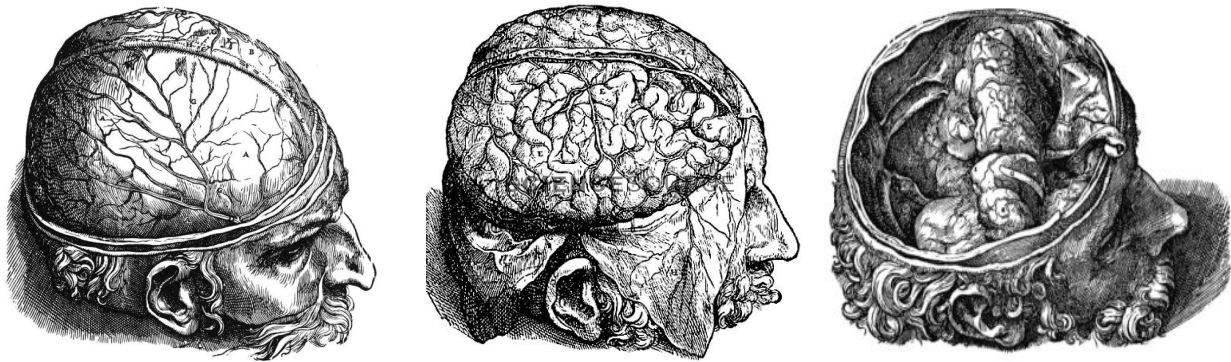


Microbiology

435's Teamwork
Neuropsychiatry Block



-
- Kindly check our [Editing File](#) before studying the document.
 - Please contact the team leaders for any suggestion, question or correction.
 - Pay attention to the statements highlighted in **red**.
 - Extra explanations are added for your understanding in **grey**.
 - **Footnotes color code:** General | **Females** | **Males**

Revised by

خولة العماري & هشام الغنيلي



Otitis Media

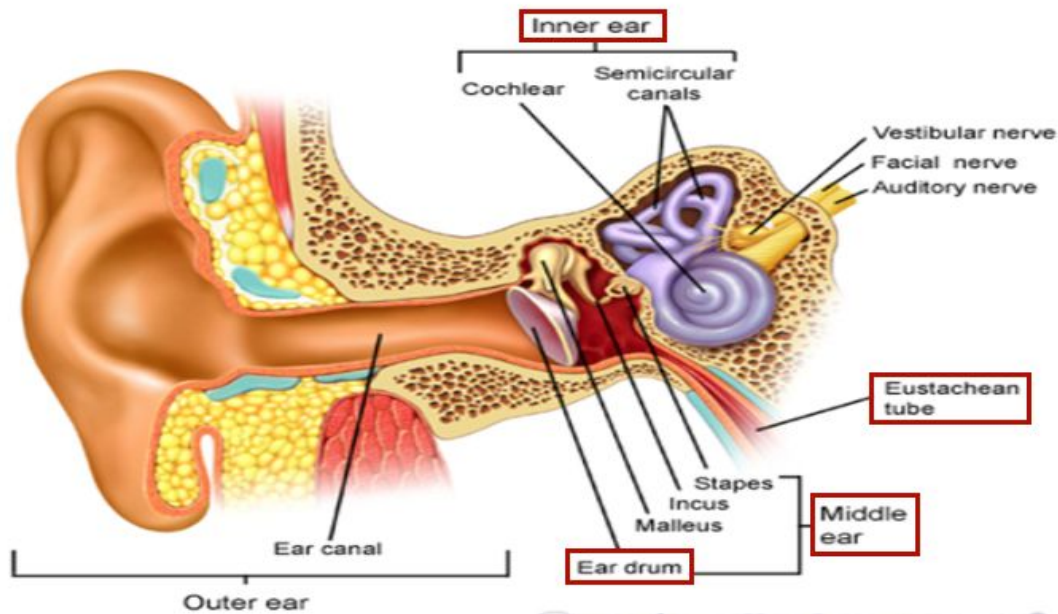
Resources: Sherris Medical Microbiology, LIR Microbiology, AAOHNS Foundation, Prof. Hanan's & Dr. Somily's 2017 lectures.

