Is it possible to diagnose acute otitis media accurately in primary health care?

Karin Blomgren and Anne Pitkäranta


**Background.** Acute otitis media causes human suffering and enormous costs to society. Symptoms of acute otitis media overlap those of the common cold, and diagnostic methods confirming the diagnosis are used only occasionally. Uncertainty in diagnostics may lead either to overdiagnosis and unnecessary treatment or to underdiagnosis and an increase in complications.

**Objective.** Our aim was to evaluate the inter-rater agreement in diagnosis of acute otitis media for children in primary health care.

**Methods.** The GP on duty and the otorhinolaryngology resident at a primary health care clinic examined the same 50 children with caregiver-suspected acute otitis media. The otorhinolaryngologist photographed the tympanic membranes. Afterwards, two experienced clinicians evaluated the photographs with and without tympanograms. Diagnostic rates and diagnostic methods between clinicians were compared.

**Results.** The otorhinolaryngologist diagnosed acute otitis media in 44% and the GP in 64%. The GP based the diagnoses on symptoms and on the colour of the tympanic membrane, whereas the otorhinolaryngologist paid more attention to the movement and position of the tympanic membrane.

**Conclusion.** The use of a pneumatic otoscope and tympanometry reduces the number of acute otitis media diagnoses by >30%, suggesting that acute otitis media may be misdiagnosed often. Between clinicians, there was a substantial discrepancy in diagnoses of acute otitis media.

**Keywords.** Acute otitis media, children, diagnosis, primary health care.

**Introduction**

Diagnosing acute otitis media (AOM) concerns practically every clinician in primary health care and every child and parent in the community. Over 70% of children suffer from AOM before their second birthday. The incidence of AOM is increasing rapidly. Estimates of the increase since 1970s vary from 60 to 250%.

AOM is defined as a combination of the presence of middle ear effusion indicated by abnormal colour, mobility or position of the tympanic membrane (TM) and by acute symptoms and signs of an infection, e.g., earache, irritability, fever, poor appetite, vomiting or diarrhoea. Although the definition of AOM is relatively uniform, the diagnosis is far from clear. Even though some symptoms, especially earache, are strongly associated with AOM, the diagnosis is unreliable if it depends on symptoms alone. Typanocentesis (needle aspiration through the TM) and myringotomy (incision in the TM to provide fluid) confirm the diagnosis, but these methods are not suitable for routine use in primary health care. The most valuable tool in diagnosing AOM is the pneumatic otoscope. It is, unfortunately, used only occasionally, with evaluation still resting on the colour and position of the TM.

In the present study we evaluated clinicians’ inter-rater agreement in AOM in children in primary health care.

**Methods**

The study was performed at the walk-in clinic of the Children’s Hospital in Helsinki, during the influenza season in November and December 2000. The only inclusion criterion was caregiver-suspected AOM. There were no exclusion criteria. The study protocol was approved by the local ethics committee, and informed written consent was obtained from each caregiver.

The GP on duty examined the patient first by the method of their current clinical practice. No instructions...
were given for diagnostic methods or diagnostic criteria. A pneumatic otoscope was available. The GP recorded the patient’s symptoms, clinical signs, diagnosis and suggestion for treatment on a form, which was then sealed in an envelope. The patient and the investigator were not told the results.

Immediately after the GP’s examination, the investigator, a senior resident in otorhinolaryngology, examined the same patient. She was responsible for the final diagnosis and treatment. In addition to the standard otorhinolaryngological examination, TMs were photographed through an endoscopic camera. The investigator performed tympanometry in all patients with a GSI 38 Auto tymp with printer (Grason-Stadler Inc., Milford, CT). Limits for middle ear pressure (MEP) abnormalities were $100 \leq \text{MEP} \leq 100 \text{ mm H}_2\text{O}$. Afterwards, two experienced clinicians, a specialist in paediatric infectious diseases (PED1) and a paediatric otorhinolaryngologist (PED2), analysed the photographs independently. They were instructed to classify the ears as healthy, or with AOM or secretory otitis media (SOM). The clinicians knew that every patient had caregiver-suspected AOM, but no clinical data concerning an individual child were given.

