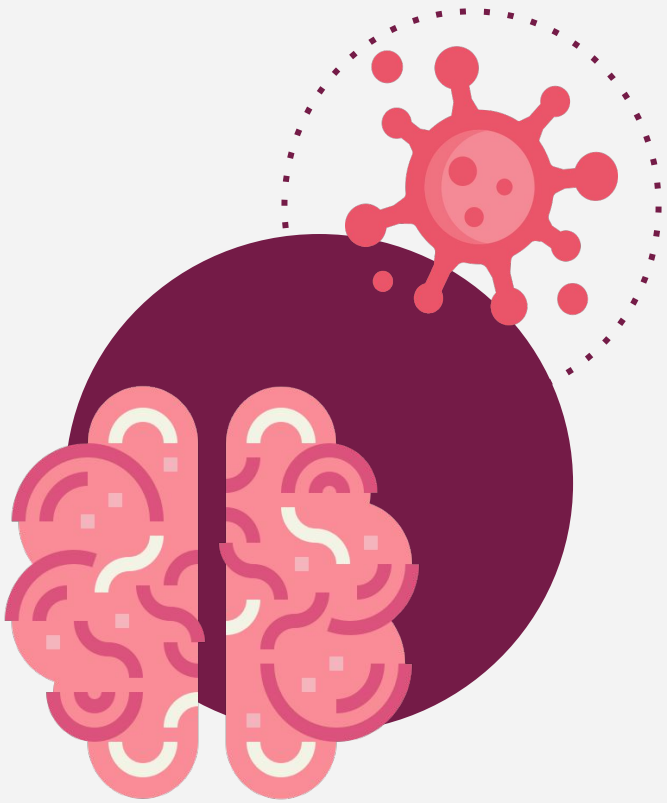
Otitis media

Objectives:

- Define middle ear infection
- Know the classification of otitis media (OM)
- Know the epidemiology of OM
- Know the pathogenesis & risk factors of OM
- List the clinical features of OM
- Know the diagnostic approaches of OM
- Know the management of OM
- Recall common complications of OM



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MED439 KING SAUD UNIVERSITY

MICROBIOLOGY TEAM 439

Revised & Approved

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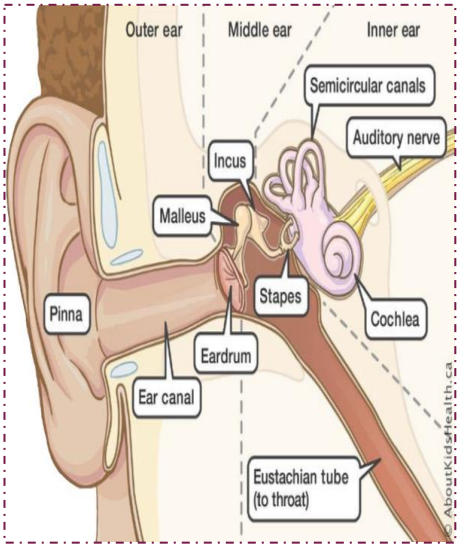
Otitis Media

Middle ear

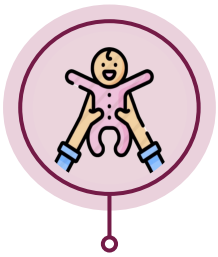
is the area between the tympanic membrane and the inner ear including the Eustachian tube[1]



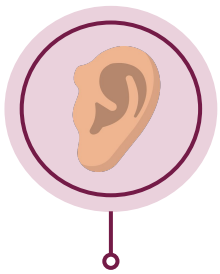
Otitis Media

is inflammation of the middle ear

Epidemiology

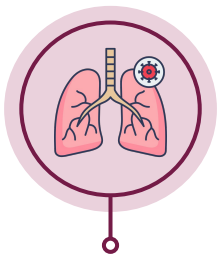


Most common in infants 6 to 18 months of age (2/3 of cases)[2]

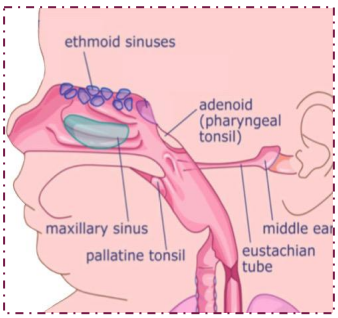


Improve with age, why? The Eustachian Tube which vents the middle ear to the nasopharynx, is horizontal in infants:

- 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.



