Updates on Otitis Media

Brian K. Reilly, MD
Children’s National Medical Center
George Washington University Medical School
Outline

• Epidemiology
• Pathophysiology
• Evaluation
• Treatments/Guidelines
• Controversies
Definition

- **Otitis media**
  - Inflammation of middle ear/mastoid

- **Sub-types**
  - Chronicity
    - Acute, Sub-acute, Chronic
  - Recurrent
  - Suppurative
  - OME (Effusion)
Background

- 2nd most common reason to see a pediatrician
- Usually self-limiting
- 2/3 of children have at least one episode of OM by age 3 years.
- Now seeing the development of multidrug-resistant bacteria
Epidemiology

• Increased incidence?

• Age of 1\textsuperscript{st} Infection important

• Incidence high 7-36 months

• Most prevalent in Winter Months
Host Risk Factors

- Age
- Male Gender
- Race
- Familial predisposition (biologic parent/sibling)
- Craniofacial malformations
- Not being breast fed
Environmental Risk Factors

- Crowded Living Conditions
- Daycare
- Seasonality
- Exposure to second-hand smoke
- Use of pacifiers

Teele, Klein, and Rosner, 1989
Pathogenesis

**Host Factors**
1. Immature/impaired immunology
2. Familial predisposition
3. Method of feeding (breast or bottle)
4. Sex
5. Race

**Anatomic/Physiologic Dysfunction**
1. Eustachian tube dysfunction
2. Cleft palate, submucous cleft

**Environmental Factors**
1. Day-care attendance
2. Smoking in households

**Infection**
Clinicians should diagnose acute otitis media in children who present with moderate to severe bulging of the tympanic membrane (TM).
Acute Otitis Media

FIGURE 2

Pediatrics 2013;131:e964–e999
Recurrent Otitis Media

• 3 -4 episodes in 6 months
• 5 – 6 episodes in 12 months
• Lower threshold
  o Younger than 1 year of age
  o Spontaneous rupture
  o Febrile seizure
Chronic Otitis Media

• Draining ear for greater than 6 weeks
• Treat with oral antibiotics and drops
  o Possible perforation
  o Cholesteatoma
  o TB
  o Neoplasm
  o HIV

• Consider culture
Guidelines

- Stringent definition of AOM
- Pain management
- Observation versus antibiotics
- Preventive measures

- Not intended as a sole source of guidance
• Guidelines are not a substitute for the experience and judgment of a physician

• Developed to enhance the physicians' ability to practice evidence-based medicine
**TABLE 4** Recommendations for Initial Management for Uncomplicated AOM<sup>a</sup>

<table>
<thead>
<tr>
<th>Age</th>
<th>Otorrhea With AOM&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Unilateral or Bilateral AOM&lt;sup&gt;a&lt;/sup&gt; With Severe Symptoms&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Bilateral AOM&lt;sup&gt;a&lt;/sup&gt; Without Otorrhea</th>
<th>Unilateral AOM&lt;sup&gt;a&lt;/sup&gt; Without Otorrhea</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 mo to 2 y</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy or additional observation</td>
</tr>
<tr>
<td>≥2 y</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy or additional observation</td>
<td>Antibiotic therapy or additional observation&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Applies only to children with well-documented AOM with high certainty of diagnosis (see Diagnosis section).

<sup>b</sup> A toxic-appearing child, persistent otalgia more than 48 h, temperature ≥39°C (102.2°F) in the past 48 h, or if there is uncertain access to follow-up after the visit.

<sup>c</sup> This plan of initial management provides an opportunity for shared decision-making with the child’s family for those categories appropriate for additional observation. If observation is offered, a mechanism must be in place to ensure follow-up and begin antibiotics if the child worsens or fails to improve within 48 to 72 h of AOM onset.
Antibiotics

- Amoxicillin → 1st line
- Augmentin → 2nd line
- Cephalosporin → 2nd line
- Ceftriaxone → 3rd line
Clinical Practice Guideline

• “There are many paths to the top of the mountain, but the view is always the same” Chinese Proverb

• American Academy of Otolaryngology has created specific criteria that govern surgical intervention: 3 episodes in 6 months, 4 in 12 months
### Assessment of Pain