**Statistical methods**

Statistical analysis was done with SPSS 9.0 for Windows. The sign-test served to compare changes in diagnostic rates. A $P$-value of 0.05 was considered significant. Agreement between clinicians was measured with Cohen’s $\kappa$. It takes the value 1 if agreement is perfect and 0 if the amount of agreement is the same as by chance. In cases where $\kappa \geq 0.75$, the agreement is considered excellent.\(^\text{11}\)

**Results**

Of 50 children enrolled, 30 (60%) were boys. Median age was 4 years 8 months (range 7 months–15 years), and 42 children (84%) had previously had an infection diagnosed as AOM. The range for the number of previous attacks of AOM was 0–20, with a median of five. For the current disease, caregivers reported the median duration of symptoms as 2 days, earache being the most common symptom.

The proportions of recorded characteristics of TM are shown in Figure 1. The colour of the TM was the most frequently recorded sign and also the sign the examiners were most likely to agree on, since they agreed on the colour for 71 (71%) ears. Classification of mobility of the TM was identical between the examiners in 41 (41%) ears as was description of the position of the TM in 44 (44%) ears. Tympanometry was normal in 65 (65%) ears. For 26 (52%) children, tympanometry was normal in both ears. The otorhinolaryngologist diagnosed AOM or SOM in 22 (44%) children and the GP in 32 (64%) (Table 1). They agreed on the diagnosis of AOM in 32 (64%) children ($\kappa = 0.3$) (Table 2).

**TABLE 1** Diagnoses of children with caregiver-suspected AOM by the otorhinolaryngologist (ORL) and the GP

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>ORL n (%)</th>
<th>GP n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>URTI</td>
<td>28 (56)</td>
<td>18 (36)</td>
</tr>
<tr>
<td>AOM or SOM</td>
<td>22 (44)</td>
<td>32 (64)</td>
</tr>
<tr>
<td>Total</td>
<td>50 (100)</td>
<td>50 (100)</td>
</tr>
</tbody>
</table>

URTI = upper respiratory tract infection.

**TABLE 2** Diagnostic agreement between examiners for 50 children

<table>
<thead>
<tr>
<th>Examiners</th>
<th>Identical diagnoses</th>
<th>$\kappa$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AOM(^\text{a})</td>
<td>URTI</td>
</tr>
<tr>
<td>ORL and GP</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>ORL and PED1(^\text{b})</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>ORL and PED1 + tymp(^\text{c})</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>ORL and PED2(^\text{b})</td>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td>ORL and PED2 + tymp(^\text{c})</td>
<td>20</td>
<td>19</td>
</tr>
</tbody>
</table>

\(^\text{a}\) AOM or SOM.
\(^\text{b}\) Diagnosis based on photographs of tympanic membranes.
\(^\text{c}\) Diagnosis based on photographs of tympanic membranes and tympanograms.

Two experienced clinicians diagnosed the ears first with only the endoscopic photographs available and then with combination of photograph and tympanogram. When diagnosis was based merely on the photograph,
PED1 and PED2 both diagnosed AOM or SOM in 38 children (76%). When, in addition to the photograph, a tympanogram was also available, PED1 diagnosed otitis in 24 (48%) children and PED2 in 29 (58%). The change in proportion of diagnosed otitis was significant (sign-test).

Agreement in diagnosis between the otorhinolaryngologist, GP, PED1 and PED2 is shown in Table 2. The best concordance, 41 (82%) children, was between PED1 and PED2 when they diagnosed the ears with photographs and tympanograms, and the worst was 30 (60%) children between the GP and PED1 without tympanograms, and the otorhinolaryngologist and PED1 without tympanograms. When PED1 and PED2 diagnosed the ears with photographs and tympanogram, their agreement with the otorhinolaryngologist and also with each other was better than when the diagnosis was based on photographs alone.