Learning Objectives:

By the end of this lecture, you should know the...

1. Definition
2. Classification
3. Epidemiology
4. Pathogenesis
5. Risk factors
6. Clinical features
7. Diagnostic approaches
8. Management
9. Complications

Of otitis media.



What is the middle ear?¹

The middle ear is the area between the tympanic membrane (Eardrum)² and the inner ear including the Eustachian tube³.

What is otitis media?

Otitis media is an inflammation of the middle ear. **It is classified into:**

1. Acute otitis media. 2. Secretory (Serous) otitis media. 3. Chronic otitis media.

¹ [Video](#): Middle Ear Anatomy.

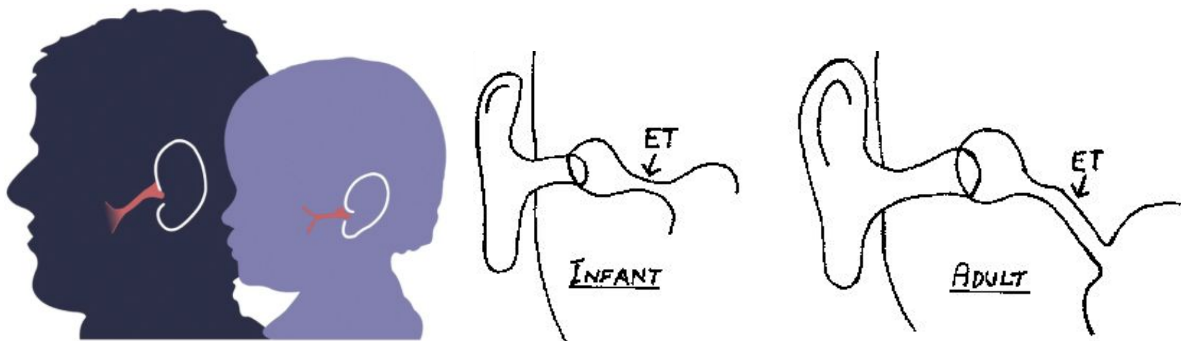
² A membrane which vibrates in response to sound waves. طبلة الأذن.

³ A tube which opens and connects the middle ear to the nasopharynx/also called auditory or pharyngotympanic.

Epidemiology:

Otitis media is one of the most frequent diagnoses (2/3 of total cases) in sick infants and children (6 to 18 months of age)⁴ visiting physicians' offices, and accounts for almost 1/3 of all antibiotics prescriptions for children in the United States. Otitis media often follows an upper respiratory tract viral infection or allergy that results in congestion of the respiratory mucosa of the nose, nasopharynx, and eustachian tube.⁵ It usually improves with age; **but what makes infants and children more susceptible to it than adults?**

1. In infants, the **Eustachian Tube**⁶ is shorter, floppy, and more horizontal⁷, making it less effective in ventilation and more difficult to drain fluid naturally than the adult.
2. The eustachian tube has a cartilaginous surface.
3. The lymphatic tissue lining the eustachian tube is an extension of adenoidal tissue.⁸



Risk factors:

- Childhood⁹.
- Bottle feeding¹⁰.
- Viral and Upper Respiratory Tract Infections (URTI).
- Allergies.
- Exposure to pathogens from daycare (nurseries).
- Exposure to secondhand smoking.
- Anatomical abnormalities, especially **Cleft Palate**¹¹.
- Medical conditions, such as:
 - Obstructed, Infected or overgrown adenoids¹².
 - Nasogastric tube¹³.
 - Malignancy/Immune dysfunction.



⁴ The baby is protected on his first 6 months because of the IgG he got from his mother.

⁵ Explained in details in the pathogenesis.

⁶ In most children there's an abnormality in the eustachian tube that it sucks the wax to the middle ear then the normal flora that is in the wax will proliferate and cause infection.

⁷ Shown in the picture below.

⁸ From the back of the nose. In infants, bacteria can get trapped in the adenoids, causing infection that can then pass on to the eustachian tubes and the middle ear, causing otitis media.

