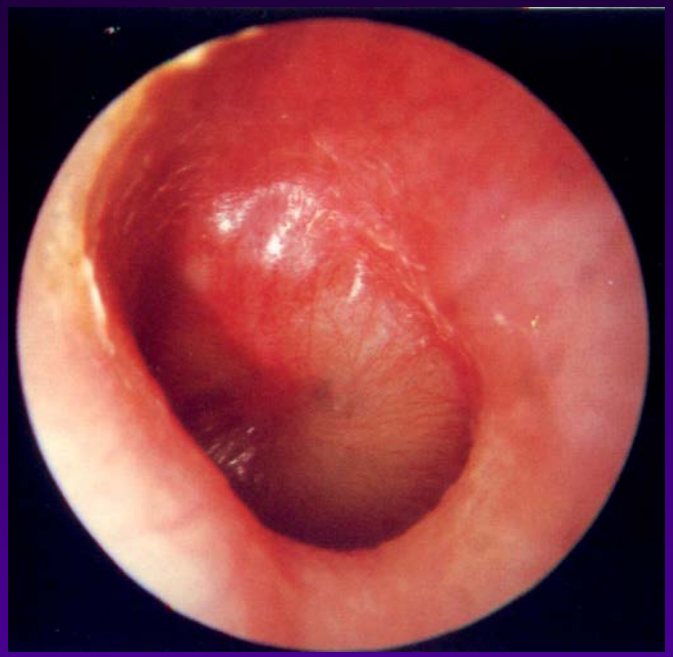
Updates on Otitis Media



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Children's National Medical Center

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 1st 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

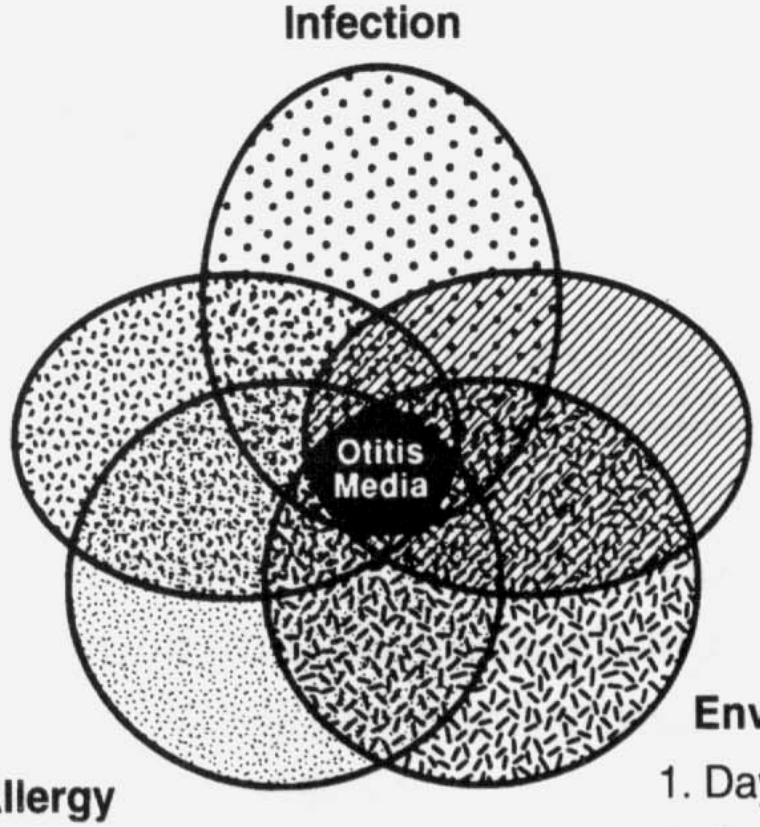
- **Crowded Living Conditions**
- **Daycare**
- **Seasonality**
- **Exposure to second-hand smoke**
- **Use of pacifiers**

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

Diagnosis

Clinicians should diagnose acute otitis media in children who present with moderate to severe bulging of the tympanic membrane (TM)

Acute Otitis Media

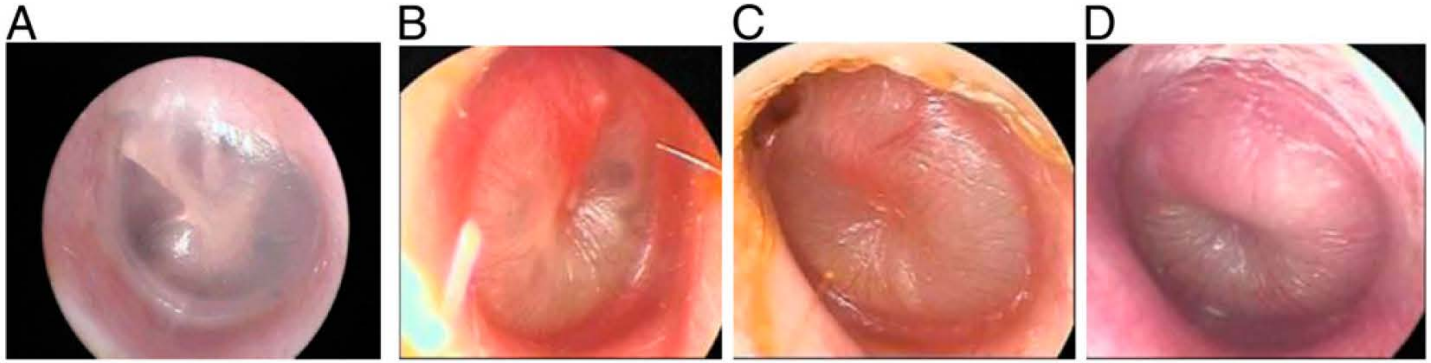


FIGURE 2

A, Normal TM. B, TM with mild bulging. C, TM with moderate bulging. D, TM with severe bulging. Courtesy of Alejandro Hoberman, MD.

Pediatrics 2013;131:e964–e999

Recurrent Otitis Media

- **3 -4 episodes in 6 months**
- **5 – 6 episodes in 12 months**
- **Lower threshold**
  - Younger than 1 year of age
  - Spontaneous rupture
  - Febrile seizure

Chronic Otitis Media

- **Draining ear for greater than 6 weeks**
- **Treat with oral antibiotics and drops**
  - Possible perforation
  - Cholesteatoma
  - TB
  - Neoplasm
  - HIV
- **Consider culture**

Guidlines

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

- Not intended as a sole source of guidance

Guidelines

- **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[a]

Age	Otorrhea With AOM[a]	Unilateral or Bilateral AOM[a] With Severe Symptoms[b]	Bilateral AOM[a] Without Otorrhea	Unilateral AOM[a] Without Otorrhea
6 mo to 2 y	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy or additional observation
≥2 y	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy or additional observation	Antibiotic therapy or additional observation[c]

[a] Applies only to children with well-documented AOM with high certainty of diagnosis (see Diagnosis section).

