A View Through
THE OTOSCOPE
Distinguishing Acute Otitis Media From Otitis Media With Effusion

Slide-Lecture Book

Date of original release: January 2000
Date of re-release: June 2002
Term of approval: through June 2004

This continuing medical education program is supported by an unrestricted educational grant from Pfizer Inc.
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*Additional cases*

*Cases also discussed in the video presentation on this CD-ROM*
A View Through
THE OTOSCOPE
Distinguishing Acute Otitis Media
From Otitis Media With Effusion

Sponsored by
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This program is supported by an unrestricted educational grant from Pfizer Inc.
Middle-ear effusion is defined as the presence, on pneumatic otoscopy, of at least two of the following three tympanic membrane (TM) abnormalities:

- abnormal color, such as white, yellow, amber, or blue discoloration;
- opacification other than due to scarring; or
- decreased or absent mobility;

or the presence of bubbles or air-fluid interfaces.\textsuperscript{1,2}

Criteria supporting a diagnosis of acute otitis media include evidence of middle-ear effusion in addition to at least one of the following indicators of acute inflammation: ear pain, including unaccustomed tugging or rubbing of the ear; marked redness of the TM; and distinct fullness or bulging of the TM.¹ ²

The pneumatic otoscope is the standard tool used in diagnosing otitis media. In addition to the pneumatic (diagnostic) head, a surgical head also is useful.

The pneumatic head (shown left) contains a lens, an enclosed light source, and a nipple for attachment of a rubber bulb and tubing. The head is designed so that when a speculum is attached and fitted snugly into the patient’s external auditory canal, an air-tight chamber is produced. In some cases, the addition of a small sleeve of rubber tubing at the end of the plastic speculum or use of a rubber-tipped speculum helps to avoid trauma and improve the air-tight seal. Gently squeezing and releasing the rubber bulb in rapid succession permits observation of the degree of eardrum mobility in response to both positive and negative pressure.

The surgical head (shown right) is most useful in cleaning cerumen from the external auditory canal and in performing diagnostic tympanocentesis or myringotomy. It consists of a lens that can swivel over a wide arc and an unenclosed light source.

Pneumatic otoscopy permits assessment of the contour of the TM (normal, retracted, full, or bulging), its color (gray, yellow, pink, amber, white, red, or blue), its translucency (translucent, semiopaque, opaque), and its mobility (normal, increased, decreased, or absent), in arriving at an assessment of middle-ear status.

Tympanometry is an ancillary test to pneumatic otoscopy that can aid in the detection of middle-ear effusion. It indirectly characterizes TM compliance and estimates middle-ear pressure by means of electroacoustic and manometric measurements. The measurements are made in the external auditory canal using an instrument known as a tympanometer. The corresponding graphic record is called a tympanogram.¹

Three key pieces of diagnostic information can be discerned from the tympanogram: TM compliance (also termed acoustic admittance), middle-ear pressure, and the peak, or shape, of the curve.²

Compliance, roughly indicative of eardrum mobility, is measured in milliliters and is rated as high, intermediate, or low.² Compliance is rated as high (left graph) when it is ≥0.5 mL, intermediate (middle graph) when it is <0.5 mL but >0.2 mL, and low (right graph) when it is ≤0.2 mL.

Middle-ear pressure is measured in millimeters of water (mm H₂O) and is categorized as normal, negative, or positive.

A peak falling between –100 and +50 mm H₂O signifies normal middle-ear pressure (left graph); a peak at < –100 mm H₂O signifies high negative pressure (center graph); and a peak at > +50 mm H₂O indicates high positive pressure (right graph).
The peak of the tympanographic curve will be either sharp, rounded, or flat. A sharp peak (left graph) suggests a low likelihood of middle-ear effusion, or normal middle-ear status. A rounded peak (middle graph) suggests a greater likelihood of effusion. A rounded peak or high negative pressure (previous slide) must be considered diagnostically equivocal. Absence of a peak or a flattened curve (right graph) suggests a high likelihood of middle-ear effusion.¹

The spectral gradient acoustic reflectometer, another diagnostic tool used in detecting middle-ear effusion, similarly supplements the information provided by pneumatic otoscopy. The instrument, known commercially as the EarCheck Pro™, assesses middle-ear effusion by measuring the response of the TM to a sound stimulus. The instrument consists of a handheld probe containing an acoustic speaker that emits sound bursts at different frequencies. Using a microphone and a microprocessor, the device analyzes the frequency of the sound reflected by the TM and displays the information as a spectral gradient angle corresponding to the probability of middle-ear effusion.

In a normal ear, most of the sound energy emitted by the instrument is transmitted into the middle ear, with little reflected back. This produces a wide spectral gradient angle, as shown on the left in Chart B. When middle-ear effusion is present, the mobility of the TM is restricted, and most of the sound energy is reflected back, producing a narrow spectral gradient angle, as shown on the right (Chart C).

