kg BW/day in one dose for 1 or 3 days)
- **In the case of definite previous anaphylactic reaction to penicillin**
 - Erythromycin
(30–50 mg/kg BW/day divided into three doses)
 - Clarithromycin
(15 mg/kg BW/day divided into two doses)
 - Azithromycin (10 mg/kg BW on day 1, 5 mg/kg for next 4 days, one dose per day)

AOM also showed no significant variance in the incidence of acute mastoiditis (18).

Taken together, these studies seem to show that in children over 1 year of age the risk of acute mastoiditis following uncomplicated AOM is not increased by an initial period of observation, provided the patients are clinically examined at short intervals and antibiotic treatment is initiated in the absence of improvement. There is also no evidence that the incidence of meningitis in connection with AOM can be reduced by early administration of antibiotics (19, 20).

Differential diagnosis

Alongside viral AOM and myringitis, the most frequent differential diagnosis of purulent AOM is serous/mucous tympanic effusion.

Analgesic treatment

Acetaminophen (paracetamol) and ibuprofen are the standard analgesics in AOM. Analgesic ear drops are not recommended.

BOX 2

Second-line antibiotics in acute otitis media (3)

- The second-line antibiotic of choice is amoxicillin + clavulanic acid (unless used as first-line antibiotic) (dosage 50 mg/kg BW/day amoxicillin + 12.5 mg/kg BW/day clavulanic acid)
- Ceftriaxone i.v. or i.m. (50 mg/kg BW/day in one dose for 3 days)
- Clindamycin (30–40 mg/kg BW/day divided into three doses) + group-3 cephalosporin

Since the mid-1980s it has been shown that differences in cure rates between immediate administration of antibiotics and an initial phase of observation with adequate analgesia (watchful waiting) are also only marginally significant (19, 21, 22) (Ia).

Spontaneous amelioration of the symptoms of AOM occurs in about 60% of patients within the first 24 h, in around 80 to 85% within 2 to 3 days, and in 90% of cases after 4 to 7 days. Owing to the latency of the antimicrobial effect, immediate antibiotic treatment offers no advantage over placebo in the first 24 h. Four percent of patients benefit from antibiotics after 2 to 3 days, 9% after 4 to 7 days (e20). There is also no evidence for more rapid improvement in hearing due to immediate antibiotic treatment (23). However, immediate administration of antibiotics increases the likelihood of diarrhea by 5 to 14% (20, 21, 24) and the probability of skin rashes by 3 to 6% (5, 25). The slight therapeutic benefit of immediate antibiotic treatment should be weighed against the considerable spontaneous remission and the potential adverse effects of antibiotics, together with the possible facilitation of resistance to antibiotics and the medicoeconomic aspects.

The factors “age” and “severity of symptoms” play an essential part in the decision between watchful waiting and immediate antibiotic treatment. The failure rate of an initial phase of watchful waiting is almost twice as high in children under 2 years as in children over that age. Patients whose symptoms are classed as severe also have a significantly higher failure rate than those with only mild symptoms (14% versus 4%) (e21).

Therefore, depending on the patient’s age and the severity of the symptoms, a large proportion of patients with uncomplicated AOM can initially be treated purely symptomatically, provided they undergo clinical examination and otomicroscopy/otoscopy after 2 to 3 days (Ia, A).

The appropriate treatment must nevertheless be determined on an individual basis. The decision relies essentially on the clinical experience of the treating physician in assessing the severity of the patient’s symptoms.

The following are considered to indicate immediate administration of antibiotics:

- Age <6 months (Ia, A)
- Age <2 years with bilateral AOM, even in the case of only mild earache and temperature <39.0 °C (Ia, A)
- AOM with moderate to severe earache or temperature ≥ 39.0 °C (Ib, A)
- Persistent purulent otorrhea (Ia, A) (26)
- Risk factors (e.g., otogenic complication, immunodeficiency, severe underlying diseases, Down syndrome, cleft lip and palate, presence of cochlear implant, influenza) (III, B)
- Monitoring within the first 3 days not assured (Ib, A).