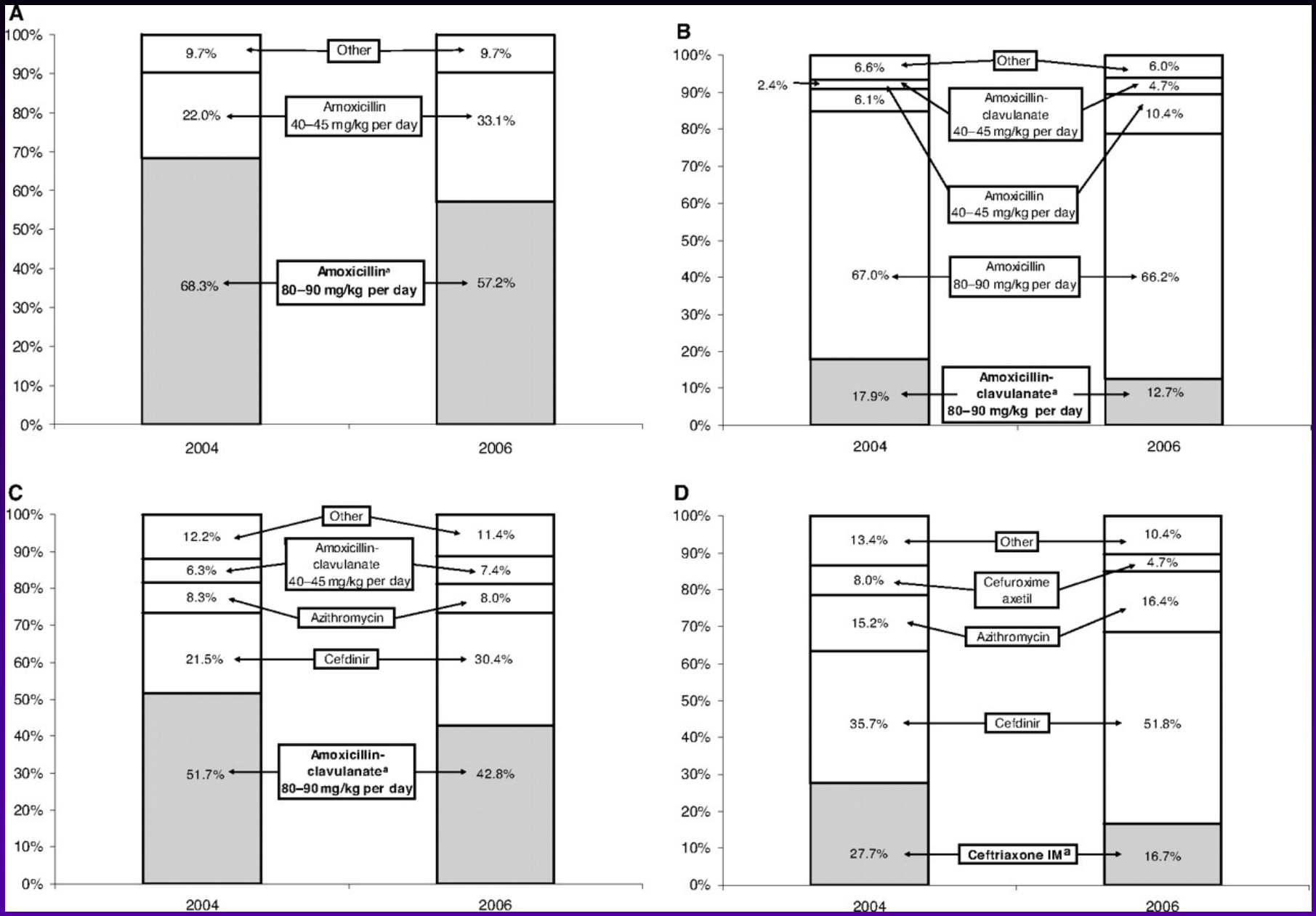
[b] A toxic-appearing child, persistent otalgia more than 48 h, temperature ≥39°C (102.2°F) in the past 48 h, or if there is uncertain access to follow-up after the visit.

[c] 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.

PEDIATRICS®

Antibiotics

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



Vernacchio L et al. Pediatrics 2007;120:281-287

PEDIATRICS®

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

AMERICAN ACADEMY OF OTOLARYNGOLOGY– HEAD AND NECK SURGERY

Assessment of Pain

TABLE 3 Treatments for Otalgia in AOM

Treatment Modality	Comments
Acetaminophen, ibuprofen[63]	Effective analgesia for mild to moderate pain. Readily available. Mainstay of pain management for AOM.
Home remedies (no controlled studies that directly address effectiveness)	May have limited effectiveness.
Distraction	
External application of heat or cold	
Oil drops in external auditory canal	
Topical agents	
Benzocaine, procaine, lidocaine[65,67,70]	Additional, but brief, benefit over acetaminophen in patients older than 5 y.
Naturopathic agents[68]	Comparable to amethocaine/phenazone drops in patients older than 6 y.
Homeopathic agents[71,72]	No controlled studies that directly address pain.
Narcotic analgesia with codeine or analogs	Effective for moderate or severe pain. Requires prescription; risk of respiratory depression, altered mental status, gastrointestinal tract upset, and constipation.
Tympanostomy/myringotomy[73]	Requires skill and entails potential risk.

Antibtiotics

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

Initial Immediate or Delayed Antibiotic Treatment		Antibiotic Treatment After 48–72 h of Failure of Initial Antibiotic Treatment	
Recommended First-line Treatment	Alternative Treatment (if Penicillin Allergy)	Recommended First-line Treatment	Alternative Treatment
Amoxicillin (80–90 mg/ kg per day in 2 divided doses)	Cefdinir (14 mg/kg per day in 1 or 2 doses)	Amoxicillin-clavulanate[a] (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
or	Cefuroxime (30 mg/kg per day in 2 divided doses)	or	Failure of second antibiotic
Amoxicillin-clavulanate[a] (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)	Cefpodoxime (10 mg/kg per day in 2 divided doses)	Ceftriaxone (50 mg IM or IV for 3 d)	Clindamycin (30–40 mg/kg per day in 3 divided doses) plus third-generation cephalosporin
	Ceftriaxone (50 mg IM or IV per day for 1 or 3 d)		Tympanocentesis[b] Consult specialist[b]

IM, intramuscular; IV, intravenous.

