

TEAM 443  
MICROBIOLOGY

# MICROBIOLOGY OF MIDDLE EAR INFECTION

LECTURE 1 :



# Objectives



Define middle ear infection.



Recall the classification & etiology of otitis media (OM).



Know the epidemiology of OM.



Know the pathogenesis & risk factors of OM.



List the clinical features of OM.



Recall the diagnostic approaches of OM.



Recall the management of OM.



Recall common complications of OM.

Any future corrections will be in the editing file, so please check it frequently

## Color Index:

Main text

Important

Notes

Boys slides

Girls slides

Extra



Recommended Video



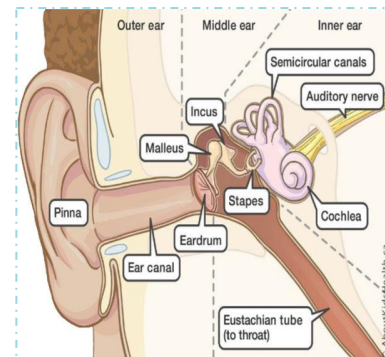
## Middle Ear

Middle ear is the area between the tympanic membrane and the inner ear including the Eustachian tube.



## Otitis Media (OM)

It's the inflammation of the middle ear.



## Classification of OM:

1

Acute

2

Chronic

3

Serous /  
Secretory



## Epidemiology of Otitis Media

1

Most common in infants 6 to 18 months of age (**2/3 of cases**).

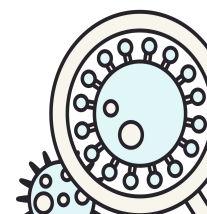
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**Improves with age, why ?**

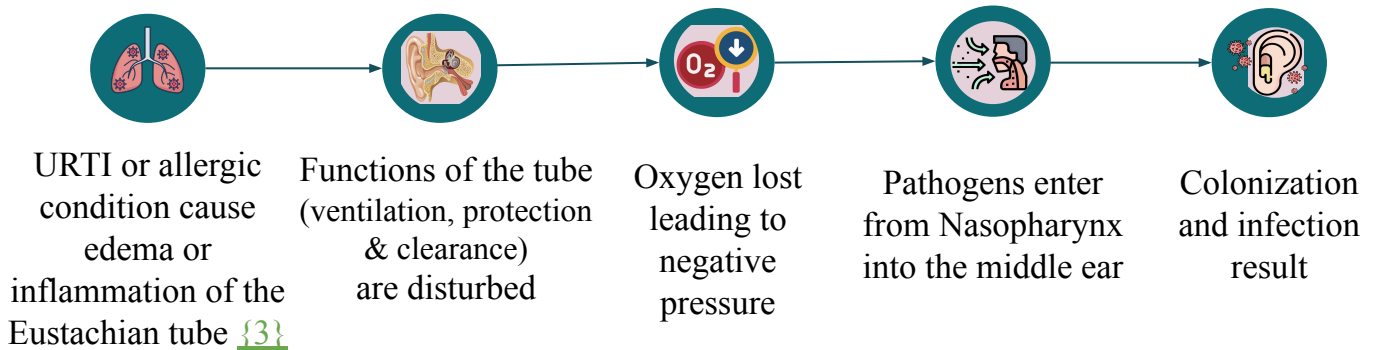
The Eustachian Tube **{1}** which vents the middle ear to the Nasopharynx is horizontal in infants, difficult to drain naturally, its surface is cartilage, and the lymphatic tissue lining is an extension of adenoidal tissue from the back of the nose.

3

Often preceded by viral **upper respiratory infection** **{2}**



# Pathogenesis



## ★ Risk Factors {4}

### Anatomic abnormalities

Medical conditions such as Cleft palate (In children) , obstruction due to adenoid or Nasogastric tube or malignancy, immune dysfunction

Exposure to pathogens from day care.

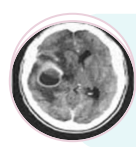
### Exposure to smoking. {5}

# Complications ★



## Extracranial (Intratemporal) inside the ear

- Hearing loss
- Tympanic Membrane Perforation
- Mastoiditis
- Cholesteatoma :Chronic inflammatory granulomatous disease
- Labyrinthitis & others



## Intracranial outside the ear Effect the layers of the brain

- Meningitis
- Extradural abscess
- Subdural empyema
- Brain abscess & others


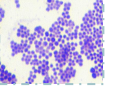
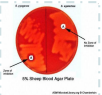
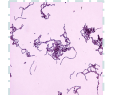
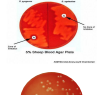


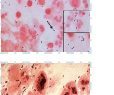
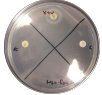
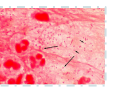