The recommendation criteria for antibiotic administration at the time of diagnosis are outlined in the *Table*.

If the initial management—whether observation or immediate antimicrobial treatment—does not result in amelioration of the symptoms within 48 to 72 h, alternative differential diagnoses must be excluded. If the diagnosis of AOM is confirmed in a patient initially treated by watchful waiting, antibiotic treatment should be started. If an antibiotic has already been given, it should be switched for a different antimicrobial substance. In patients who respond to antibiotic treatment the symptoms generally begin to lessen after 24 h. Any fever should have disappeared by 48 to 72 h after commencement of antibiotic administration.

The antibiotic of choice is amoxicillin, 50 (–60) mg/kg BW/day, divided into three doses (*Box 1*) (3). The advantages of amoxicillin are its high efficacy rate, high degree of safety, narrow microbiological spectrum, relatively low rate of adverse effects, and low cost (e22). In children, water-soluble dehydrated juice preparations should be used because of their higher resorption rate and thus bioavailability and their lower rate of gastrointestinal complications.

Spontaneous improvement

Spontaneous amelioration of the symptoms of AOM occurs in about 60% of patients within the first 24 h, in around 80 to 85% within 2 to 3 days, and in 90% of cases after 4 to 7 days.

Factors in decision making

The factors “age” and “severity of symptoms” play an essential part in the decision between watchful waiting and immediate antibiotic treatment.

If the patient has been treated with amoxicillin in the previous 30 days or has a history of recurring episodes of AOM that have not responded to amoxicillin, in cases of suspected infection with a β -lactamase-positive pathogen, and possibly in the presence of accompanying purulent conjunctivitis, primary administration of amoxicillin + clavulanic acid is recommended (Box 1) (3, e23).

Cefuroxime and cefpodoxime can be considered as alternatives in patients who are allergic to penicillins (14). In the event that oral intake is not feasible, a single dose of ceftriaxone i.v. or i.m. can be administered as adequate initial treatment (e24).

In the case of a true penicillin allergy, i.e., if the patient has had an unambiguous anaphylactic reaction to penicillin, erythromycin, clarythromycin, and azithromycin should be considered, bearing in mind the limited effect of macrolides against *H. influenzae* and *S. pneumoniae* (27).

Patients with a cochlear implant who develop AOM within 2 months of implantation should be given parenteral ceftriaxone. If AOM occurs more than 3 months after implantation, empirical treatment with amoxicillin or amoxicillin + clavulanic acid is recommended (28).

With regard to the duration of antibiotic treatment, the recommendations are as follows: children under 2 years old or with severe AOM should be treated for 10 days, children aged 2 to 6 years for 7 days, and children aged 7 years and above for 5 to 7 days (3, 29).

If the first-line antibiotic treatment fails, the following recommendations apply:

- The second-line antibiotic after failure of amoxicillin is amoxicillin + clavulanic acid.
- Failure of first- or second-line amoxicillin + clavulanic acid should be followed by paracentesis and microbiological testing. Alternatively, a 3-day course of parenteral ceftriaxone can be considered (3, e23) (Box 2).

Surgical treatment

If the above-mentioned escalation of antibiotic treatment still fails to ameliorate the symptoms, paracentesis and swabbing are indicated to identify the pathogen and thus establish the appropriate antibiotic.

Otogenic complications of AOM such as the development of acute mastoiditis, sinus thrombosis, otogenic meningitis, labyrinthitis, facial palsy, cerebral abscess, or Gradenigo syndrome generally necessitate, in addition to adequate antibiotic treatment, surgical intervention in the form of mastoidectomy with additional paracentesis and, if required, insertion of tympanic tubes to improve the circulation of air in the middle ear. Depending on the individual situation, further measures may be necessary (Box 3).

Antibiotic of choice

The antibiotic of choice is amoxicillin, 50 (–60) mg/kg BW/day, divided into three doses.