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

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

[c] 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

	No. of Ear Examinations in the Vaccinated Group	No. of Ear Examinations in the Unvaccinated Group	*P*
Before influenza season	n = 119	n = 112	
OME	25 (21.0%)	28 (25.0%)	0.393
AOM	4 (3.3%)	7 (6.2%)	0.352
OM	29 (24.3%)	35 (31.2%)	0.243
Influenza season	n = 120	n = 113	
OME	31 (25.8%)	41 (36.3%)	0.040
AOM	4 (3.3%)	10 (8.8%)	0.048
OM	35 (29.1%)	51 (45.1%)	0.012
After influenza season (early phase)	n = 113	n = 115	
OME	32 (28.3%)	41 (35.6%)	0.253
AOM	3 (2.6%)	4 (3.4%)	0.710
OM	35 (30.9%)	45 (39.1%)	0.197
After influenza season (late phase)	n = 112	n = 101	
OME	18 (16.1%)	27 (26.7%)	0.063
AOM	0 (0.0%)	2 (1.9%)	0.193
OM	18 (16.1%)	29 (28.6%)	0.032
Total	n = 464	n = 440	
OME	106 (22.8%)	137 (31.1%)	0.002
AOM	11 (2.3%)	23 (5.2%)	0.012
OM	117 (25.2%)	160 (36.3%)	<0.001

Eustachian tube

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

Bluestone

Pathogenesis

- Multifactorial
- More frequent URIs
- Less mature immune system

Eustachian tube in Infancy

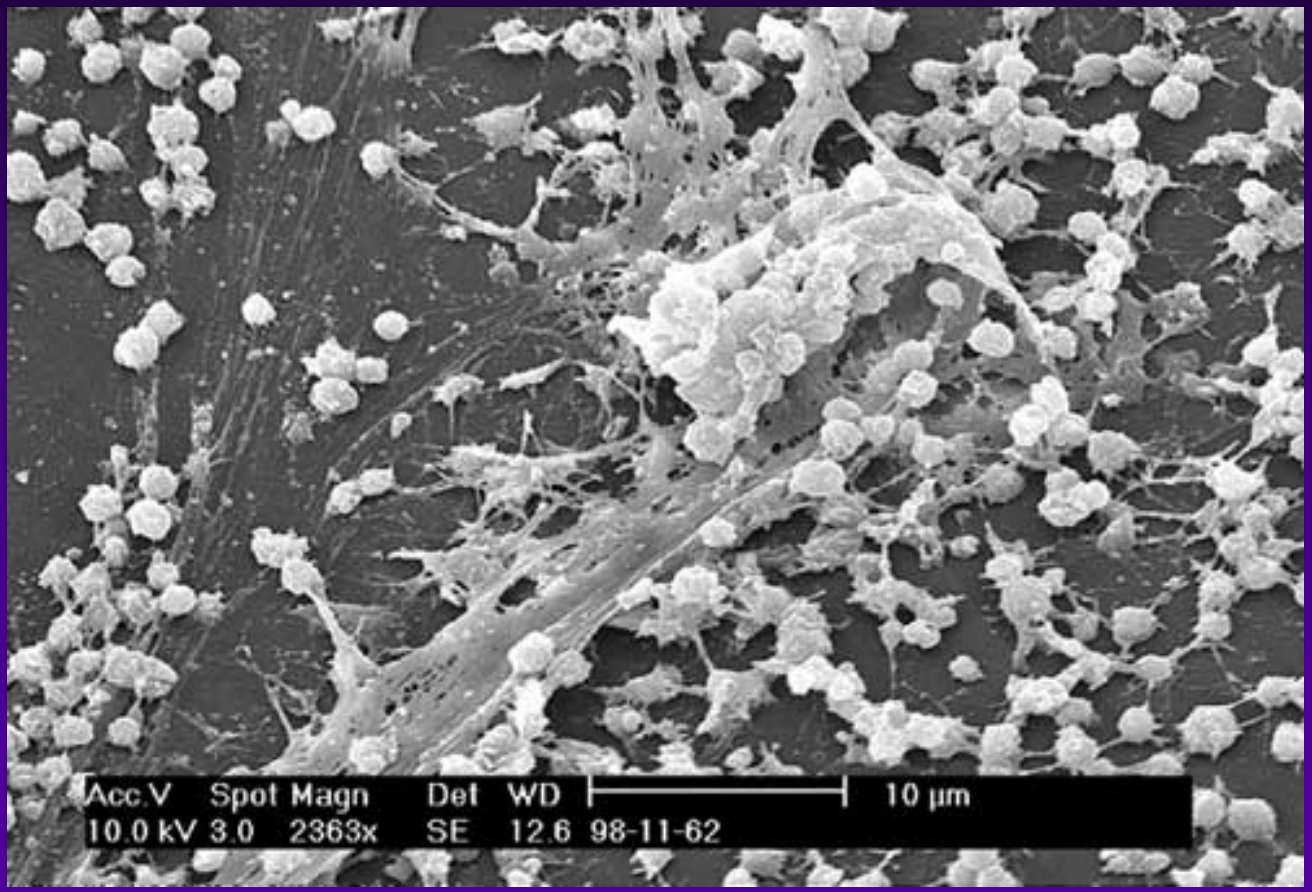
- Length shorter
- More acute Angle to horizontal plane
- Compliance -> greater (less tubal mass and stiffness)

(Holborow, 1975)