#### TABLE 3 Treatments for Otitis Media in AOM

<table>
<thead>
<tr>
<th>Treatment Modality</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen, ibuprofen</td>
<td>Effective analgesia for mild to moderate pain.</td>
</tr>
<tr>
<td></td>
<td>Readily available. Mainstay of pain management for AOM.</td>
</tr>
<tr>
<td>Home remedies (no controlled studies that directly address effectiveness)</td>
<td>May have limited effectiveness.</td>
</tr>
<tr>
<td>Distraction</td>
<td></td>
</tr>
<tr>
<td>External application of heat or cold</td>
<td></td>
</tr>
<tr>
<td>Oil drops in external auditory canal</td>
<td></td>
</tr>
<tr>
<td>Topical agents</td>
<td></td>
</tr>
<tr>
<td>Benzocaine, procaine, lidocaine</td>
<td>Additional, but brief, benefit over acetaminophen in patients older than 5 y.</td>
</tr>
<tr>
<td>Naturopathic agents</td>
<td>Comparable to amethocaine/phenazone drops in patients older than 6 y.</td>
</tr>
<tr>
<td>Homeopathic agents</td>
<td>No controlled studies that directly address pain.</td>
</tr>
<tr>
<td>Narcotic analgesia with codeine or analogs</td>
<td>Effective for moderate or severe pain. Requires prescription; risk of respiratory depression, altered mental status, gastrointestinal tract upset, and constipation.</td>
</tr>
<tr>
<td>Tympanostomy/myringotomy</td>
<td>Requires skill and entails potential risk.</td>
</tr>
</tbody>
</table>
# Antibiotics

## TABLE 5
Recommended Antibiotics for (Initial or Delayed) Treatment and for Patients Who Have Failed Initial Antibiotic Treatment

<table>
<thead>
<tr>
<th>Initial Immediate or Delayed Antibiotic Treatment</th>
<th>Antibiotic Treatment After 48–72 h of Failure of Initial Antibiotic Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommended First-line Treatment</strong></td>
<td><strong>Recommended First-line Treatment</strong></td>
</tr>
<tr>
<td>Amoxicillin (80–90 mg/kg per day in 2 divided doses) or Amoxicillin-clavulanate*, (90 mg/kg per day of amoxicillin, with 6.4 mg/kg per day of clavulanate [amoxicillin to clavulanate ratio, 14:1] in 2 divided doses)</td>
<td>Cefdinir (14 mg/kg per day in 1 or 2 doses) or Cefuroxime (30 mg/kg per day in 2 divided doses) or Cefpodoxime (10 mg/kg per day in 2 divided doses)</td>
</tr>
</tbody>
</table>

**Recommended Alternative Treatment (if Penicillin Allergy)**

- Cefdinir (14 mg/kg per day in 1 or 2 doses)
- Cefuroxime (30 mg/kg per day in 2 divided doses)
- Cefpodoxime (10 mg/kg per day in 2 divided doses)
- Ceftriaxone (50 mg IM or IV for 3 d)

**Alternative Treatment**

- Amoxicillin-clavulanate* (90 mg/kg per day of amoxicillin, with 6.4 mg/kg per day of clavulanate in 2 divided doses)
- Ceftriaxone, 3 d Clindamycin (30–40 mg/kg per day in 3 divided doses), with or without third-generation cephalosporin failure of second antibiotic
- Ceftriaxone (50 mg IM or IV for 3 d) or Clindamycin (30–40 mg/kg per day in 3 divided doses) plus third-generation cephalosporin tympanocentesis?

* May be considered in patients who have received amoxicillin in the previous 30 d or who have the otitis-conjunctivitis syndrome.

? Perform tympanocentesis/drainage if skilled in the procedure, or seek a consultation from an otorhinolaryngologist for tympanocentesis/drainage. If the tympanocentesis reveals multidrug-resistant bacteria, seek an infectious disease specialist consultation.

* Cefdinir, cefuroxime, cefpodoxime, and ceftriaxone are highly unlikely to be associated with cross-reactivity with penicillin allergy on the basis of their distinct chemical structures. See text for more information.
Breastfeeding

• Exclusive Breastfeeding for 6 months
Annual Influenza Vaccination

- Reduced Risk of Influenza
- Reduced Risk of Otitis Media

### TABLE 2. Otitis Media With Effusion (OME) or Acute Otitis Media (AOM) Episodes in Vaccinated and Unvaccinated Children According to Influenza Season