⁹ Less likely in school age, more likely in children between 6-18 or 6-12 months of age.

¹⁰ 75% of the risk is decreased in breast-fed children due to the posture (angle) that prevents milk of entering the ears.

¹¹ A congenital split in the roof of the mouth. الشَّفَاة الأرنبيَّة.

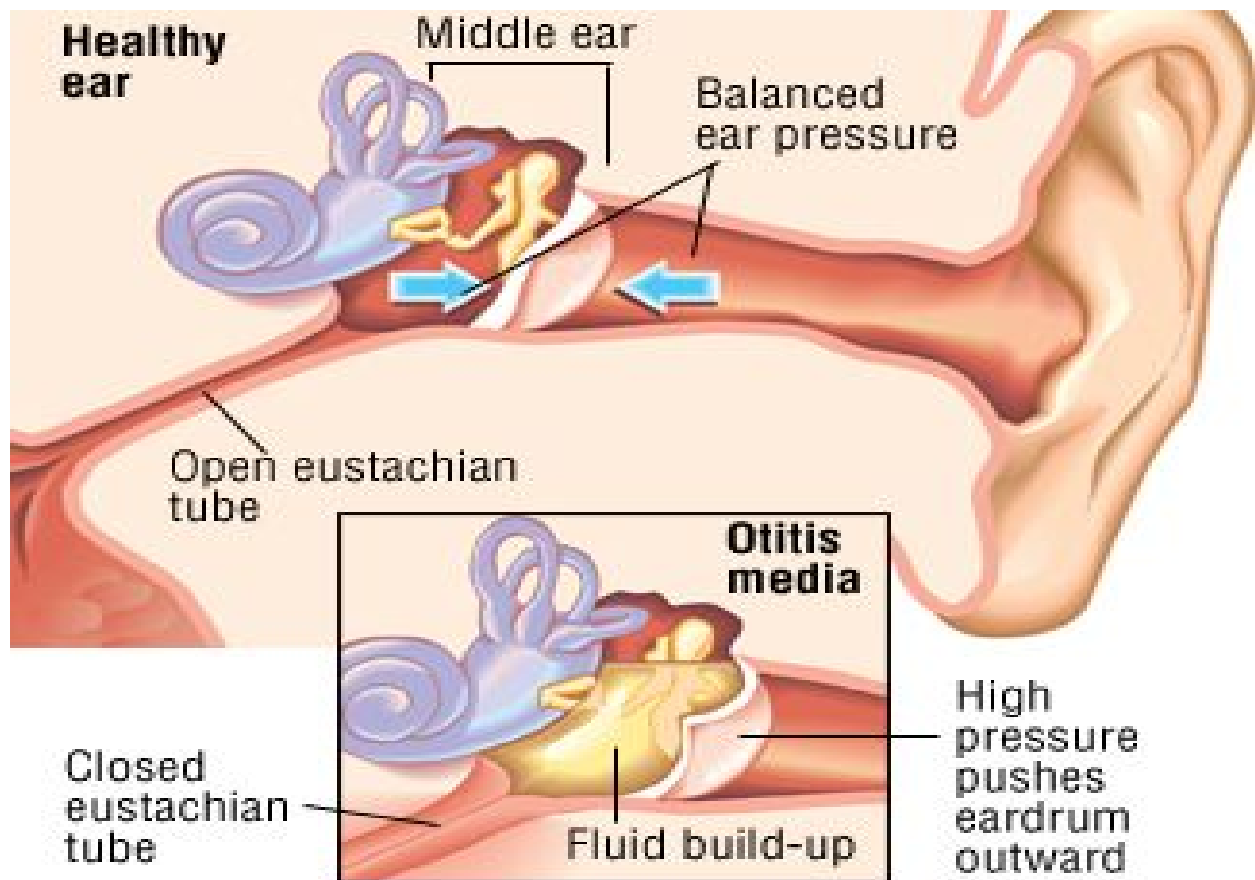
¹² Obstruction due to adenoids or "Big tonsils".