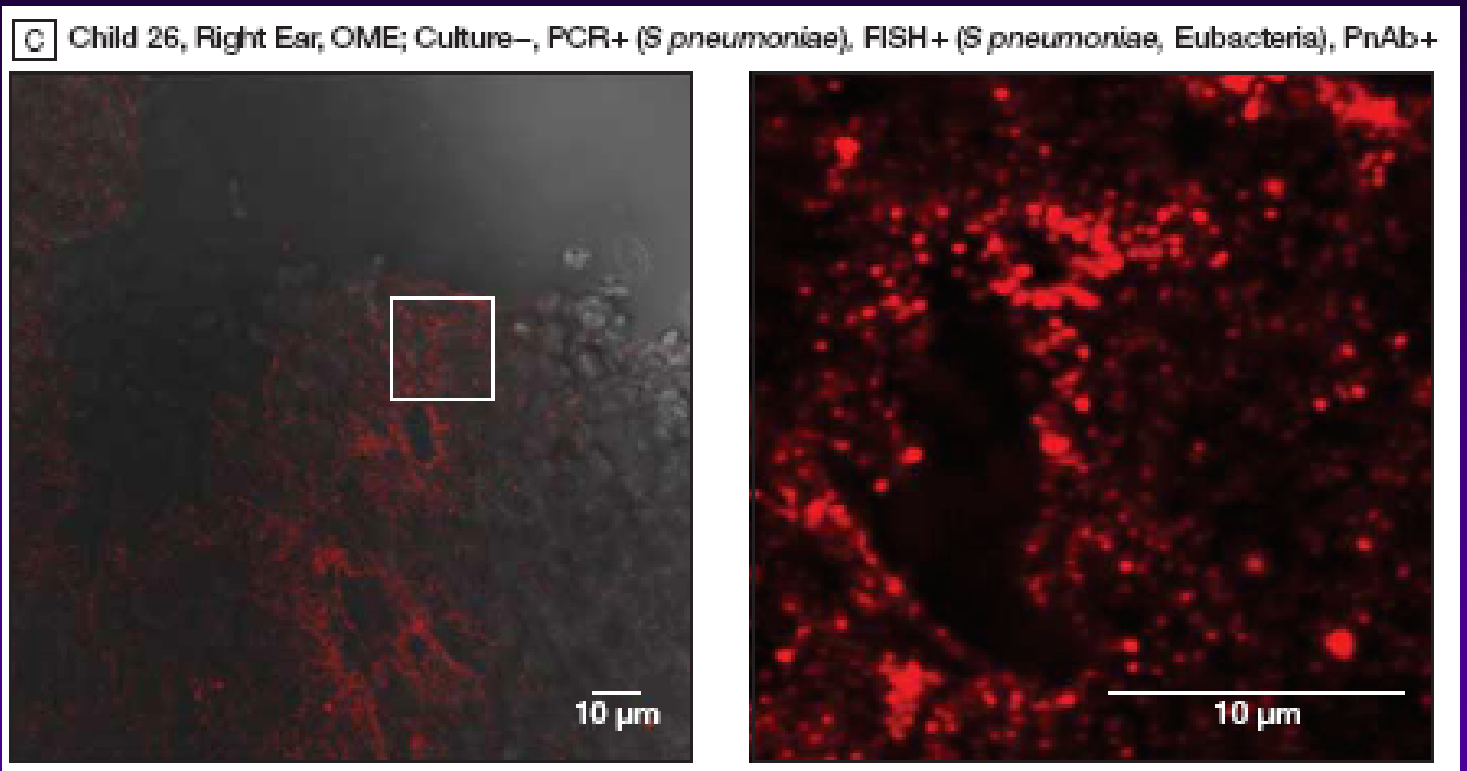
Biofilm

- Complex, Sessile Microbial Ecosystems
- Impart resistance to immune system and antibiotics
- Substances to disrupt under investigation