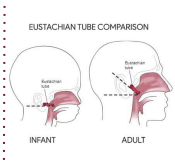
Often preceded by viral upper respiratory infection (URTI).[3]



[1] Is a tube that links the nasopharynx to the middle ear. It drains fluid from the middle ear into the nasopharynx (throat)

[2] Because of several reasons:
- Their shorter, more horizontal eustachian tubes let bacteria and viruses find their way into the middle ear more easily.
- The tubes are narrower, so more likely to get blocked.

[3] Viral URI leads to Eustachian tube inflammation resulting in its dysfunction and negative middle ear pressure permitting secretions containing the infecting virus and pathogenic bacteria that colonize the nasopharynx to enter the middle ear.



Pathogenesis

1. URTI or allergic condition cause edema or inflammation of the tube
2. Functions of the tube (ventilation, protection and clearance) disturbed.
3. Oxygen lost leading to negative pressure
4. Pathogens enter from Nasopharynx into the middle ear.
5. Colonization and infection result

Risk factors

- Anatomic abnormalities
- Medical conditions such as Cleft palate[1], obstruction due to adenoid[2] or Nasogastric tube or malignancy, immune dysfunction
- Exposure to pathogens from day care.
- Exposure to smoking. [3]

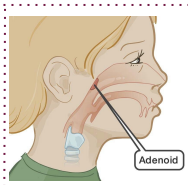
Classification of OM

1. Acute
2. Chronic OM
3. Secretory (serous) OM

[1]The eustachian tube allows the inside of the ear to drain any fluid out into the back of the nose. Because of the abnormal position of the muscles and tendons in children with cleft palate, the eustachian tube cannot drain the ear as well as in children without a cleft palate. This is important, as fluid collecting inside the ear can affect hearing and can lead to higher risks of middle ear infections.

[2]It is a mass of lymphatic tissue located behind the nasal cavity in the roof of the nasopharynx beside the opening of the tube. Enlarged adenoid can block and obstruct the tube this blockage causes fluid to build up in the ear which can lead to ear infection

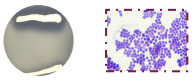
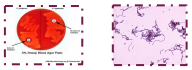
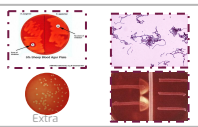
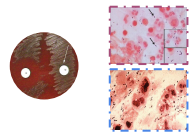
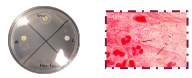
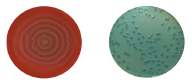
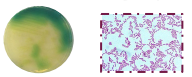
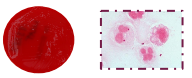
[3] The exposure to smoke effects and damages the tissue in nose and throat, and since the ear is connected to that area by the Eustachian tube, it will be affected as well, especially in children since the tube is horizontally placed



★ **Prof. Ali: You MUST know the morphology** as it will come as hints in the exam

About the bacteria in this lecture (Extra info 438)

Only the pictures were in the doctor slides

Gram stain	Bacteria	Catalase	Coagulase	Distinguishing Features	Pictures
Gram +VE	**Staph. aureus**	Positive	Positive	- Cocci in clusters - Yellow colonies in blood agar A - DNAse +ve	A 
	Strept. pyogenes (group A)	Negative	Negative	- Cocci in chains - **Beta** hemolytic B - Bacitracin sensitive	B 
	Strept. agalactiae (group B)	Negative	Negative	- Cocci in chains - **Beta** hemolytic C - Bacitracin resistant	C 
	Strept. pneumoniae	Negative	Negative	- Diplococci (Pairs) - **Alpha** hemolytic - Bile soluble D - Optochin sensitive	D 
Gram -VE	**H.influenzae**	-	-	- Coccobacilli E - Requires growth factor x(hemin) and v (NAD)	E 
	Proteus species	-	-	- Bacilli (Rods) - Non-lactose fermentation - Oxidase -ve - Urease +ve	Extra pictures 
	Pseudomonas aeruginosa	-	-	- Bacilli (Rods) - Non-lactose fermentation - Oxidase +ve	Extra 
	Moraxella Catarrhalis	-	-	- Diplococci (Pairs) - Oxidase +ve	Extra pictures 

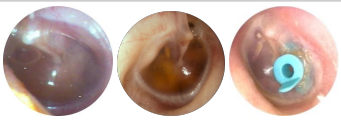
Types	Acute	Chronic	Serous
Bacterial cause	**< 3 months of age:** ★ **Group B Streptococcus** [1] ○ H.influenzae (non typable)[2] ○ S.pneumoniae,(40%)[3] ○ Gram negative bacteria including Pseudo.aeruginosa, E.coli **> Than 3 months of age:** ○ H.influenzae ○ S.pneumoniae ○ Others (S.pyogenes, Moraxella catarrhalis, S.aureus)	Mixed flora in 40% of cases ★ **Pseudo.aeruginosa**[4] ★ **Anaerobic bacteria** ○ H.influenzae ○ S.aureus ○ Proteus species ○ K.pneumoniae ○ Moraxella catarrhalis	Same as chronic OM, but most of the effusions are sterile with a few acute inflammatory cells.
Viral cause	○ RSV (Respiratory Syncytial Virus) 74%. ○ Rhinovirus	○ Parainfluenza virus ○ Influenza virus	