¹³ A tube passed into the stomach via the nose for nutritional support or aspiration of stomach contents.

Pathogenesis:

As explained above, otitis media often follows an upper respiratory tract infection or allergy that results in congestion of the respiratory mucosa of the nose, nasopharynx, and eustachian tube. Congestion of the mucosa of the eustachian tube causes an obstruction which can lead to accumulation of secretions produced by the mucosa of the middle ear¹⁴. These secretions have no way to exit, thus, accumulate in the middle ear space. Viruses and bacteria that colonize the upper respiratory tract can reach the middle ear and result in suppuration (formation of pus).

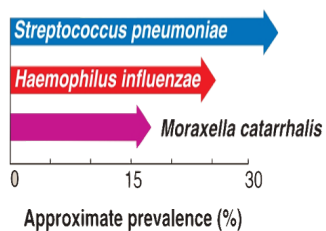
In short: Edema or inflammation of the **Eustachian Tube** → Functional disturbance (which include ventilation, protection, and clearance) → Accumulation of fluid → Oxygen lost → Negative pressure → Pathogens enter from the nasopharynx into the middle ear → Colonization and infection take place.



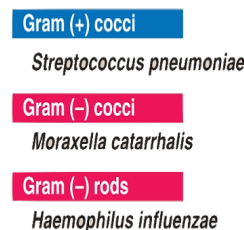
¹⁴ Please recall that although air-filled, the middle ear is lined by a mucus membrane.

Etiology		
Bacterial ¹⁵		Viral
Acute otitis media		RSV ¹⁶ (74%) Rhinovirus Parainfluenza virus Influenza virus
Mostly bacterial, but can often be a complication of viral URTI.		
< 3 months of age	> 3 months of age	
<i>Streptococcus pneumoniae</i> (40%) ¹⁷ Group B <i>Streptococcus</i> <i>Haemophilus influenzae</i> ¹⁸ <i>Pseudomonas Aeruginosa</i> ¹⁹	<i>Streptococcus pneumoniae</i> <i>Haemophilus influenzae</i> <i>Streptococcus Pyogenes</i> <i>Moraxella catarrhalis</i> <i>Staphylococcus Aureus</i>	
Chronic otitis media		
Mixed flora <i>Pseudomonas Aeruginosa</i> ²⁰ <i>Haemophilus influenzae</i> <i>Staphylococcus Aureus</i> <i>Klebsiella Pneumoniae</i> <i>Moraxella catarrhalis</i> <i>Proteus species</i> Anaerobic bacteria		
Serous otitis media		
Same as chronic otitis media, but most of the effusions are sterile with few acute inflammatory cells.		

A Common pathogens¹



B Classification of pathogens



¹⁵ Bacterial infections are more serious than the viral infection.

¹⁶ Respiratory Syncytial Virus.

¹⁷ Most common one in children less than and older than 3 months.

¹⁸ Non-typable.

A serotype is a subdivision of a species that is distinguishable from other strains depending on the basis of antigenicity (antigen-antibody reaction). *H. Influenzae* strains are genetically diverse, some occupy serotypes (typable) and some lack it (nontypable).

¹⁹ Gram -ve can lead to otitis media in babies, especially *Pseudomonas Aeruginosa*.

²⁰ If you could not find *Pseudomonas Aeruginosa*, then Anaerobes would probably be the cause.