The spectral gradient angle correlates with five levels of risk of middle-ear effusion. At spectral gradient level 1, for example, the spectral gradient angle exceeds 95° and the risk of middle-ear effusion is low. When the spectral gradient angle is less than 49°—classified as spectral gradient level 5—the probability of middle-ear effusion is high.

CASE 1

A 13-month-old girl who attends day care presents with clear nasal discharge and cough. She has no fever or irritability, is not rubbing or tugging at her ear, and has slept through the night.

Tympanometry and reflectometry findings: The tympanogram suggests that middle-ear effusion is unlikely. Reflectometry findings suggest that the risk of middle-ear effusion is low.

Otoscopic findings: The TM shows injection along the handle of the malleus. This may be due to trauma associated with removal of cerumen from the external auditory canal. In general, the TM appears normal in color and translucent, but inferiorly and posteriorly there is a narrow area of opacification (arrow) and white discoloration. The TM appears to be slightly retracted, and mobility is rated as 4+.

Interpretation: Opacification, white discoloration, and an air-fluid interface indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

Diagnosis: Otitis media with effusion

Note: In this case, the findings on tympanometry and reflectometry are inconsistent with the clinical findings; the diagnosis is made based on the otoscopic findings. An air-fluid interface is diagnostic of middle-ear effusion even if mobility is rated as 4+, as in this case.
CASE 2

A 3-year-old girl who attends day care presents with ear pain, disturbed sleep, irritability, clear nasal discharge, dry cough, and a temperature of 38.5°C.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is probable. Reflectometry findings suggest that the risk of middle-ear effusion is high.

**Otoscopic findings:** The TM is bulging, white, and opaque. Mobility is rated as 2+.

**Interpretation:** Opacity, white discoloration, and decreased mobility indicate the presence of middle-ear effusion. Ear pain and bulging are indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 3

A 29-month-old boy presents for follow-up examination 3 weeks after he was diagnosed as having bilateral acute otitis media.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is probable. Reflectometry findings suggest that the risk of middle-ear effusion is moderate.

**Otoscopic findings:** The TM is retracted, faintly amber and white, and semiopaque. A small air-fluid interface is seen anterosuperiorly (arrow). Mobility is rated as 1+.

**Interpretation:** Opacity, amber discoloration, decreased mobility, and an air-fluid interface indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion
CASE 4

A 5 1/2-year-old boy with a history of eczema and asthma presents with clear nasal discharge and mild cough; he is afebrile and has no evidence of ear pain.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is probable. Reflectometry findings suggest that the risk of middle-ear effusion is moderate to low.

**Otoscopic findings:** The TM is seen as sharply retracted, with marked prominence of the short process of the malleus (arrow). The membrane is bluish and opaque; mobility is rated as absent.

**Interpretation:** Opacity, blue discoloration, and absent mobility indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion
CASE 5

An 18-month-old boy who attends day care presents with ear pain, intermittent fever (up to 38.8°C), irritability, clear nasal discharge, and mild diarrhea. He had an episode of acute otitis media 7 months earlier.

**Tympanometry and reflectometry findings:** The tympanogram is equivocal. Reflectometry findings suggest that the risk of middle-ear effusion is moderate.

**Otoscopic findings:** The TM is moderately bulging, white, and opaque. The white plaques seen posteriorly and superiorly are not part of the TM and probably consist of epithelial debris or cerumen. Mobility is rated as 2+.

**Interpretation:** Opacity, white discoloration, and decreased mobility indicate the presence of middle-ear effusion. Ear pain and bulging are indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 6

A 9-month-old girl presents with clear nasal discharge; she is afebrile and has no evidence of ear pain. She has a history of recurrent acute otitis media, her last episode having occurred 2 weeks ago.

**Tympanometry and reflectometry findings:** The tympanogram is equivocal. Reflectometry findings suggest that the risk of middle-ear effusion is low.

**Otoscopic findings:** The TM is moderately retracted, with prominence of the short process of the malleus (upper arrow). The membrane shows both injection and white discoloration, and is opaque. Air-fluid interfaces are plainly visible (lower arrows). Mobility is rated as 2+.

**Interpretation:** Opacity, white discoloration, decreased mobility, and air-fluid interfaces indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or distinct bulging argues against the presence of acute inflammation, but the findings are somewhat equivocal and illustrate the arbitrary nature of the distinction between acute otitis media and otitis media with effusion.

**Diagnosis:** Given the history of acute otitis media 2 weeks before, the most likely diagnosis is otitis media with effusion.
CASE 7

A 31-month-old boy presents with ear pain, purulent left conjunctival discharge, clear nasal discharge, and cough; he is afebrile.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is probable. Reflectometry findings suggest that the risk of middle-ear effusion is moderate to high.