Electron Micrograph



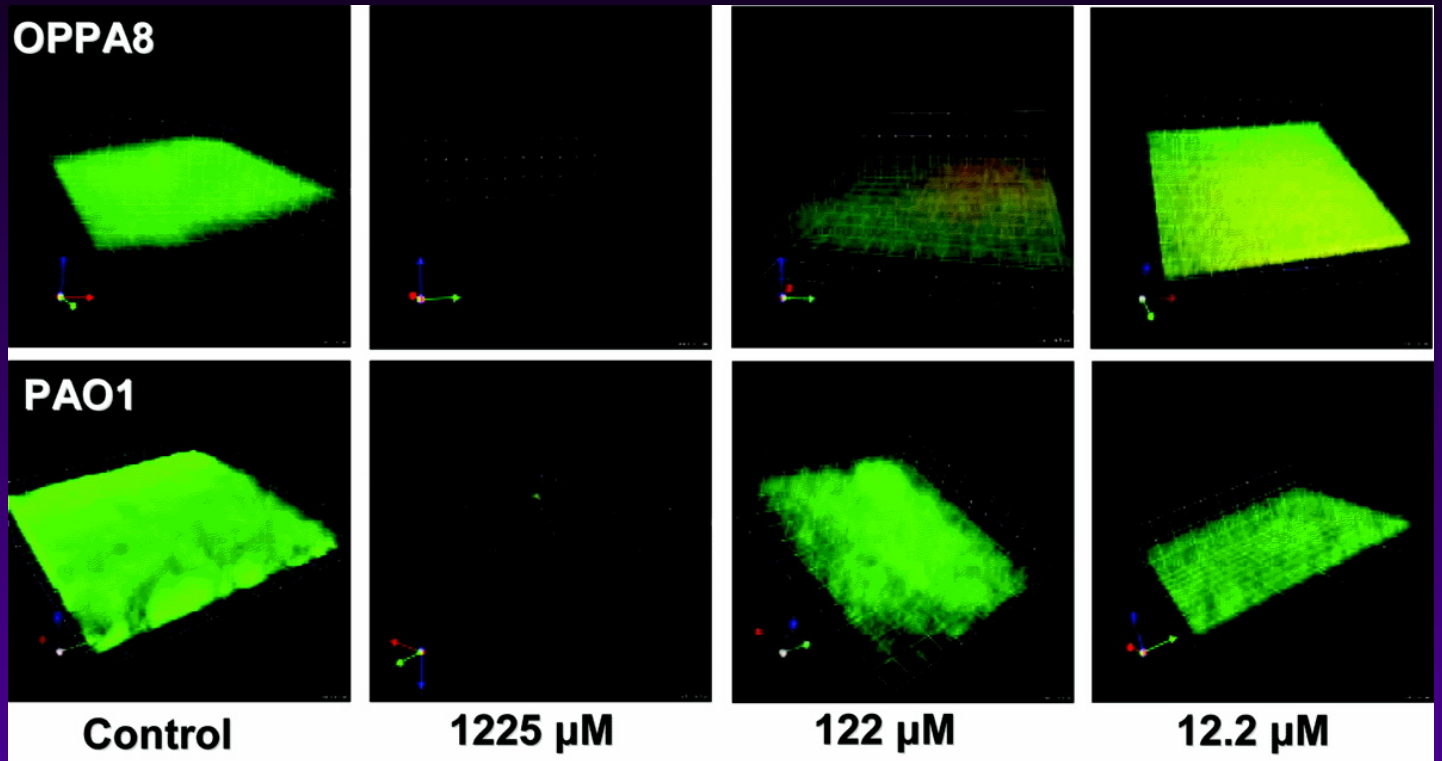
Biofilm in COME

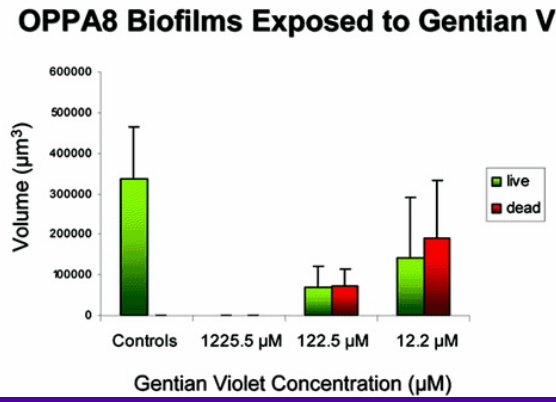


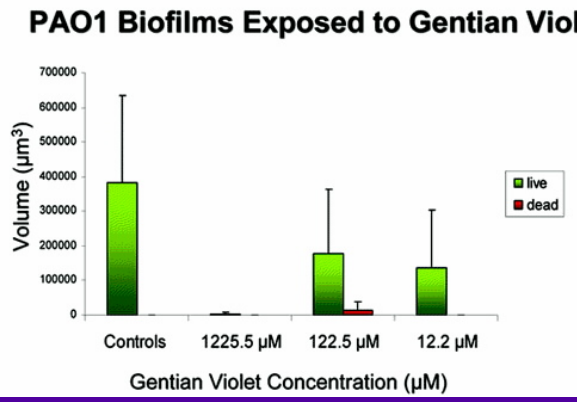
Left, Low-magnification CLSM image in fluorescent and transmission mode of a PnAb-positive MEM specimen. The pneumococci stain red (Texas Red–conjugated antibody, fluorescent channel) and the MEM surface appears gray (transmission channel). White box indicates the area of the specimen detail (right).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

Hall-Stoodley, L. et al. JAMA

Biofilms


OPPA8
PAO1
Control
1225 µM
122 µM
12.2 µM


OPPA8 Biofilms Exposed to Gentian Violet
Volume (µm³)
600000
500000
400000
300000
200000
100000
0
live
dead
Controls
1225.5 µM
122.5 µM
12.2 µM
Gentian Violet Concentration (µM)


PAO1 Biofilms Exposed to Gentian Violet
Volume (µm³)
700000
600000
500000
400000
300000
200000
100000
0
live
dead
Controls
1225.5 µM
122.5 µM
12.2 µM
Gentian Violet Concentration (µM)

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)

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

NR: not reported.

[a] Ag: antigen detection, RT: reverse transcription, PCR: polymerase chain reaction.

[b] 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

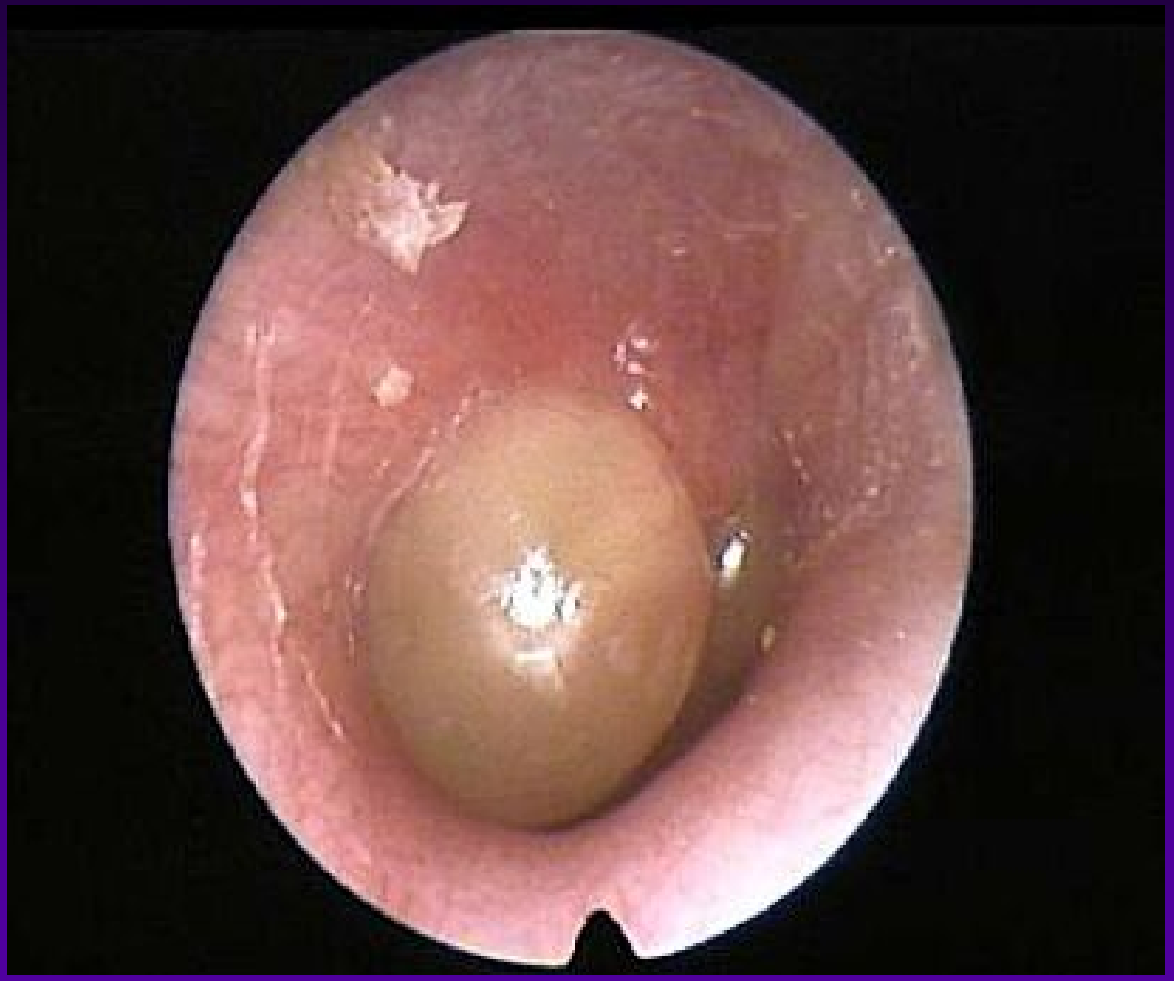
Diagnosis

- Acute OM
  - Preceding URI
  - Fever
  - Otalgia
  - Hearing loss
  - Constitutional sx
- Chronic MEE
  - Often asymptomatic
  - Hearing loss
  - “Plugged”
  - “Popping”