Clinical Presentation		
Acute otitis media		
Severe, continuous pain in bacterial causes.		
First 1-2 days	3-8 days	2-4 weeks
<ul style="list-style-type: none"> ● Fever of 39°C²¹ ● Irritability²² ● Earache ● Muffled nose²³ ● Bulged, erythematous tympanic membrane ● Vomiting and diarrhea ● Poor mobility due to the obstruction by fluid ● Some of children pull their ear ● Inflammatory cells on otoscopic examination 	<p>Pus and ear exudative discharge released spontaneously due to Tympanic membrane rupture²⁴, then pain and fever begin to decrease.</p>	<p>Healing phase, discharge dries up and hearing becomes normal.</p>
Chronic otitis media		
<ul style="list-style-type: none"> ● Usually result from unresolved acute infection due to inadequate treatment or host factors that perpetuate the inflammatory process. ● Involves perforation of the tympanic membrane and an active bacterial infection for a long period.²⁵ ● Pus may drain to the outside (otorrhea). ● Result in destruction of the middle ear structures and significant risk of permanent hearing loss. 		
Secretory (Serous) otitis media		
<ul style="list-style-type: none"> ● Collection of fluid within the middle ear as a result of negative pressure produced by altered eustachian tube function. ● Represent a form of chronic otitis media or allergy-related inflammation. ● Over weeks to months, the middle ear fluid become very thick and glue-like (Glue ear). ● Tends to be chronic, with non-purulent secretions. ● Cause conductive hearing impairment. 		

²¹ Fever or febrile “Having high body temperature”.

²² The child is stressed, he can’t eat, sleep, crying all the time.

²³ Filled with secretion.

²⁴ من الممكن أن تقول الأم بأن طفلها صحى من نومه و وسادته مليئة بالمياه.

²⁵ Long period = months.

Diagnostic Approach:

- Clinical examination.
- Otoscopy.
- Tympanometry²⁶: Detect the presence of fluid.
- Gram stain and culture of aspirated fluid to determine the etiologic agents.²⁷

Management:

- **Acute otitis media** requires antimicrobial therapy and careful follow up. The antibiotics used are usually empirical, depending on the most common bacterial pathogens. However, it must cover *Streptococcus pneumoniae* and *Haemophilus influenzae*.
- **Chronic or Serous otitis media** need complex management, possibly surgical.
- Drainage of exudate is required at all times.

Antibiotics:

1. **Amoxicillin** or 2nd generation **Cefuroxime** with *S. Pneumoniae* and *H. Influenzae*.
2. **Augmentin**²⁸ or 3rd generation **Ceftriaxone** if the infection was not resolved.

Complications	
Extracranial	Intracranial
<ul style="list-style-type: none">● Hearing loss²⁹● Tympanic membrane perforation³⁰● Mastoiditis³¹● Cholesteatoma³²● Labyrinthitis³³... and others	<ul style="list-style-type: none">● Meningitis● Extradural abscess● Subdural empyema³⁴● Brain abscess... and others

²⁶ An examination used to test the condition of the middle ear and mobility of the eardrum (tympanic membrane) and the conduction bones by creating variations of air pressure in the ear canal.

²⁷ They usually don't do this because the therapy is empirical (based on experience).

²⁸ Amoxicillin + Clavulanic Acid.

²⁹ Hearing is very important to children as they learn how to speak by listening to the older people, in case of recurrent and chronic otitis media they might develop a delay in speech due to hearing loss.

³⁰ A hole in the eardrum. ثقب طبلة الأذن.

³¹ Inflammation of the [mastoid process](#).

³² An abnormal skin growth in the middle ear behind the eardrum.

³³ Inflammation of the [labyrinth](#) or inner ear.

³⁴ Collection of pus between the dura mater and the underlying arachnoid mater.

OPTIONAL / EXTRA

Organism	Typical Scenario	Symptoms	Culture Morphology	Microscopy	Tests
<i>Streptococcus Pneumoniae</i>	A parent would bring his/her child to the ER complaining of acute symptoms that emerged 2-7 days ago	Fever	Alpha Hemolytic Colonies on blood agar	Gram Stain shows gram +ve Diplococci (short chains)	Catalase negative and Sensitive to optochin disk
<i>Haemophilus & Moraxella</i>		Earache Discharge	Large, opaque colonies on chocolate agar	Gram Stain shows gram -ve Coccobacilli or Diplococci	Oxidase +ve for both, XV factor is only +ve in <i>H. Influenzae</i>
<i>Pseudomonas Aeruginosa</i>	Recurrent (chronic) attacks of Otitis Media	Perforated tympanic membrane and fever <u>might not</u> be present	Non-Lactose fermenter, produce Pyocyanin on Nutrient agar	Gram Stain shows gram -ve Bacilli	Oxidase +ve