**Otoscopic findings:** The TM is moderately bulging, pinkish-white, and opaque. Mobility is rated as 3+.

**Interpretation:** Opacity and white discoloration indicate the presence of middle-ear effusion. Ear pain and bulging are indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 8

An 18-month-old boy presents for well-child care. He has had clear nasal discharge for the past 2 days.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is unlikely. Reflectometry findings suggest that the risk of middle-ear effusion is low.

**Otoscopic findings:** The TM is in normal position, gray, and translucent. Mobility is rated as 4+.

**Interpretation:** A gray and translucent TM with normal mobility indicates the absence of middle-ear effusion.

**Diagnosis:** Normal middle-ear status
CASE 9

A 24-month-old girl presents with clear nasal discharge, vomiting, and diarrhea; she has had recurrent episodes of acute otitis media. Her most recent episode was 1 month ago.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is probable. Reflectometry findings suggest that the risk of middle-ear effusion is high.

**Otoscopic findings:** The TM is retracted, with prominence of the short process of the malleus. Amber discoloration and opacification of the posterior and inferior portions of the TM are seen; air-fluid interfaces are visible both anteriorly and posteriorly (arrows). Mobility is rated as 2+.

**Interpretation:** Opacity, amber discoloration, decreased mobility, and air-fluid interfaces indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion
CASE 10

A 12-month-old boy presents with clear nasal discharge, slight wheezing, difficulty sleeping, and tugging at his right ear.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is probable. Reflectometry findings suggest that the risk of middle-ear effusion is moderate to high.

**Otoscopic findings:** The TM is markedly bulging, pinkish-white, and opaque. Mobility is rated as 1+.

**Interpretation:** Opacity, white discoloration, and decreased mobility indicate the presence of middle-ear effusion. Ear pain and bulging are indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 11

A 9-month-old boy presents with clear nasal discharge for the past 3 days, nasal congestion, cough, and a temperature of 38.5°C.

Tympanometry and reflectometry findings: The tympanogram suggests that middle-ear effusion is unlikely. Reflectometry findings suggest that the risk of middle-ear effusion is moderate to low.

Otoscopic findings: The TM is in normal position, pearly gray, and translucent. Mobility is rated as 4+.

Interpretation: A gray and translucent TM with normal mobility indicates the absence of middle-ear effusion.

Diagnosis: Normal middle-ear status
CASE 12

A 15-month-old boy with a history of asthma presents for well-child care. He has no respiratory tract symptoms or ear pain.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is unlikely. Reflectometry findings suggest that the risk of middle-ear effusion is moderate to low.

**Otoscopic findings:** The TM is slightly retracted, with prominence of the short process of the malleus. The membrane shows slight erythema peripherally and an air-fluid interface with yellow discoloration (arrow). Mobility is rated as 3+.

**Interpretation:** Opacity, yellow discoloration, and an air-fluid interface indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion
CASE 13

A 9-month-old girl presents with ear pain, irritability, clear nasal discharge, and decreased appetite.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is probable. Reflectometry findings suggest that the risk of middle-ear effusion is moderate to low.

**Otoscopic findings:** The TM is moderately bulging. It is white and opaque inferiorly and posteriorly, with an air-fluid interface visible in the anterior portion of the eardrum (right arrow) and an area of intense erythema posterosuperiorly (left arrow). Mobility is rated as 1+.

**Interpretation:** Opacity, white discoloration, decreased mobility, and an air-fluid interface indicate the presence of middle-ear effusion. Ear pain, distinct erythema, and bulging are indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 14

An 18-month-old boy presents with a temperature of 39.5°C, clear nasal discharge, irritability, dry cough, and tugging at his left ear.

**Tympanometry and reflectometry findings:** The tympanogram suggests that middle-ear effusion is probable. Reflectometry findings suggest that the risk of middle-ear effusion is moderate to high.

**Otoscopic findings:** The left TM is markedly bulging, pinkish-white, and opaque. Mobility is rated as 1+.

**Interpretation:** Opacity, white discoloration, and decreased mobility indicate the presence of middle-ear effusion. Ear pain and bulging are indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 15

This is the opposite ear of the same child as in the previous case. This 18-month-old boy presented with a temperature of 39.5°C, clear nasal discharge, irritability, dry cough, and tugging at his left ear.

**Tympanometry and reflectometry findings:** The tympanogram is equivocal. Reflectometry findings suggest that the risk of middle-ear effusion is moderate.

**Otoscopic findings:** The right TM is slightly full and pinkish-gray generally, with a central opaque area of white discoloration. A small air-fluid interface is visible anteriorly (arrow). Mobility is rated as 2+.