BOX 3

Symptoms of otogenic complications

- **Acute mastoiditis**
 - Unusual prominence of external ear, doughy retroauricular swelling and redness with pressure sensitivity, lowering of posterosuperior wall of external auditory meatus, elevated BSG, elevated CRP, radiologically visible shadowing of the mastoid with fusion of the bony trabecula (Bezold mastoiditis: swelling of the sternocleidomastoid muscle with torticollis)
- **Labyrinthitis**
 - Vertigo with nystagmus beating initially towards the affected ear, later towards the other side, progressive inner ear deafness
- **Facial palsy**
 - Incomplete or complete peripheral facial palsy
- **Sinus vein thrombosis**
 - Deterioration in general condition due to bacteremia and sepsis, retroauricular swelling of the skin over the emissary vein of the mastoid (Griesinger sign)
- **Epidural abscess, subdural abscess, meningitis**
 - Deterioration in general condition, headache, fever, stiff neck, somnolence, seizures
- **Cerebral abscess**
 - Uncharacteristic symptoms—dramatic in the final phase—may occur, piercing headache, stiff neck, somnolence, seizures, bradycardia, compression of brainstem by increasing cerebral pressure or breakthrough into the ventricular system
- **Gradenigo syndrome** (otorrhea with involvement of petrous apex of temporal bone) (very rare)
 - Irritation of the trigeminal nerve with severe pain behind the eye and paralysis of the oculomotor nerve and abducent nerve

tion to adequate antibiotic treatment, surgical intervention in the form of mastoidectomy with additional paracentesis and, if required, insertion of tympanic tubes to improve the circulation of air in the middle ear. Depending on the individual situation, further measures may be necessary (Box 3).

Recurring AOM

Recurring AOM is considered to be present when the patient has had at least three episodes of AOM in the previous 6 months or at least four episodes in the

Duration of antibiotic treatment

- Children under 2 years old or with severe AOM: treatment for 10 days
- Children aged 2 to 6 years: treatment for 7 days
- Children aged 7 years and above: treatment for 5 to 7 days

previous 12 months. Besides the exclusion of allergies and immune defects, patients with recurring AOM should have their vaccination status with regard to pneumococci checked, because vaccination can reduce the number of infections by 10 to 25% (e25).

The insertion of tympanic tubes, alone or in combination with adenotomy, can reduce the rate of recurrences by 1.5 events in 6 months (number needed to treat [NNT] = 2–5) (30, 31). Adenotomy alone does not lead to a reduction in the frequency of recurrent episodes of AOM (32).

Long-term low-dose antibiotic treatment reduces the recurrence rate by only 0.5 to 1.5 events within 12 months (e20), so it is not recommended (3, 33).

Follow-up

Apart from the above-mentioned follow-up after 2 to 3 days, it should be borne in mind that remission of the tympanic effusion is often a protracted affair. Tympanic effusion is still evident in 60 to 70% of children after 2 weeks, in 40% after 4 weeks, and in up to 25% as long as 3 months after onset of AOM. This must be monitored and treated as required in order to avoid delays in speech development. In the short term, decongestant nose drops can be given, the active Valsalva maneuver employed, or the tube opened passively by means of a Politzer balloon or a special nasal balloon. If the tympanic effusion persists for over 3 months, earlier in more severe cases, paracentesis is indicated, possibly accompanied by insertion of tympanic tubes together with adenotomy (e7).

Prevention

Some factors that contribute to early or recurring AOM are not amenable to influence: these include genetic predisposition, premature birth, male sex, some ethnicities, number of siblings, and low socioeconomic status (34). The following measures, however, reduce the risk of AOM:

- Breastfeeding for the first 6 months (35)
- Avoidance of exposure to tobacco smoke (10, 35, e26)
- Adequate vaccination against pneumococci and influenza (36–38).