<table>
<thead>
<tr>
<th></th>
<th>No. of Ear Examinations in the Vaccinated Group</th>
<th>No. of Ear Examinations in the Unvaccinated Group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before influenza season</td>
<td>n = 119</td>
<td>n = 112</td>
<td>0.393</td>
</tr>
<tr>
<td>OME</td>
<td>25 (21.0%)</td>
<td>28 (25.0%)</td>
<td></td>
</tr>
<tr>
<td>AOM</td>
<td>4 (3.3%)</td>
<td>7 (6.2%)</td>
<td>0.352</td>
</tr>
<tr>
<td>OM</td>
<td>29 (24.3%)</td>
<td>35 (31.2%)</td>
<td>0.243</td>
</tr>
<tr>
<td>Influenza season</td>
<td>n = 120</td>
<td>n = 113</td>
<td></td>
</tr>
<tr>
<td>OME</td>
<td>31 (25.8%)</td>
<td>41 (36.3%)</td>
<td>0.040</td>
</tr>
<tr>
<td>AOM</td>
<td>4 (3.3%)</td>
<td>10 (8.8%)</td>
<td>0.048</td>
</tr>
<tr>
<td>OM</td>
<td>35 (29.1%)</td>
<td>51 (45.1%)</td>
<td>0.012</td>
</tr>
<tr>
<td>After influenza season</td>
<td>n = 113</td>
<td>n = 115</td>
<td></td>
</tr>
<tr>
<td>season (early phase)</td>
<td>OME</td>
<td>32 (28.3%)</td>
<td>0.253</td>
</tr>
<tr>
<td></td>
<td>30 (25.6%)</td>
<td>41 (35.6%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AOM</td>
<td>4 (3.4%)</td>
<td>0.710</td>
</tr>
<tr>
<td></td>
<td>35 (30.9%)</td>
<td>45 (39.1%)</td>
<td>0.197</td>
</tr>
<tr>
<td></td>
<td>OM</td>
<td>35 (30.9%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 (25.6%)</td>
<td>41 (35.6%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After influenza season (late phase)</td>
<td>n = 112</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OME</td>
<td>15 (12.8%)</td>
<td>0.063</td>
</tr>
<tr>
<td></td>
<td>18 (16.1%)</td>
<td>27 (26.7%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AOM</td>
<td>0 (0.0%)</td>
<td>0.193</td>
</tr>
<tr>
<td></td>
<td>2 (1.8%)</td>
<td>2 (1.8%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OM</td>
<td>18 (16.1%)</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td>27 (26.7%)</td>
<td>29 (28.6%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>n = 464</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OME</td>
<td>106 (22.6%)</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>AOM</td>
<td>11 (2.3%)</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>OM</td>
<td>117 (25.2%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Eustachian tube

- Protection from nasopharyngeal sound and secretions
- Clearance of middle ear secretions
- Ventilation (pressure regulation) of middle ear
Pathogenesis

• Multifactorial
• More frequent URIs
• Less mature immune system
Eustachian tube in Infancy

- Length shorter

- More acute Angle to horizontal plane

- Compliance -> greater (less tubal mass and stiffness)

(Holborow, 1975)
Biofilm

- Complex, Sessile Microbial Ecosystems
- Impart resistance to immune system and antibiotics
- Substances to disrupt under investigation
Electron Micrograph
Biofilm in COME

Left, Low-magnification CLSM image in fluorescent and transmission mode of a PnAb-positive MEM specimen. The pneumococci stain red (Texas Red–conjugated antibody, fluorescent channel) and the MEM surface appears gray (transmission channel). White box indicates the area of the specimen detail (right). Right, Detail of cell clusters with bacterial coccocal morphology that stain with PnAb.

Hall-Stoodley, L. et al. JAMA
Biofilms

OPPA8 Biofilms Exposed to Gentian Violet

PAO1 Biofilms Exposed to Gentian Violet
AOM Microbiology

- *S. pneumoniae* - 30-35%
- *H. influenzae* - 20-25%
- *M. catarrhalis* - 10-15%
- Gram negative Bacilli – 20% infants
Virology

- 74% of middle ear isolates
  - Rhinovirus
  - Parainfluenza virus
  - Influenza virus
  - RSV
# Virus Associated Otitis Media

## Table 2

Selected data from studies of viruses associated with acute otitis media (AOM)