SUMMARY

Definition	<ul style="list-style-type: none"> Otitis media (OM) is an inflammation of the middle ear. The functions of the Eustachian tube → ventilation, protection and clearance*
Epidemiology	<ul style="list-style-type: none"> Most common in infants 6 to 18 months of age (2/3 of cases). Improves with age, why? <ol style="list-style-type: none"> The Eustachian Tube is horizontal in infants “oblique in adults” / its surface is cartilage the lymphatic tissue lining is an extension of adenoidal tissue from the back of the nose. Accompanied by viral upper respiratory infection (URTI).
Pathogenesis	<ol style="list-style-type: none"> URTI or allergic condition cause edema or inflammation of the tube → functions of the tube* is disturbed. Oxygen lost → -ve pressure → pathogens enter from nasopharynx into the middle ear → colonization & infection.
Risk factors	<ul style="list-style-type: none"> Anatomic abnormalities / Exposure to pathogens from day care / Exposure to smoking. Medical conditions (Cleft palate / obstruction due to adenoid or nasogastric tube or malignancy / immune dysfunction).
Diagnostic Approaches	<ul style="list-style-type: none"> Clinical examination / Tympanometry (detect the presence of fluid). Gram stain and culture of aspirated fluid to determine the etiologic agents.
Complications	Intracranial
	Hearing loss / Mastoiditis / Cholesteatoma / Labyrinthitis / Tympanic membrane perforation
	Extracranial
	Meningitis / extradural abscess / subdural empyema / Brain abscess

Classification	Acute OM (Mostly Bacterial / complication of viral URTI)		Chronic OM	Secretory (serous) OM
Causes	Less than 3 months of age	More than 3 months of age	40% Mixed flora <ul style="list-style-type: none"> P.aeruginosa H.influenzae S.aureus Proteus species K.pneumoniae Moraxella catarrhalis anaerobic bacteria 	<ul style="list-style-type: none"> Same as chronic OM, but most of the effusions are sterile Few acute inflammatory cells
	<ul style="list-style-type: none"> S.pneumoniae (40%) H.influenzae (non typable) Group B Streptococcus Gram -ve bacteria including: <i>P.Aeruginosa</i> 	<ul style="list-style-type: none"> S.pneumoniae H.influenzae <i>S.Pyogenes</i> (group A) <i>Moraxella catarrhalis</i> <i>S.Aureus</i> 		
	Viral URTI: RSV(Respiratory Syncytial Virus) 74%			
Clinical Presentation	<p>❑ Pain often severe and continuous in bacterial causes</p> <p>First 1-2 days: Fever (39 C), irritability, earache, loss of appetite, muffled nose. Bulging tympanic membrane, poor mobility & obstruction by fluid or inflammatory cells on otoscopic examination</p> <p>3-8 days: Pus and ear exudative discharge released spontaneously, then pain and fever begin to decrease.</p> <p>2-4 weeks (Healing phase): discharge dries up and hearing becomes normal.</p>		<ul style="list-style-type: none"> Result from unresolved acute infection Involves perforation of tympanic membrane & active bacterial infection for long period. Pus may drain to the outside (otorrhea). Result in destruction of middle ear structures and significant risk of permanent hearing loss. 	<ul style="list-style-type: none"> Collection of fluid within the middle ear A form of chronic OM or allergy-related inflammation. Over time, fluid become very thick & glue like (glue ear) Tends to be chronic, with non-purulent secretions. Cause conductive hearing impairment.
Management	<ul style="list-style-type: none"> Requires antimicrobial therapy + careful follow up. Antimicrobial usually empirical to cover <i>S. Pneumoniae</i> and <i>H.influenzae</i>. Augmentin (amoxicillin with clavulanic acid) - Cefuroxime - Ceftriaxone. Drainage of exudate may be required. 		Need complex management, possibly surgical	Need complex management, possibly surgical

Multiple Choice and Short Answer Integrated Questions

-To open an answered sheet, please click [here](#)-

CASE - 1

A 3-year-old boy was brought to the ER. His mother reported that he has had a low grade fever of 38°C for 3 days and difficulty sleeping due to pain in the ear. She also says that the ears were secreting fluid, and that he has had a dry, non-productive cough that started yesterday.