Other measures that may exert a protective effect include:

- Dispensing with a pacifier (39)
- Reduction of the rate of upper respiratory tract infections by lowering kindergarten group size (e27)

- Use of xylitol chewing gum or xylitol lozenges several times a day during the time of year when common colds are prevalent (40)
- Insertion of tympanic tubes, in combination with adenotomy if required.

Conclusion

The criteria that have to be fulfilled before a diagnosis of AOM can be assigned are demonstration of a purulent tympanic effusion and, if applicable, demonstration of inflammatory changes of the tympanic membrane.

Uncomplicated AOM must be distinguished from AOM with complicating factors or the danger of otogenic complications.

In selected patients, depending on age, severity of symptoms, and accompanying diseases, management of uncomplicated AOM can begin with 2 to 3 days of symptomatic treatment and observation, followed by clinical examination.

If there is no remission of the symptoms, antibiotic treatment with amoxicillin should be initiated.

Conflict of interest statement

Prof. Berner has received lecture fees from Glaxo Smith Kline (*Impfakademie*), InfectoPharm, the Falk Foundation, and Milupa.

Dr. Thomas, Prof. Zahnert, and Prof. Dazert declare that no conflict of interest exists.

Manuscript received on 3 May 2013, revised version accepted on 5 November 2013.

Translated from the original German by David Roseveare.

REFERENCES

1. Holstiege J, Garbe E: Systemic antibiotic use among children and adolescents in Germany: a population-based study. *Eur J Pediatr* 2013; 172: 787–95.
2. van Buchem FL, Dunk JH, van't Hof MA: Therapy of acute otitis media: myringotomy, antibiotics, or neither? A double-blind study in children. *Lancet* 1981; 2: 883–7.
3. Lieberthal AS, Carroll AE, Chonmaitree T, et al.: The diagnosis and management of acute otitis media. *Pediatrics* 2013; 131: e964–99.
4. Uitti JM, Laine MK, Tahtinen PA, Ruuskanen O, Ruohola A: Symptoms and otoscopic signs in bilateral and unilateral acute otitis media. *Pediatrics* 2013; 131: e398–405.
5. Tahtinen PA, Laine MK, Huovinen P, et al.: A placebo-controlled trial of antimicrobial treatment for acute otitis media. *N Engl J Med* 2011; 364: 116–26.
6. Hoberman A, Paradise JL, Rockette HE, et al.: Treatment of acute otitis media in children under 2 years of age. *N Engl J Med* 2011; 364: 105–15.

Indications for surgical treatment

Complications such as acute mastoiditis, sinus thrombosis, otogenic meningitis, labyrinthitis, facial palsy, cerebral abscess, or Gradenigo syndrome generally necessitate surgical intervention.

Preventive measures

- Breastfeeding for the first 6 months
- Avoidance of exposure to tobacco smoke
- Adequate vaccination against pneumococci and influenza