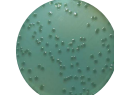



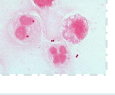


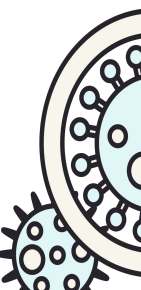
# Classification of OM:

Type	Acute	Chronic	Serous
<b>Bacterial cause</b>	<p><b>&lt; 3 months of age:</b></p> <ul style="list-style-type: none"> <li>○ S.pneumoniae,(40%)</li> <li>○ H.influenzae (non typhable)</li> <li>○ Group B Streptococcus <b>especially in neonate</b></li> <li>○ Gram negative bacteria including Pseudo.aeruginosa .</li> </ul> <p><b>&gt; Than 3 months of age: {6}</b></p> <ul style="list-style-type: none"> <li>○ H.influenzae</li> <li>○ S.pneumoniae</li> <li>○ Others (S.pyogenes, Moraxella catarrhalis, S.aureus)</li> </ul>	<p><b>Mixed flora in 40% of cases</b></p> <ul style="list-style-type: none"> <li>○ Pseudo.aeruginosa</li> <li>○ Anaerobic bacteria</li> <li>○ H.influenzae</li> <li>○ S.aureus</li> <li>○ Proteus species</li> <li>○ K.pneumoniae</li> <li>○ Moraxella catarrhalis</li> </ul>	<p>Same as chronic OM, but most of the <b>effusions</b> are sterile with a few acute inflammatory cells.</p>
<b>Viral cause</b> <u>{7}</u>	<ul style="list-style-type: none"> <li>○ <b>Mainly RSV (Respiratory Syncytial Virus) 74% Isolate.</b></li> <li>○ Para-influenza virus</li> <li>○ Influenza virus</li> <li>○ Rhinovirus</li> </ul>		
<b>Clinical Presentation</b>	<ul style="list-style-type: none"> <li>○ <b>Mostly bacterial</b></li> <li>○ <b>Often a complication of viral URTI</b></li> </ul> <p><b>First 1-2 days:</b></p> <ul style="list-style-type: none"> <li>○ <b>Fever</b> (39 C), irritability, earache.</li> <li>○ Muffled nose</li> <li>○ <b>Bulging tympanic membrane</b>, poor mobility and obstruction by fluid or inflammatory cells on otoscopic examination.</li> </ul> <p><b>After 3-8 days:</b></p> <p>Pus and ear exudative discharge released spontaneously → then pain and fever begin to decrease.</p> <p><b>After 2-4 weeks:</b></p> <p>Healing phase, discharge clears and hearing becomes normal.</p>	<ul style="list-style-type: none"> <li>○ Usually result from unresolved acute infection due to <b>inadequate treatment</b> or host factors that perpetuate the inflammatory process.</li> <li>○ <b>Involves perforation (rupture/hole formation) of tympanic membrane and active bacterial infection for long period.</b></li> <li>○ <b>Pus may drain to the outside (otorrhea).</b></li> <li>○ Results in destruction of middle ear structures and significant risk of permanent hearing loss.</li> </ul>	<ul style="list-style-type: none"> <li>○ Collection of fluid within the middle ear as a result of negative pressure produced by altered Eustachian tube function.</li> <li>○ Represents a form of chronic otitis media or allergy related inflammation.</li> <li>○ <b>Over weeks to months: Thickening of middle ear fluid (glue ear)</b></li> <li>○ Tends to be chronic with non-purulent secretions.</li> <li>○ Cause hearing deficit./ <b>Leads to conductive hearing impairment.</b></li> </ul>
<b>Management</b> <u>{8}</u>	<ul style="list-style-type: none"> <li>○ <b>Empirical</b> antimicrobial therapy depending on the most likely bacterial pathogens, usually to cover <b>my</b></li> <li>○ <b>Amoxicillin +/- Clavulanic acid, or cefuroxime</b> <u>{9}</u></li> <li>○ Careful follow up</li> <li>○ Drainage of exudates may be required</li> </ul>	<p>Need complex management, Possibly surgical</p>	
<b>Diagnosis</b>	<ul style="list-style-type: none"> <li>○ Clinical examination</li> <li>○ Tympanometry (detect the presence of fluid)</li> <li>○ Gram stain &amp; culture of aspirated fluid to detect the etiologic agents.</li> </ul>		
<b>Images</b>			