Discussion

In this study of inter-rater agreement of AOM in children in primary health care, the clinicians agreed on 64% of the diagnoses of AOM. There was a substantial discrepancy concerning their impressions of TM. Use of a tympanogram reduced the number of diagnosed AOM and increased the inter-rater agreement.

The otorhinolaryngologist was less likely to diagnose AOM than were the GPs; she diagnosed otitis in 44% of the children compared with the GPs’ 64%. Diagnostic criteria for AOM frequently were either unknown or ignored in the primary health care clinic, and GPs seemed to base their diagnosis mainly on symptoms or the colour of the TM. Yet, even the most highly qualified clinicians, an experienced specialist in paediatric infectious diseases and a paediatric otorhinolaryngologist, were unable to agree on the diagnosis when a photograph of the TM was the only information available. When the two experts had both photograph and tympanogram available, they agreed on the diagnosis of AOM more often with each other and also with both otorhinolaryngologist and GP.

Since we did not verify the presence of middle ear fluid with myringotomy, we do not know which children actually had AOM. It would have been unethical to conduct myringotomy on a child if AOM were not suspected by a clinician and we wanted to examine the children with the equipment and methods suitable for primary health care. Instead of myringotomy, we therefore used a combination of pneumatic otoscopy and tympanometry, both of which are reliable methods in diagnosing AOM.7,12

Other authors have also noted the diagnostic difficulties and pointed out the importance of formularized training. In Canada and the USA, only 59% of paediatric residency programmes even have a structured curriculum of the diagnosis and treatment of AOM.13 In Texas, 66% of family practice residents used a pneumatic otoscope and half of the residents had insufficient criteria in diagnosing AOM. Education in diagnostic criteria and equipment increased the use of the pneumatic otoscope.14 In Steinbach’s study on inter-rater agreement on AOM, paediatric residents and paediatric otolaryngologists had only slight to moderate correlation between the clinical examination.15

Why is there such uncertainty in diagnosing AOM? GPs should all be aware of the diagnostic criteria, and there certainly are enough patients. There also exists equipment to aid in diagnosis. Although not reachable for every GP, there are teaching methods to assess diagnostic accuracy.16 Circumstances for diagnosing are, unfortunately, frequently far from optimal: it is night or evening, the GP on duty may be young and inexperienced, the child is screaming and struggling, the ear canals are filled with cerumen, and there are plenty of children with identical symptoms waiting outside the door.

Is the incidence of AOM really increasing as dramatically as statistics show or is the increase just a consequence of parents who demand antimicrobial treatment for their children’s common cold? GPs need objective methods to help in diagnosing and perhaps also to convince the parents. Inventing more sophisticated and sensitive techniques is, however, of little use as long as the importance of accurate diagnosis is overlooked, and even the already available methods are ignored. More precise diagnosing could decrease the amount of diagnosed AOM and thereby reduce the amount of prescribed antibiotics, delay the development of antimicrobial resistance, lessen unnecessary tympanostomy tube settings and adenotomies, cut down on costs for families and society, and, moreover, ease parental stress and human suffering. On the other hand, failure to diagnose AOM may lead to an increased number of acute mastoiditis cases, which has already been suspected in some countries.17

In this study, performing tympanometry significantly reduced the number of AOM cases diagnosed. If primary care clinics have appropriate equipment, i.e. tympanometry and pneumatic otoscopy, and GPs get enough education in using them, it is possible to increase diagnostic accuracy for AOM, thus ensuring the right treatment for the right patient.

Acknowledgements

We thank Heikki Peltola and Merja Pettay for evaluating the photographs of TMs and tympanograms, Hanna Oksanen for her aid with the statistics, and Petri Kylmänen for his assistance with the children. This study was supported financially by Helsinki University Central Hospital.
References