7. Stangerup SE, Tos M: Epidemiology of acute suppurative otitis media. *Am J Otolaryngol* 1986; 7: 47–54.
8. Vergison A, Dagan R, Arguedas A, et al.: Otitis media and its consequences: beyond the earache. *Lancet Infect Dis* 2010; 10: 195–203.
9. Taylor S, Marchisio P, Vergison A, et al.: Impact of pneumococcal conjugate vaccination on otitis media: a systematic review. *Clin Infect Dis* 2012; 54: 1765–73.
10. Alpert HR, Behm I, Connolly GN, Kabir Z: Smoke-free households with children and decreasing rates of paediatric clinical encounters for otitis media in the United States. *Tob Control* 2011; 20: 207–11.
11. Coker TR, Chan LS, Newberry SJ, et al.: Diagnosis, microbial epidemiology, and antibiotic treatment of acute otitis media in children: a systematic review. *JAMA* 2010; 303: 2161–9.
12. Casey JR, Adlowitz DG, Pichichero ME: New patterns in the otopathogens causing acute otitis media six to eight years after introduction of pneumococcal conjugate vaccine. *Pediatr Infect Dis J* 2010; 29: 304–9.
13. Heikkinen T, Block SL, Toback SL, Wu X, Ambrose CS: Effectiveness of intranasal live attenuated influenza vaccine against all-cause acute Otitis Media in children. *Pediatr Infect Dis J* 2013; 32: 669–74.
14. American Academy of Pediatrics Subcommittee on Management of Acute Otitis Media: Diagnosis and management of acute otitis media. *Pediatrics* 2004; 113: 1451–65.
15. Bertin L, Pons G, d'Athis P, et al.: A randomized, double-blind, multi-centre controlled trial of ibuprofen versus acetaminophen and placebo for symptoms of acute otitis media in children. *Fundam Clin Pharmacol* 1996; 10: 387–92.
16. Coleman C, Moore M: Decongestants and antihistamines for acute otitis media in children. *Cochrane Database Syst Rev* 2008: CD001727.
17. Palva T, Pulkkinen K: Mastoiditis. *J Laryngol Otol* 1959; 73: 573–88.
18. van Zuijlen DA, Schilder AG, van Balen FA, Hoes AW: National differences in incidence of acute mastoiditis: relationship to prescribing patterns of antibiotics for acute otitis media? *Pediatr Infect Dis J* 2001; 20: 140–4.
19. van Buchem FL, Peeters MF, van 't Hof MA: Acute otitis media: a new treatment strategy. *BMJ (Clin Res Ed)* 1985; 290: 1033–7.
20. Damoiseaux RA, van Balen FA, Hoes AW, Verheij TJ, de Melker RA: Primary care based randomised, double blind trial of amoxicillin versus placebo for acute otitis media in children aged under 2 years. *BMJ* 2000; 320: 350–4.
21. Spiro DM, Tay KY, Arnold DH, et al.: Wait-and-see prescription for the treatment of acute otitis media: a randomized controlled trial. *JAMA* 2006; 296: 1235–41.
22. Little P, Gould C, Williamson I, et al.: Pragmatic randomised controlled trial of two prescribing strategies for childhood acute otitis media. *BMJ* 2001; 322: 336–42.
23. Glasziou PP, Del Mar CB, Sanders SL, Hayem M: Antibiotics for acute otitis media in children. *Cochrane Database Syst Rev* 2004: CD000219.
24. Bartlett JG: Clinical practice. Antibiotic-associated diarrhea. *N Engl J Med* 2002; 346: 334–9.
25. deShazo RD, Kemp SF: Allergic reactions to drugs and biologic agents. *JAMA* 1997; 278: 1895–6.
26. Rovers MM, Glasziou P, Appelman CL, et al.: Antibiotics for acute otitis media: a meta-analysis with individual patient data. *Lancet* 2006; 368: 1429–35.
27. Tristram S, Jacobs MR, Appelbaum PC: Antimicrobial resistance in *Haemophilus influenzae*. *Clin Microbiol Rev* 2007; 20: 368–89.
28. Rubin LG: Prevention and treatment of meningitis and acute otitis media in children with cochlear implants. *Otol Neurotol* 2010; 31: 1331–3.
29. Paradise JL: Short-course antimicrobial treatment for acute otitis media: not best for infants and young children. *JAMA* 1997; 278: 1640–2.
30. McDonald S, Langton Hewer CD, Nunez DA: Grommets (ventilation tubes) for recurrent acute otitis media in children. *Cochrane Database Syst Rev* 2008: CD004741.
31. Lous J, Ryborg CT, Thomsen JL: A systematic review of the effect of tympanostomy tubes in children with recurrent acute otitis media. *Int J Pediatr Otorhinolaryngol* 2012; 75: 1058–61.
32. van den Aardweg MT, Schilder AG, Herkert E, Boonacker CW, Rovers MM: Adenoidectomy for otitis media in children. *Cochrane Database Syst Rev* 2010: CD007810.
33. Leach AJ, Morris PS, Mathews JD: Compared to placebo, long-term antibiotics resolve otitis media with effusion (OME) and prevent acute otitis media with perforation (AOMwIP) in a high-risk population: a randomized controlled trial. *BMC Pediatr* 2008; 8: 23.
34. Groth A, Enoksson F, Hermansson A, et al.: Acute mastoiditis in children in Sweden 1993–2007—no increase after new guidelines. *Int J Pediatr Otorhinolaryngol* 2011; 75: 1496–501.
35. Paradise JL, Rockette HE, Colborn DK, et al.: Otitis media in 2253 Pittsburgh-area infants: prevalence and risk factors during the first two years of life. *Pediatrics* 1997; 99: 318–33.
36. Principi N, Baggi E, Esposito S: Prevention of acute otitis media using currently available vaccines. *Future Microbiol* 2012; 7: 457–65.
37. Eskola J, Kilpi T, Palmu A, et al.: Efficacy of a pneumococcal conjugate vaccine against acute otitis media. *N Engl J Med* 2001; 344: 403–9.
38. Haggard M: Otitis media: prospects for prevention. *Vaccine* 2008; 26 (Suppl 7): G20–24.
39. Post JC, Goessier MC: Is pacifier use a risk factor for otitis media? *Lancet* 2001; 357: 823–4.
40. Azarpazhooh A, Limeback H, Lawrence HP, Shah PS: Xylitol for preventing acute otitis media in children up to 12 years of age. *Cochrane Database Syst Rev* 2011: CD007095.