**Interpretation:** Opacity, white discoloration, decreased mobility, and an air-fluid interface indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion
CASE 16

A 30-month-old boy presents after a fall down a flight of stairs. In order to visualize the TM, an extensive amount of cerumen had to be removed.

Tympanometry and reflectometry were not performed.

**Otoscopic findings:** The right TM is in normal position, gray, and translucent. An area of intense erythema can be seen posteriorly, thought to be the result of trauma associated with removal of cerumen from the external auditory canal. Mobility is rated as 4+.

**Interpretation:** A gray and translucent TM with normal mobility indicates the absence of middle-ear effusion.

**Diagnosis:** Normal middle-ear status
CASE 17

A 17-month-old boy who had recently completed a 5-day hospitalization for reactive airway disease presents with purulent nasal discharge, a temperature of 39.5°C, and tugging at his right ear. He has not been noted to tug at his ear previously.

Tympanometry and reflectometry were not performed.

**Otoscopic findings:** The right TM is bulging, pinkish-white, and opaque. Mobility is rated as 1+.

**Interpretation:** Opacity, white discoloration, and decreased mobility indicate the presence of middle-ear effusion. Ear pain and bulging are indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 18

The patient is a 5-month-old boy with a temperature of 38.5°C who was admitted to the hospital for treatment of bronchiolitis 2 days previously.

Tympanometry and reflectometry were not performed.

**Otoscopic findings:** The TM is moderately bulging, whitish-pink, and opaque. Mobility is rated as 2+.

**Interpretation:** Opacity, white discoloration, and decreased mobility indicate the presence of middle-ear effusion. Bulging is indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 19

A 17-month-old boy presents with clear nasal discharge and cough; he has a history of recurrent acute otitis media.

Tympanometry and reflectometry were not performed.

**Otoscopic findings:** The TM is moderately bulging, white, and opaque. Mobility is rated as 3+.

**Interpretation:** Opacity and white discoloration indicate the presence of middle-ear effusion. Bulging is indicative of acute inflammation.

**Diagnosis:** Acute otitis media
CASE 20

A 9-month-old boy presents with clear nasal discharge, a temperature of 39.0°C, cough, and vomiting.

Tympanometry and reflectometry were not performed.

Otoscopic findings: The TM is markedly bulging, whitish-amber with areas of distinct erythema, and opaque. A bulla can be visualized inferiorly (arrow). Mobility is rated as 1+.

Interpretation: Opacity, white-amber discoloration, and decreased mobility indicate the presence of middle-ear effusion. Bulging and distinct erythema are indicative of acute inflammation.

Diagnosis: Acute otitis media
A 4 1/2-year-old boy with a history of recurrent acute otitis media, persistent otitis media with effusion, and mild asthma presents with clear nasal discharge. He is afebrile and has no evidence of ear pain.

Tympanometry and reflectometry were not performed.

**Otoscopic findings:** The TM is slightly full, amber, and opaque. Mobility is rated as 1+.

**Interpretation:** Opacity, amber discoloration, and decreased mobility indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion
CASE 22

A 10-month-old boy presents with irritability, loss of appetite, clear nasal discharge, and a temperature of 38.3°C.

Tympanometry and reflectometry were not performed.

**Otoscopic findings:** The view of this TM is posteriorly rotated. The TM is slightly full, whitish-amber in color, and opaque; air-fluid interfaces are visible (arrow). A whitish area, the result of a recent tympanocentesis, also can be seen. Mobility is rated as 3+.

**Interpretation:** Opacity, white-amber discoloration, and air-fluid interfaces indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion
CASE 23

A 3-year-old boy who attends day care presents with clear nasal discharge, sneezing, a temperature of 39.6°C, loss of appetite, decreased activity, and loose stools. He has had no ear pain.

Tympanometry and reflectometry were not performed.

**Otoscopic findings:** The TM is in normal position, gray and also slightly amber. Air-fluid interfaces can be visualized (arrows). Mobility is rated as 3+.

**Interpretation:** Opacity, amber discoloration, and air-fluid interfaces indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion
CASE 24

A 4-year-old girl with a history of persistent middle-ear effusion and placement of tympanostomy tubes twice previously presents with clear nasal discharge. She is afebrile and has had no ear pain.

Tympanometry and reflectometry were not performed.

**Otoscopic findings:** The TM is retracted, with prominence of the short process of the malleus. The membrane is white and amber and opaque; hypertrophic white plaques indicative of tympanosclerosis are visible. Mobility is rated as 1+.

**Interpretation:** Opacity and amber discoloration indicate the presence of middle-ear effusion. The absence of either ear pain, distinct erythema, or bulging rules out the presence of acute inflammation.

**Diagnosis:** Otitis media with effusion