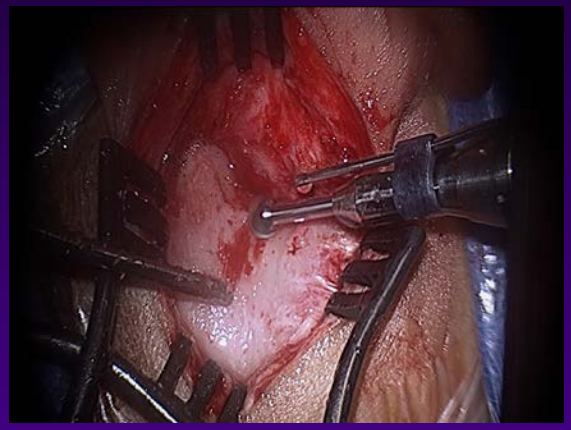
Diagnostics

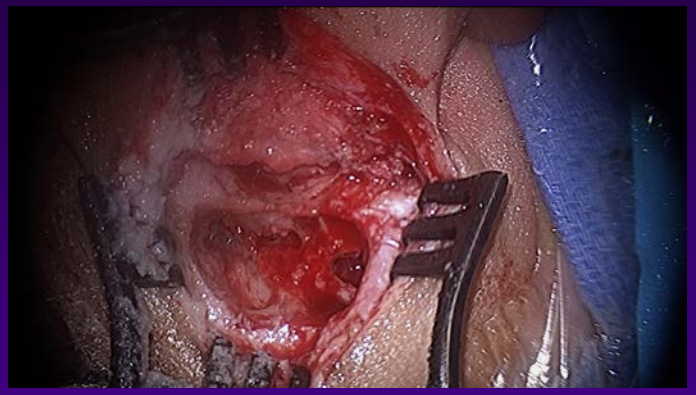
- Pneumatic otoscopy
- Impedance audiometry
- Tympanocentesis
- Immunologic Testing
- CT

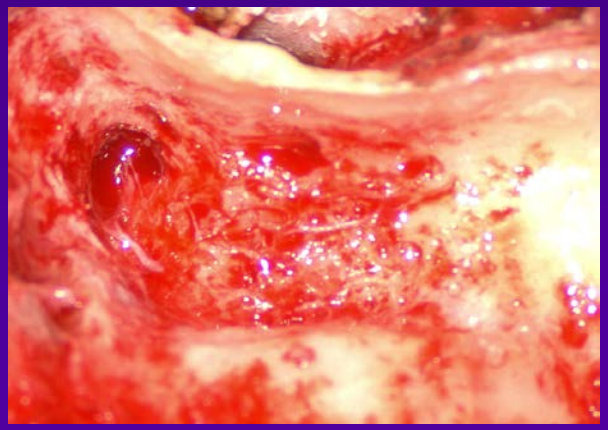
Supperative Otitis Media

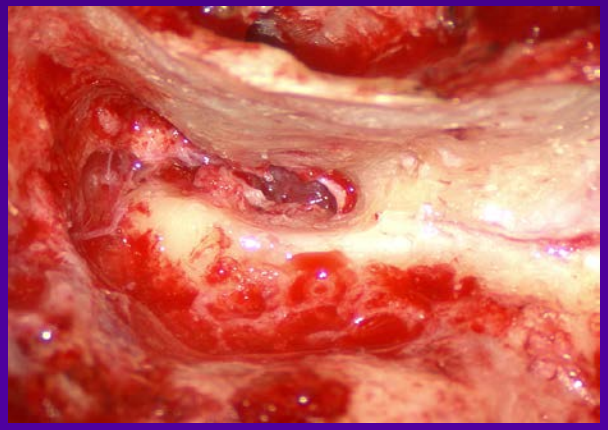


Mastoiditis



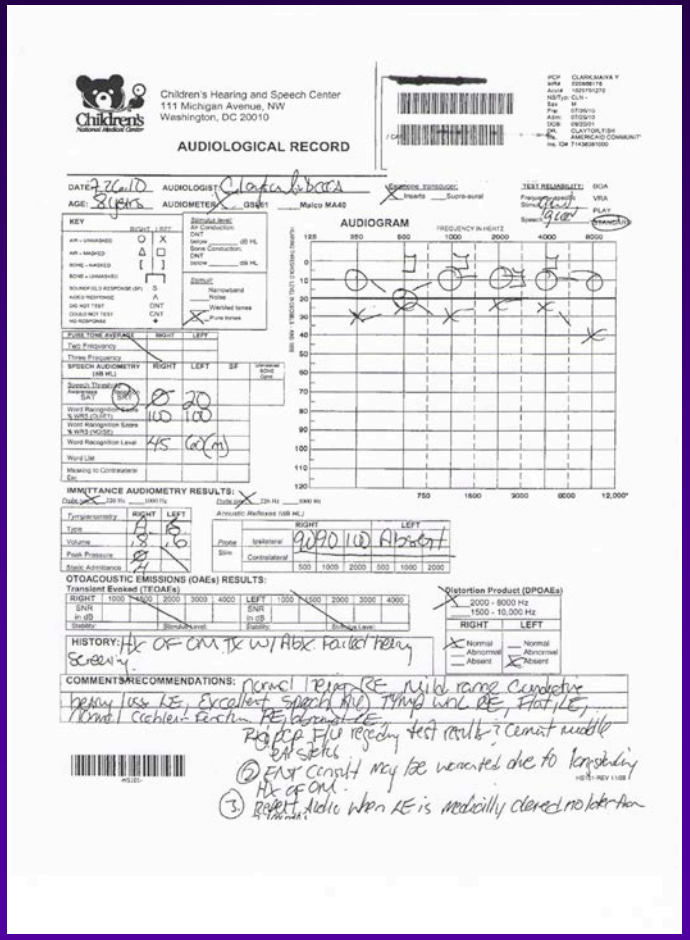






Bezold Abscess

Serous Otitis Media



Children's Hearing and Speech Center
111 Michigan Avenue, NW
Washington, DC 20010

AUDIOLOGICAL RECORD

AUDIOGRAM

IMMITTANCE AUDIOMETRY RESULTS:

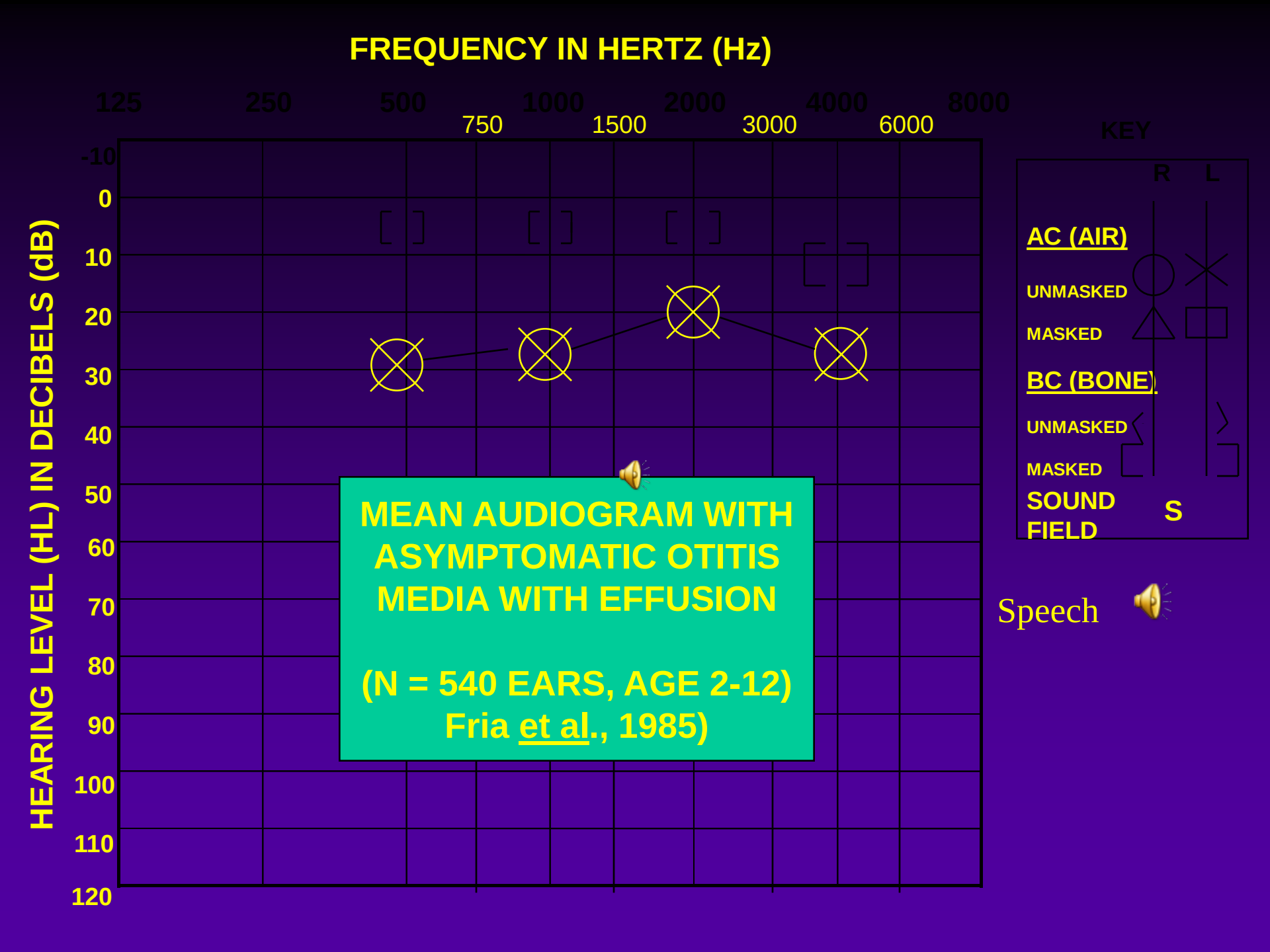
OTOACOUSTIC EMISSIONS (OAEs) RESULTS:

HISTORY:

COMMENTS/RECOMMENDATIONS:

Audiometry

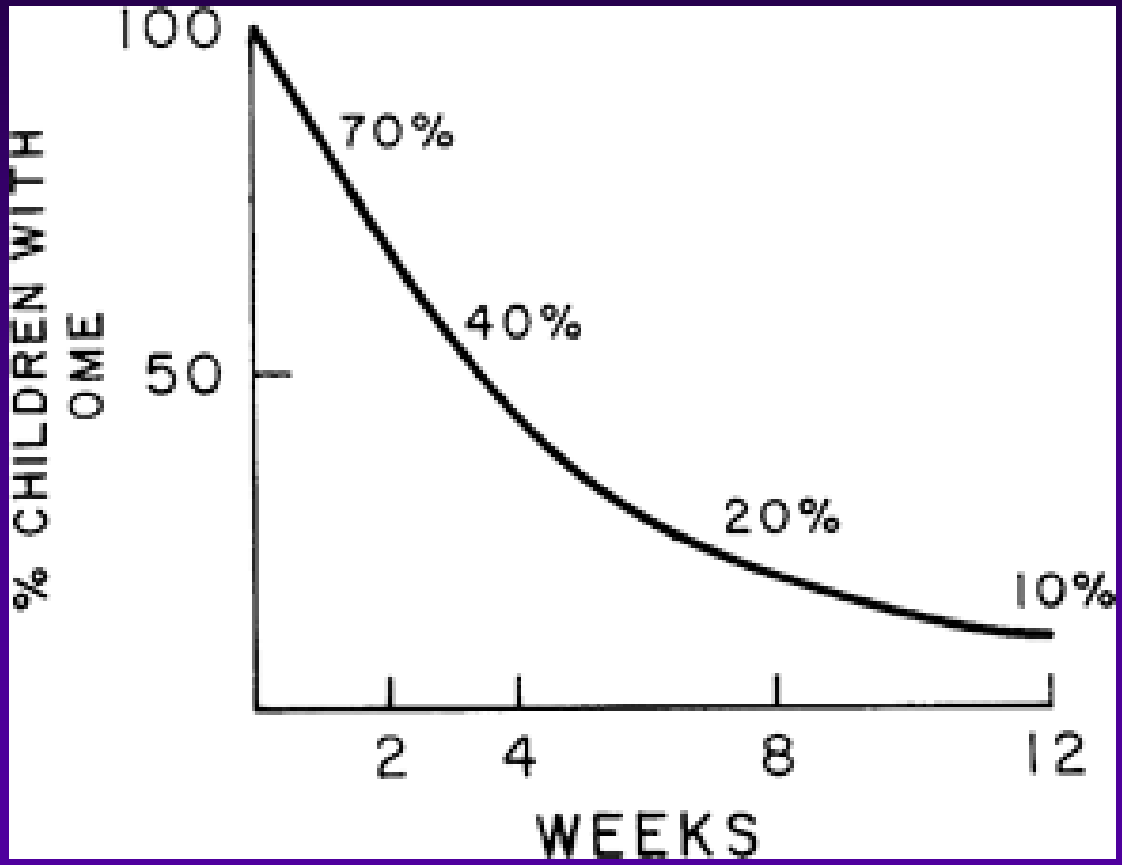
- Effusions of 3 months duration and recurrent OM
- Document any conductive loss
- Document any sensorineural loss
- Pre-operative counseling
- Baseline for later comparison