Corresponding author

Dr. med. Jan Peter Thomas
Klinik für Hals-, Nasen- und Ohrenheilkunde
Kopf- und Halschirurgie der Ruhr-Universität Bochum
St. Elisabeth Hospital, Bleichstr. 15, 44787 Bochum, Germany
jan.thomas@rub.de

For e-references please refer to:
www.aerzteblatt-international.de/ref0914

Please answer the following questions to participate in our certified Continuing Medical Education program. Only one answer is possible per question. Please select the answer that is most appropriate.

Question 1

Which antibiotic is considered the agent of choice in uncomplicated AOM?

- a) Amoxicillin; b) azithromycin; c) erythromycin; d) cefuroxime; e) cefpodoxime

Question 2

In which years of life is the incidence of AOM highest?

- a) Years 1 and 2
- b) Years 3 and 4
- c) Years 5 and 6
- d) Years 7 and 8
- e) Years 9 and 10

Question 3

What should follow failure of second-line antibiotic treatment with amoxicillin + clavulanic acid?

- a) Antibiotic treatment with cefuroxime
- b) Antibiotic treatment with azithromycin
- c) Computed tomography of the petrous bone
- d) Magnetic resonance imaging of the skull
- e) Paracentesis and swab analysis

Question 4

Which finding can be differentiated from AOM by tympanometry?

- a) The normal situation
- b) Mucous tympanic effusion
- c) Seromucous tympanic effusion
- d) Serous tympanic effusion
- e) Viral otitis media with granulocyte-poor tympanic effusion

Question 5

Which criteria are indispensable for the diagnosis of AOM?

- a) Inflammatory changes of the tympanic membrane
- b) Inflammatory changes of the tympanic membrane and serous tympanic effusion
- c) Bulging of the tympanic membrane due to purulent tympanic effusion
- d) Inflammatory changes and perforation of the tympanic membrane
- e) Purulent tympanic effusion and perforation of the tympanic membrane

Question 6

In which patient with AOM do you begin with a period of observation?

- a) A 1-year-old child with bulging of both tympanic membranes and a temperature of 38.6 °C
- b) A 1.5-year-old child with reddening and bulging of the tympanic membrane and severe earache
- c) A 2.5-year-old child with reddening of the tympanic membrane, purulent tympanic effusion, and mild earache
- d) A 3-year-old child with reddening of the tympanic membrane, purulent tympanic effusion, and a temperature of 39.3 °C
- e) A 6-year-old child with reddening of the tympanic membrane, purulent tympanic effusion, and severe earache

Question 7

In which situation would you initiate treatment with amoxicillin + clavulanic acid in a patient with AOM?