[1] Group B streptococcus: Gram + , cocci , catalase -, B hemolytic

[2] Haemophilus Influenzae: Gram -, bacilli, fastidious

[3] Streptococcus pneumoniae: Gram +, cocci, aerobic, catalase - , alpha hemolytic

[4] Pseudomonas aeruginosa: Gram -, bacilli, non-lactose fermenting

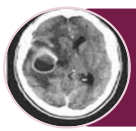
Types	Acute	Chronic	Serous ★ Not important
Clinical presentation	○ Mostly Bacterial →Severe and continuous Pain ○ Often a complication of viral URTI. **First 1-2 days:** ○ **Fever**/hyperthermia (39 C), irritability, earache (otalgia). ○ muffled nose. ○ Bulging tympanic membrane, poor mobility and obstruction by fluid or inflammatory cells on otoscopic examination. **(Pain)** **After 3-8 days:** Pus and ear exudative discharge released spontaneously (otorrhea) → then pain and fever begin to decrease. **After 2-4 weeks:** Healing phase, discharge clears and hearing becomes normal.	○ Usually result from unresolved acute infection due to inadequate treatment or host factors that perpetuate the inflammatory process. ○ Involves perforation (rupture/hole formation) of tympanic membrane and active bacterial infection for long period. ○ Pus may drain to the outside (otorrhea). ○ Results in destruction of middle ear structures and significant risk of permanent hearing loss.	○ Collection of fluid within the middle ear as a result of negative pressure produced by altered Eustachian tube function. ○ Represents a form of chronic otitis media or allergy related inflammation. **Over weeks to months**: Thickening of middle ear fluid (glue ear) ○ Tends to be chronic with non–purulent secretions. ○ Cause conductive hearing impairment.
Images			
Management	○ **Empirical** antimicrobial therapy depending on the most likely bacterial pathogens, usually to cover **S.pneumoniae** and **H.influenzae.** ○ **Amoxicillin +/- Clavulanic acid, or cefuroxime** ○ Careful follow up ○ Drainage of exudates may be required.	○ Need complex management, Possibly surgical.	
How to diagnose	○ Clinical examination ○ Tympanometry (detect the presence of fluid) ○ Gram stain & culture of aspirated fluid to detect the etiologic agents.		

Complications

★ **Prof. Ali : We like to ask about it.**

Extracranial (intratemporal)
(inside the ear)

- **Hearing loss**
- **Tympanic Membrane Perforation.**
- **Mastoiditis** [1]
- Cholesteatoma [2]
- Labyrinthitis & others [3]



Intracranial
(outside the ear)

- **Meningitis** [5]
- **Extradural abscess**
- Subdural empyema [4]
- Brain abscess[5] & others

[1] Mastoiditis is a serious infection in the mastoid process (as shown in the picture beside the extracranial title)
[2] Cholesteatoma is an abnormal growth of skin in the middle ear
[3] Labyrinthitis is an inner ear infection which affects your balance
[4] Subdural empyema is a collection of pus in the subdural space
[5] Usually results from bacterial infection

Drs' notes

Prof. Ali

- Otitis media is generally a childhood infection. (Disease of pediatrics)

★ List the risk factors of OM in pediatrics? (The answer is the following note):

- Infants 6-18 months are more susceptible to otitis media due to many reasons. **Very important.** Prof. Ali: it is a possible exam question.
  - Anatomical structure (short, straight, horizontal eustachian tube)
  - Immunity is still developing. (susceptible to viral infections & producing secretions allowing more bacteria to be sucked in).
  - The way of bottle-feeding (bottles are held horizontally), which allows some fluid to be sucked into the inner ear providing a favorable environment for microorganisms to grow.
  - Their adenoids are larger, that are positioned in the back of throat near to the eustachian tube opening.
  - Medical conditions such as **cleft palate**.

- Pathogenesis: Edema → obstruction/narrowing of tube → negative pressure → normal flora of nasopharynx is sucked into the middle ear → otitis media.

- Secretory / serous otitis media is not infectious (it has a colorless secretion & no pus cells). Dr:"We will NOT ask about it/it is not that important but it's mainly due to allergy and some viral infections and might lead to an infection".