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of children</th>
<th>No. of MEF</th>
<th>Virus detection method&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Virus infection associated with AOM&lt;sup&gt;b&lt;/sup&gt; (%)</th>
<th>Proportion of virus-positive MEF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yoshie (1955)</td>
<td>10</td>
<td>10</td>
<td>Culture, serology</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Grönroos (1964)</td>
<td>322</td>
<td>399</td>
<td>Culture</td>
<td>NR</td>
<td>0</td>
</tr>
<tr>
<td>Berglund (1966)</td>
<td>27</td>
<td>44</td>
<td>Culture, serology</td>
<td>37</td>
<td>33</td>
</tr>
<tr>
<td>Tilless (1967)</td>
<td>90</td>
<td>NR</td>
<td>Culture, serology</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>Klein (1982)</td>
<td>53</td>
<td>53</td>
<td>Ag</td>
<td>34</td>
<td>25</td>
</tr>
<tr>
<td>Chonmaintree (1986)</td>
<td>84</td>
<td>84</td>
<td>Culture</td>
<td>39</td>
<td>20</td>
</tr>
<tr>
<td>Sarkkinen (1985)</td>
<td>137</td>
<td>137</td>
<td>Ag</td>
<td>42</td>
<td>18</td>
</tr>
<tr>
<td>Pitkäranta (1998)</td>
<td>92</td>
<td>92</td>
<td>RT-PCR</td>
<td>75</td>
<td>48</td>
</tr>
<tr>
<td>Heikkinen (1999)</td>
<td>456</td>
<td>815</td>
<td>Culture, Ag, serology</td>
<td>41</td>
<td>17</td>
</tr>
<tr>
<td>Chonmaintree (2000)</td>
<td>40</td>
<td>65</td>
<td>Culture, PCR</td>
<td>NR</td>
<td>74</td>
</tr>
<tr>
<td>Nokso-Koivisto (2004)</td>
<td>940</td>
<td>3210</td>
<td>Ag, RT-PCR</td>
<td>63</td>
<td>38</td>
</tr>
</tbody>
</table>

NR: not reported.

<sup>a</sup> Ag: antigen detection, RT: reverse transcription, PCR: polymerase chain reaction.

<sup>b</sup> Specific virus detected in nasopharyngeal aspirate (NPA) and/or middle ear fluid (MEF) specimen(s), and/or a viral infection documented serologically from paired serum samples.
History

• Onset
• Duration
• Frequency
• Antibiotics
• Associated Symptoms
Diagnosis

• Acute OM
  o Preceding URI
  o Fever
  o Otalgia
  o Hearing loss
  o Constitutional sx

• Chronic MEE
  o Often asymptomatic
  o Hearing loss
  o “Plugged”
  o “Popping”
Diagnostics

• Pneumatic otoscopy
• Impedance audiometry
• Tympanocentesis
• Immunologic Testing
• CT
Suppurative Otitis Media
Bezold Abscess
Serous Otitis Media
Audiometry

- Effusions of 3 months duration and recurrent OM
- Document any conductive loss
- Document any sensorineural loss
- Pre-operative counseling
- Baseline for later comparison
MEAN AUDIOGRAM WITH ASYMPTOMATIC OTITIS MEDIA WITH EFFUSION

(N = 540 EARS, AGE 2-12) Fria et al., 1985)
Principles

- Observation vs. Treatment
- If complicated, severe, under 2 treat
- Pain medication
- Response should occur 48 to 72 hrs
Duration of Effusion

Teele & Klein
Treatments

• **Watchful waiting**
  - Prevent antibiotic resistance
  - 80% resolve spontaneously
  - Safety Net Script

• **Antibiotics- get better faster?**
Antibiotics

- **First line**
  - Amox - 80-90 mg/kg divided tid

- **Second line**
  - Augmentin
  - Cephalosporins - Omnicef, Ceftin, Rocephin
  - Macrolides – Zithromax
Microbiology

• **PCN-resistant Strep**
  - Altered PCN-binding proteins
  - Lysis defective
  - 1979 - 1.8%
  - 1992 - 41%

• **H flu / M. catarrhalis**
  - beta-lactamase production
  - All *M. catarrhalis*
  - 45-50% *H. flu*
Treatment of Recurrent AOM

- Role of tympanostomy tube insertion
  - Indicated in cases with 3-4 or more episodes in 6 months or 4-5 or more episodes in 1 year
  - Effective in preventing recurrent AOM (Gebhart, 1981; Casselbrant, 1992; Le, 1991)
Treatment of OME

- Role of tympanostomy tube placement
  - Serial otoscopy, 90% of effusions resolve spontaneously
  - Hearing loss in excess of 20dB in the better-hearing ear after 12 weeks with bilateral middle ear effusion
  - Concern about language/speech delay
Down Syndrome

- Increased risk of eustachian tube dysfunction and development of OME

- Important consequences for language and learning skills

- Narrow Canals
Cleft lip/palate

- High risk of chronic ear disease

- Functional eustachian tube obstruction due to abnormal insertion of tensor veli palatini into soft palate

- Early placement of tympanostomy tubes warranted

- Considered at palate repair
Adenoidectomy

• Physical Obstruction of orifice

• Bacterial Reservoir

• Reserved for 2\textsuperscript{nd} set of PE tubes
Controversies

- **Antihistamines/decongestants**
  - Clinical data demonstrates lack of efficacy (Cantekin, 1983)

- **Steroids**
  - Efficacy uncertain at best
  - Routine use not recommended

- **Middle ear inflation**
  - Questionable efficacy for COME
Thank you

Email: breilly@cnmc.org