From the brief introduction of the case, what is your primary diagnosis?

- A. Sinusitis
- B. Otitis media
- C. Meningitis
- D. Pharyngitis

How can you explain/confirm your choice?

What is the most probable causative agent in this case?

- A. Bacterial
- B. Viral

How can you explain/confirm your choice?

Examination of both ears reveals significant redness and fluid in both middle ears with no apparent involvement of the eardrum or tympanic membrane. Further examination of the patient's breathing and other manifestations indicates an upper respiratory infection. The patient's parents are chronic heavy smokers and the child is exposed to secondhand smoking in the home environment.

What is your final diagnosis?

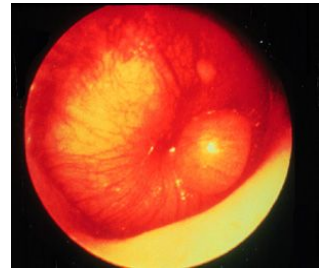
- A. Acute otitis media
- B. Acute serous otitis media
- C. Chronic otitis media
- D. Chronic serous otitis media

How can you explain/confirm your choice?

What are the risk factors in this case?

CASE - 2

This is my 9-month-old son Damon. "Last night when I was getting Damon ready for bed he didn't want to quiet down, but I did notice he was pulling at his ears, especially the right one." On clinical examination, Damon's temperature was 39°C and his other vital signs were normal. His right ear exam showed the tympanic membrane to be erythematous with fluid behind the membrane and poor movement. His left tympanic membrane revealed normal landmarks but had slightly decreased movement.



What is your primary diagnosis, and why?

Name three organisms that are known of causing such disease?

What is tympanic membrane? Mention its pathological and diagnostic role in otitis media.

How can we treat the patient?

- A. Antibiotic
- B. Surgical
- C. Exudate drainage
- D. A & C

What is the main intracranial complication for this condition?

- A. Stroke
- B. Voice change
- C. Delayed speech
- D. Double vision

If we supposed that Damon has an anatomical abnormality, what would it most likely be according to his clinical presentation?

CASE - 3

1.5-year-old bottle-fed female was brought in by her father to the emergency, complaining from left ear pain with otorrhea. Her temperature was 37.5°C, her father said it's not the first time. Otolaryngologist found that her tympanic membrane was perforated.

What is your diagnosis?

- A. Chronic meningitis
- B. Chronic otitis media
- C. Chronic sinusitis
- D. Chronic conjunctivitis

How would bottle-feeding contribute in the development of otitis media?

Which of following is the most common causative agent?

- A. Pseudomonas Aeruginosa
- B. Proteus species
- C. Anaerobic bacteria
- D. Klebsiella Pneumoniae

Which sense will be lost or decrease in the patient, and why?

What is the treatment required?

- A. Antibiotic and follow-up
- B. Surgical

Additional Information

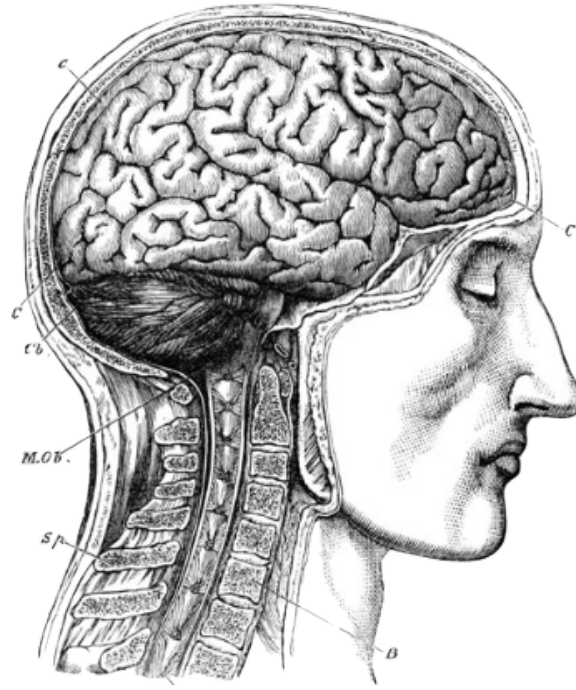
معلومات إضافية

Table 1. Abbreviations and Definitions of Common Terms.