- a) Treatment with amoxicillin within the previous 30 days
- b) Simultaneous cystitis
- c) Insertion of a cochlear implant 6 weeks earlier
- d) Presence of Down syndrome
- e) Presence of cleft palate

Question 8

Which of the following diseases is an inflammatory otogenic complication?

- a) Bell's palsy; b) cholesteatoma; c) labyrinthitis; d) perichondritis; e) sinus cavernosus thrombosis

Question 9

In the presence of which of the following risk factors can you initially adopt an observant attitude in a patient with AOM?

- a) Down syndrome
- b) Cleft palate
- c) Status post cochlear implantation 1.5 months ago
- d) Status post cochlear implantation 3 years ago
- e) Fourth year of life, mild earache, temperature 38.5 °C

Question 10

In which proportion of patients with AOM managed by observation is improvement seen by 4 to 7 days after onset?

- a) 60%; b) 70%; c) 80%; d) 90%; e) 95%

FURTHER INFORMATION ON CME

This article has been certified by the North Rhine Academy for Postgraduate and Continuing Medical Education. Deutsches Ärzteblatt provides certified continuing medical education (CME) in accordance with the requirements of the Medical Associations of the German federal states (*Länder*). CME points of the Medical Associations can be acquired only through the Internet, not by mail or fax, by the use of the German version of the CME questionnaire. See the following website:

cme.aerzteblatt.de.

Participants in the CME program can manage their CME points with their 15-digit "uniform CME number" (einheitliche Fortbildungsnummer, EFN). The EFN must be entered in the appropriate field in the cme.aerzteblatt.de website under "meineDaten" ("my data"), or upon registration. The EFN appears on each participant's CME certificate. The present CME unit can be accessed until 25 May 2014.

The CME unit "The Treatment of Type 2 Diabetes" (volume 5/2014) can be accessed until 27 April 2014, the CME unit "Rhegmatogenous Retinal Detachment—an Ophthalmologic Emergency" (volume 1–2/2014) until 30 March 2014, the CME unit "The Diagnosis and Treatment of Celiac Disease" (Issue 49/2013) until 9 March 2014.