# Extra classification

Gram stain	Bacteria	Catalase	Coagulase	Distinguishing Features	Pictures
Gram +VE	<b>Staph. aureus</b>	Positive	Positive	<ul style="list-style-type: none"> <li>○ Cocci in clusters</li> <li>○ Yellow colonies in blood agar</li> <li>○ <b>DNase +ve</b></li> </ul>	 
	Strept. pyogenes (group A)	Negative	Negative	<ul style="list-style-type: none"> <li>○ Cocci in chains</li> <li>○ Beta hemolytic</li> <li>○ Bacitracin sensitive</li> </ul>	 
	Strept. agalactiae (group B)	Negative	Negative	<ul style="list-style-type: none"> <li>○ Cocci in chains</li> <li>○ Beta hemolytic</li> <li>○ Bacitracin resistant</li> </ul>	 
	<b>Strept. pneumoniae</b>	Negative	Negative	<ul style="list-style-type: none"> <li>○ Diplococci (Pairs)</li> <li>○ <b>Alpha hemolytic</b></li> <li>○ Bile soluble</li> <li>○ <b>Optochin sensitive</b></li> </ul>	 
Gram -VE	<b>H.influenzae</b>	-	-	<ul style="list-style-type: none"> <li>○ <b>Coccobacilli</b></li> <li>○ Requires growth factor x(hemin) &amp; v (NAD)</li> </ul>	 
	Proteus species	-	-	<ul style="list-style-type: none"> <li>○ Bacilli (Rods)</li> <li>○ Non-lactose fermentation</li> <li>○ Oxidase -ve</li> <li>○ Urease +ve</li> </ul>	 
	<b>Pseudomonas aeruginosa</b>	-	-	<ul style="list-style-type: none"> <li>○ <b>Bacilli (Rods)</b></li> <li>○ Non-lactose fermentation</li> <li>○ <b>Oxidase +ve</b></li> </ul>	 
	Moraxella Catarrhalis	-	-	<ul style="list-style-type: none"> <li>○ Diplococci (Pairs)</li> <li>○ Oxidase +ve</li> </ul>	 





# Prof Ali Notes

{1}:

- Eustachian Tube in infants is shorter and wider “straight” and not “S shaped” So in babies during sucking/drinking milk; stagnant and stasis of milk can happen so it will reach the middle ear through Eustachian Tube (it’s horizontal remember?)
- What is the importance of the Eustachian tube?
  - 1- keep the pressure balance between middle ear and atmosphere
  - 2- keep the middle ear clean

{2}: you know in URTI, many nasty bacteria can reach the middle ear and cause infection, especially if the baby got UTI more than one time per 6 months

{3}: Caused by blockage of Eustachian Tube, because of sucking or disturbance in pressure inside ear —> No sufficient cleaning of ear

{4}: **SAQ**, What are the risk factors/ factors that increase risk of Otitis Media in children/infants?

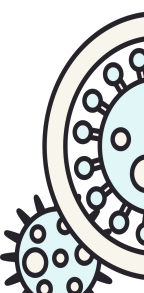
Medical deformities are the most important factor eg; Soft palate and hard palate.

{5}: How smoking affects babies? “passive smoking” inhalation of nicotine in air leading to destruction of cilia in respiratory tracts —> fluids Accumulation

{6}: Why do these organisms always cause infections? Because they are normal flora in URT

{7}:

- Virus can cause mild OM
- most serious thing, viruses can slough mucosa & this will increase the risk of having otitis media in children as a secondary bacterial infection.