Term	Definition
Otitis media with effusion (OME) Chronic OME	The presence of fluid in the middle ear without signs or symptoms of acute ear infection. OME persisting for ≥ 3 mo from the date of onset (if known) or from the date of diagnosis (if onset is unknown).
Acute otitis media (AOM) Middle ear effusion	The rapid onset of signs and symptoms of inflammation of the middle ear. Fluid in the middle ear from any cause. Middle ear effusion is present with both OME and AOM and may persist for weeks or months after the signs and symptoms of AOM resolve.
Hearing assessment	A means of gathering information about a child's hearing status, which may include caregiver report, audiologic assessment by an audiologist, or hearing testing by a physician or allied health professional using screening or standard equipment, which may be automated or manual. Does not include use of noisemakers or other nonstandardized methods.
Pneumatic otoscopy	A method of examining the middle ear by using an otoscope with an attached rubber bulb to change the pressure in the ear canal and see how the eardrum reacts. A normal eardrum moves briskly with applied pressure, but when there is fluid in the middle ear, the movement is minimal or sluggish.
Tympanogram	An objective measure of how easily the tympanic membrane vibrates and at what pressure it does so most easily (pressure admittance function). If the middle ear is filled with fluid (eg, OME), vibration is impaired, and the result is a flat, or nearly flat, tracing; if the middle ear is filled with air but at a higher or lower pressure than the surrounding atmosphere, the peak on the graph will be shifted in position based on the pressure (to the left if negative, to the right if positive).
Conductive hearing loss	Hearing loss from abnormal or impaired sound transmission to the inner ear, which is often associated with effusion in the middle ear but can be caused by other middle ear abnormalities, such as tympanic membrane perforation, or ossicle abnormalities
Sensorineural hearing loss	Hearing loss that results from abnormal transmission of sound from the sensory cells of the inner ear to the brain.

Table 2. Frequently Asked Questions: Understanding Ear Fluid.

Question	Answer
What is ear fluid, and how common is it?	Ear fluid, also called otitis media with effusion (OME), is a buildup of mucus or liquid behind the eardrum, without symptoms of an ear infection. Nearly all children get ear fluid at least once by school age.
How does ear fluid differ from an ear infection?	Ear infections (acute otitis media [AOM]) occur when germs (bacteria and/or viruses) enter the middle ear and cause fever, ear pain, and active (acute) inflammation. Both AOM and OME have fluid in the middle ear, but with OME the fluid is not actively infected, and pain may be absent or minimal.
If my child gets ear fluid, how can I tell?	You might not be able to tell. Some children with OME have obvious hearing problems, but other children may have no symptoms at all or more subtle findings (eg, ear rubbing, clumsiness, selective hearing, disturbed sleep). Your doctor can detect ear fluid by looking in the ear canal (otoscopy) or by measuring the movement of the eardrum (tympanometry or pneumatic otoscopy).
What causes ear fluid?	OME may be caused by a cold, an ear infection (AOM), or the normal congestion (negative pressure) that many young children have in their middle ear. Often OME is detected during a routine doctor's visit, and the exact cause is unknown.
Should I worry if my child has ear fluid?	Most fluid goes away on its own in weeks or months, especially if it was caused by a cold or an ear infection. OME is of more concern if it lasts >3 mo or when your child has other problems that could be made worse by persistent ear fluid (eg, delays in speech, language, learning, or development). Your doctor should check the ears periodically until the fluid is gone.
What is the best way to manage ear fluid?	There are many opinions about managing OME, but the best advice can be found in clinical practice guidelines, which make recommendations based on best available evidence and by considering the potential benefits and harms of different strategies.



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Heartful thanks to our phenomenal team members

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