CONTINUING MEDICAL EDUCATION

Acute Otitis Media—a Structured Approach

Jan Peter Thomas, Reinhard Berner, Thomas Zahnert, Stefan Dazert

eREFERENCES

- e1. Agrawal S, Husein M, MacRae D: Complications of otitis media: an evolving state. *J Otolaryngol* 2005; 34 Suppl 1: 33–39.
- e2. Schwartz RH, Schwartz DM: Acute otitis media: diagnosis and drug therapy. *Drugs* 1980; 19: 107–18.
- e3. Appelmann C, Balen F, Lisdonk E, Weert H, Eizenga W: Otitis media acuta: NHG-standaard (eerste herziening). *Huisarts Wet* 1999; 362–6.
- e4. Scottish Intercollegiate Guidelines Network: Diagnosis and management of childhood otitis media in primary care. Guideline No 66 February 2003. In: *Edinburgh CoPi* (ed.): Edinburgh: Scottish Intercollegiate Guidelines Network; 2003. www.sign.ac.uk/pdf/qrg66.pdf (last accessed on 5 February 2014)
- e5. Forgie S, Zhanel G, Robinson J: Management of acute otitis media. *Paediatr Child Health* 2009; 14: 457–64.
- e6. Leitlinie der Deutschen Gesellschaft für Allgemeinmedizin und Familienmedizin (DEGAM) Ohrschmerzen. AWMF-Register Nr. 053/009 Klasse S3.
- e7. Leitlinie Seromukotympanon der Deutschen Gesellschaft für HNO-Heilkunde, Kopf- und Halschirurgie. AWMF-Register Nr. 017/004 Klasse S1.
- e8. Johnson DL, McCormick DP, Baldwin CD: Early middle ear effusion and language at age seven. *J Commun Disord* 2008; 41: 20–32.
- e9. Kamtsiuris P, Atzpodien K, Ellert U, Schlack R, Schlaud M: Prevalence of somatic diseases in German children and adolescents. Results of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS). *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2007; 50: 686–700.
- e10. Turner D, Leibovitz E, Aran A, et al.: Acute otitis media in infants younger than two months of age: microbiology, clinical presentation and therapeutic approach. *Pediatr Infect Dis J* 2002; 21: 669–74.
- e11. Klein JO: Otitis media. *Clin Infect Dis* 1994; 19: 823–33.
- e12. Casey JR, Pichichero ME: Changes in frequency and pathogens causing acute otitis media in 1995–2003. *Pediatr Infect Dis J* 2004; 23: 824–8.
- e13. Hildmann H: Akute Otitis media. In: Naumann HH, Helms, J, Herberhold, C (ed.): *Oto-Rhino-Laryngologie in Klinik und Praxis*. Heidelberg, New York: Thieme 1994; 582.
- e14. Pelton SI: Otoscopy for the diagnosis of otitis media. *Pediatr Infect Dis J* 1998; 17: 540–543; discussion 580.
- e15. Helenius KK, Laine MK, Tahtinen PA, Lahti E, Ruohola A: Tympanometry in discrimination of otoscopic diagnoses in young ambulatory children. *Pediatr Infect Dis J* 2012; 31: 1003–6.
- e16. Laine MK, Tahtinen PA, Helenius KK, Luoto R, Ruohola A: Acoustic reflectometry in discrimination of otoscopic diagnoses in young ambulatory children. *Pediatr Infect Dis J* 2012; 31: 1007–11.
- e17. Hoberman A, Paradise JL, Reynolds EA, Urkin J: Efficacy of Auralgan for treating ear pain in children with acute otitis media. *Arch Pediatr Adolesc Med* 1997; 151: 675–8.
- e18. Wollenberg B, Heumann H: Zenner HP (ed.): *Praktische Therapie von HNO-Krankheiten*. Stuttgart: Schattauer 2008; 90.
- e19. Marcy M, Takata G, Chan LS, et al.: Management of acute otitis media. *Evid Rep Technol Assess (Summ)* 2000: 1–4.
- e20. Rosenfeld R (ed.): *Evidence-based Otitis media*. 2nd edition. Canada: Hamilton, ON 2003; 28.
- e21. Kaleida PH, Casselbrant ML, Rockette HE, et al.: Amoxicillin or myringotomy or both for acute otitis media: results of a randomized clinical trial. *Pediatrics* 1991; 87: 466–74.
- e22. Piglansky L, Leibovitz E, Raiz S, et al.: Bacteriologic and clinical efficacy of high dose amoxicillin for therapy of acute otitis media in children. *Pediatr Infect Dis J* 2003; 22: 405–13.
- e23. Dagan R, Hoberman A, Johnson C, et al.: Bacteriologic and clinical efficacy of high dose amoxicillin/clavulanate in children with acute otitis media. *Pediatr Infect Dis J* 2001; 20: 829–37.
- e24. Leibovitz E, Piglansky L, Raiz S, et al.: Bacteriologic and clinical efficacy of one day vs. three day intramuscular ceftriaxone for treatment of nonresponsive acute otitis media in children. *Pediatr Infect Dis J* 2000; 19: 1040–5.
- e25. Fireman B, Black SB, Shinefield HR, et al.: Impact of the pneumococcal conjugate vaccine on otitis media. *Pediatr Infect Dis J* 2003; 22: 10–6.
- e26. Ilicali OC, Keles N, Deger K, Savas I: Relationship of passive cigarette smoking to otitis media. *Arch Otolaryngol Head Neck Surg* 1999; 125: 758–62.
- e27. Daly KA, Giebink GS: Clinical epidemiology of otitis media. *Pediatr Infect Dis J* 2000; 19: 31–6.