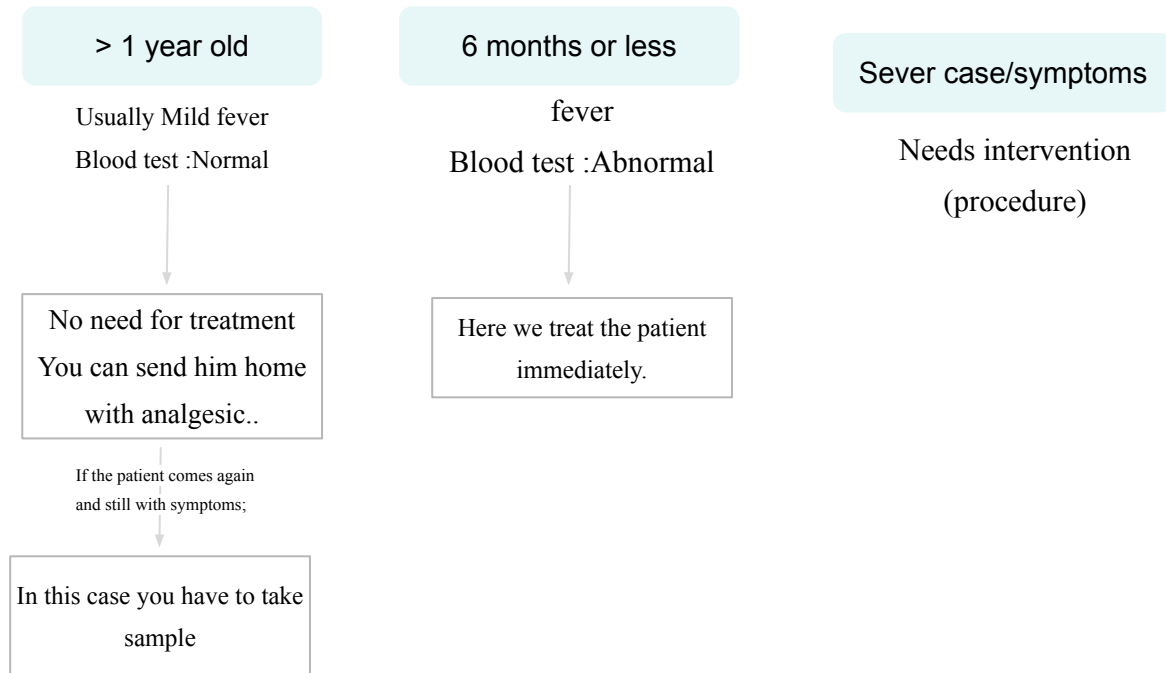


{8}:

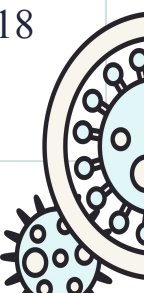
- If the organism is resistant or not treated early —> leads to chronic infection.



There are THREE possible conditions in management



- **9** infection caused by Strep. pneumoniae, haemophilus influenzae treated by “Amoxicillin+clavulanic acid” why? Haemophilus influenzae produce beta lactamases, so you have to use beta lactamases inhibitors ( Clavulanic acid).
- usually, strep.pneumonia infections comes with haemophilus, so H.influenzae will produce Extracellular beta lactamase that can protect strep.pneumoniae from the antibiotic as well, So Amoxicillin has to be with clavulanic acid (beta lactamases inhibitor), If there’s no improvement we increase the dose. Another option to start with, is cephalosporin (eg.Cefuroxime) 2nd generation If fastidious organism, 3rd generation cephalosporin (eg.ceftriaxone) can be used.
- So antibiotics in otitis media depend on organism (can be penicillin, cephalosporin 2/3gen) In H.influenzae we can use Ciprofloxacin, But NOT in children under 18 years







# MCQs - SAQ

Q1 -Which of the following bacterial pathogens MOST COMMONLY causes acute Otitis media in a 2 month old infant?

A) Proteus species

B) Group B streptococcus

C) K.pneumoniae

D) Staphylococcus aureus

Q2 - Which of the following group of ages is MOST LIKELY to have an ear infection?

A) 6-18 months

B) Teenagers

C) 6-8 years

D) Elderly

Q3 - ..... Otitis media causes glue-like discharge and thickening of the ear.

A) Acute

B) Chronic

C) Recurrent

D) Serous

Q4 - All the following are extracranial complications EXCEPT:

A) Hearing loss

B) Tympanic perforation

C) Meningitis

D) Mastoiditis

Q5 - All the following are clinical manifestations of acute Otitis Media EXCEPT:

A)Fever

B) Earache

C) Tympanic membrane bulging

D) Permanent hearing loss

Q6 - ..... is a risk factor for ear infection in infants?

A) Diarrhea

B) Bottle feeding

C) Premature birth

D) Being first born

Q7 -The BEST treatment of acute Otitis Media includes all the following EXCEPT:

A) Rifampicin

B) Clavulanic acid

C) Cefuroxime

D) Amoxicillin

Q1:A child came to the clinic suffering from a viral URTI with continuous pain that made him cry all the time and hit his head continuously. He has been very sick and irritable the first 1-2 days. He suffered from **fever** (39C°) and muffled nose. When performing an otoscopy it was found that there was a **bulging** tympanic membrane. Gram stain was performed on the pus smear and it revealed **gram positive diplococci** bacteria with pus cells.

A : What is the most likely diagnosis?

Acute otitis Media

B: What is the most likely causative agent?

Strept. pneumoniae

C: What diagnostic tests would you perform?

Clinical examination

Tympanometry (detect the presence of fluid)

Gram stain & culture of aspirated fluid to detect the etiologic agents.

D: What is the appropriate treatment for this patient?

Amoxicillin/clavulanic acid or cefuroxime

A 2 years old child presented to the ER complaining from fever, hyperthermia, pain in the ear and bulging of tympanic membrane.

A: What Is the most likely diagnosis?

Acute otitis media

B: Mention 3 organisms that causes this condition ?

Moraxella catarrhalis H.influenzae

S.pneumoniae

C: mention two extracranial complications ?

1-hearing loss

2-tympanic membrane perforation

Q3: what are the factors that increase risk of Otitis Media in children/infants?

Anatomic abnormalities, Medical deformities are the most important factor eg; Soft palate and hard palate



TEAM 443  
MICROBIOLOGY

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