- Chronic otitis media is a result of untreated acute otitis media.

- Generally, the causative agents in OM is normal flora in oral cavity.

★ **In acute OM**: we have 3 common organisms. (1) **Group B strept** can be seen In children less than 3 months of age (<12 weeks) only, (because it usually comes from the mother), whereas (2) H.influenzae and (3) S.pneumoniae can be seen in both less AND more than 3 months of age.

★ **In chronic OM**: You expect anything, including organisms of acute OM; however, the most important ones are:
(1) Pseudomonas aeruginosa, (2) Anaerobic bacteria, and Gram negatives in general.

- Respiratory viruses can sometimes lead to otitis media. Sometimes it will be accompanied by secondary bacterial infection. (We usually aren't in a rush to treat patients of URTIs because they are mostly self-limiting; however, in the case of neonates and children less than 3 years old, we have to observe them carefully to make sure they don't develop secondary pyogenic infection).

- Otitis media presents mainly as fever, bulging of tympanic membrane, and pain due to inflammation & obstruction. After a few days, fever and pain will decrease as the pus is discharged. A few weeks later, patient will either heal if he was treated well, or his condition will worsen and progress to the chronic phase with worse symptoms such as tympanic membrane rupture.

- Diagnosis of otitis media is mainly by clinical examination.

- Culture is rarely done (as it is only diagnostic if the membrane has ruptured, or if an ENT surgeon is going to rupture it to release pressure, relieve other complications, or in case of significant antibiotic resistance).

- Remember that majority of otitis media will recover by itself, ESPECIALLY in children >2 years old.

- For children <2 years old, they need to be observed carefully and treated with antibiotics in most cases.

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★ Treatment of acute OM: usually is to cover S.pneumoniae and H.influenzae. Drug of choice is **Amoxicillin**, and **Clavulanic acid** (added if it was a β lactamase producing organism). Alternatives include 2nd generation cephalosporins (**cefuroxime**).

- Most serious thing about intracranial complications is that it might lead to bone infection (osteomyelitis), which will later on might develop into meningitis and cause brain abscess and empyema etc..

Prof. Hanan

- H. influenzae has many types (A,B,C,D,E,F); however, the H.influenzae in otitis media is non-typeable (does not belong to any type).

- An example of anaerobic bacteria that is associated with chronic otitis media is Bacteroides. (common in ear infection/Gut flora).

- Pathogenesis of OM: obstruction and disturbance of the eustachian tube functions (by edema/inflammation) causes the pressure inside the ear to be negative (allowing nasopharyngeal normal flora in the tube), and if this is accompanied by a URTI, chances of getting otitis media will be increase.

- Antimicrobial treatment of otitis media is no less than 10 days.

Quiz

Click on the icon to check out the team's summary and extra cases

MCQ

★Q1: Which one of the following is an intratemporal complication of otitis media ?

A- Meningitis
B- Mastoiditis
C- Subdural empyema
D- Extradural abscess

★ Q2: What is the most common pathogen in an infant whose age is less than 3 months ?

A- S. Aureus
B- Proteus species
C- Moraxella
D- Group B streptococcus

★Q3: A 6 months old baby was brought to the hospital's emergency due to high fever (39℃), earache, ear discharge and continuous crying because of irritability. Tympanometry showed perforated edema and clinical examinations showed inflammation in his middle ear. Bacterial culture of aspirated fluid revealed gram positive cocci in pairs. What is the most likely organism to cause this disease ?

A- Staphylococcus aureus
B- Group B streptococci
C- Streptococcus pneumonia
D- Haemophilus influenzae

Q4: Which one of the following structures is related to otitis media in children ?

A- Tonsils
B- Eustachian tube
C- Nasopharynx
D- Inferior jugular vein

Q5: Where is it more likely for the pathogen to enter the middle ear and cause OM ?

A- External Ear
B- Blood stream
C- Nasopharynx
D- Middle Ear

Q6:Which one of the following antibiotics is used to treat otitis media ?

A- Vancomycin
B- Gentamicin
C- Amoxicillin/clavulanic acid
D- Tetracycline

Answers: Q1:B | Q2:D | Q3:C | Q4:B| Q5:C| Q6:C

SAQ

CASE: A child came to the clinic suffering from a viral upper respiratory tract infection 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 (39℃) 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.

Q1: What is the most likely diagnosis?

Acute otitis Media

Q2: What is the most likely causative agent?

Strept. pneumoniae

Q3: 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.

Q4: What is the appropriate treatment for this patient?

Amoxicillin/clavulanic acid or cefuroxime

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