FREQUENCY IN HERTZ (Hz)
125
250
500
750
1000
1500
2000
3000
4000
6000
8000
HEARING LEVEL (HL) IN DECIBELS (dB)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
KEY
R
L
AC (AIR)
UNMASKED
MASKED
BC (BONE)
UNMASKED
MASKED
SOUND FIELD
S
Speech
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

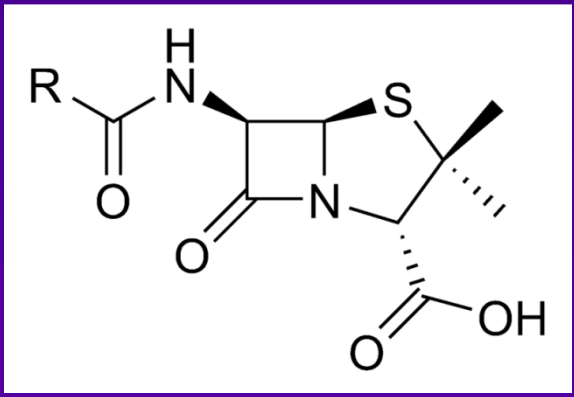
- **Antibiotics- get better faster ?**

Antibiotics

- **First line**
  - Amox - 80-90 mg/kg divided tid
- **Second line**
  - Augmentin
  - Cephalosporins- Omnicef,Ceftin, Rocephin
  - Macrolides – Zithromax

Microbiology

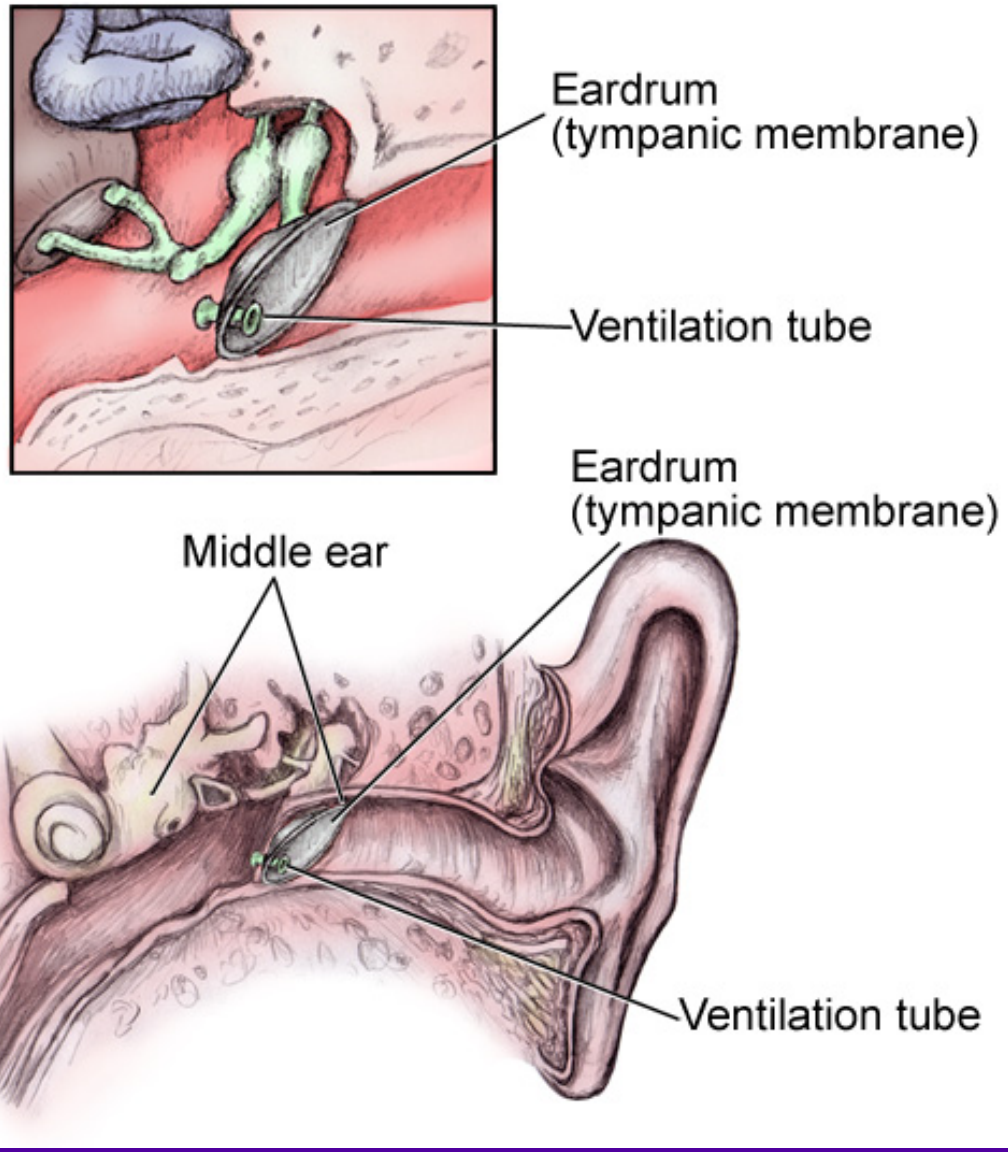
- ***PCN-resistant Strep***
  - Altered PCN-binding proteins
  - Lysis defective
  - 1979 - 1.8%
  - 1992 - 41%
- ***H flu / M. catarrhalis***
  - beta-lactamase production
  - All *M. catarrhalis*
  - 45-50% *H. flu*



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)

Ventilation Tube



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 2nd 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

Children's National Medical Center

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