



433 Teams  
**ENT**

1, 2, 3 and 4

**Ear I, II, III and IV**

**Anatomy and Physiology of the ear & Ear diseases.**

Color index:

432 Team – **Important** – 433 Notes – Not important

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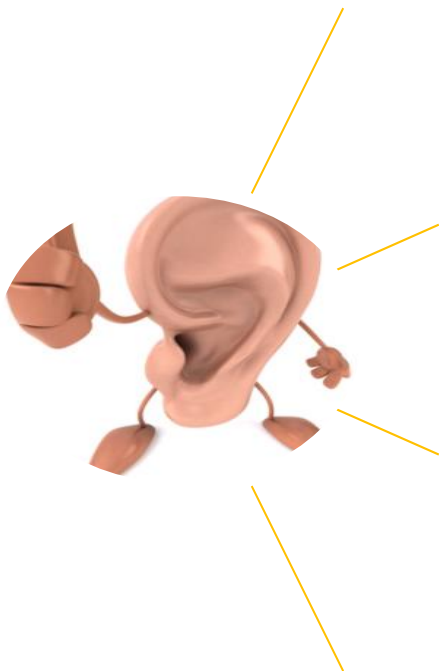


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## Objectives:

Ear I	Ear III
<ul style="list-style-type: none"> <li>Anatomy &amp; physiology of the ear, gross anatomy of the external, middle and inner ears, nerve supply.</li> </ul>	<ul style="list-style-type: none"> <li>Definition and classifications.</li> <li>Otitis media with effusion.</li> <li>Adhesive otitis media.</li> <li>Chronic suppurative otitis media.</li> </ul>
Ear II	Ear IV
<ul style="list-style-type: none"> <li>Congenital anomalies of auricle.</li> <li>Traumatic injury and its complications.</li> <li>Perichondritis.</li> <li>Otitis externa, classifications, presentation and treatment.</li> <li>Acute otitis media.</li> <li>Recurrent otitis media.</li> </ul>	<ul style="list-style-type: none"> <li>The predisposing factors for complications.</li> <li>The pathways for spreading the infections beyond the ear?</li> <li>To know the classifications of complications</li> <li>To know presentations, clinical findings, investigations and management of each complication.</li> </ul>



### • Anatomy of the Ear

(External, Middle and Inner ear).

### • Physiology of Eustachian tube

(External, Middle and Inner ear).

### • Hearing.

### • External Ear Diseases.

- Congenital malformations.
- Otitis externa.
- Otitis media.

### • Chronic Otitis media.

- Otitis media with effusion.
- Adhesive otitis media.
- Chronic suppurative otitis media.
- Tubo-tympanic/Attico-antral.

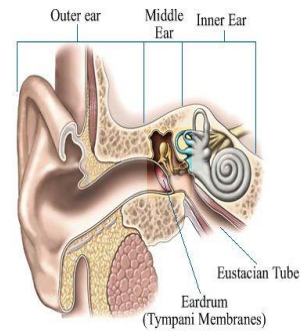
### • Complication:

- Intracranial.
- Intertemporal.
- Extracranial.

## Anatomy of the ear:

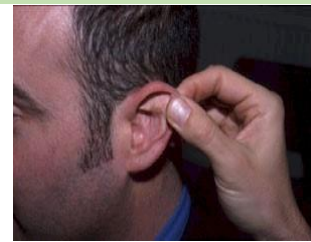
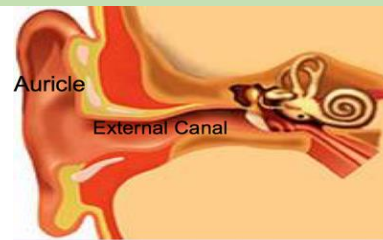
### The ear consists of:

- ✓ **External ear:** From the outer part till the eardrum (tympanic membrane).
- ✓ **Middle ear:** (tympanic cavity); From the eardrum till the stapes footplate.
- ✓ **Internal ear:** Cochlea and semicircular canals.



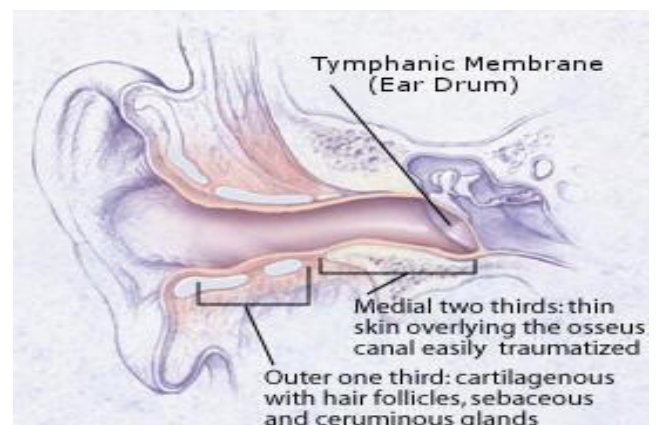
## A: External ear

- Formed of **Auricles** and **External auditory meatus** (auditory canal).
- Both of them are lined by skin.
  - **Auricle** is fibrous cartilage (except lobule area) lined by skin
    - ❖ In case of **Perichondritis** (lobule is intact ) but in case of any skin problem like **Erysipelas** , all of auricle is affected .
    - ❖ **Auricle** is attached to **temporomandibular joint** (so, movement of this joint will aggravate the pain in case of inflammation of pinna)
- **The external auditory meatus (2.5 cm)** is an S shape canal (to protect the ear drum and middle ear. So, at examination you should pull the auricle posteriorly and superiorly to straighten the canal).



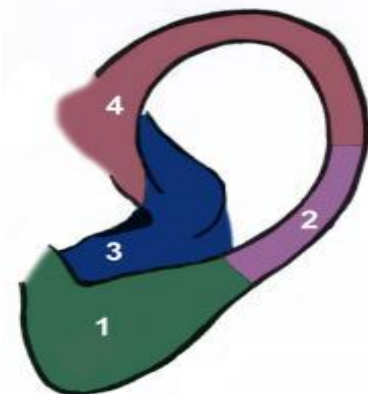
### Auditory canal consists of:

- A. Cartilaginous part (outer 1/3):** formed by elastic cartilage and contains hair follicles, sebaceous and ceruminous glands (secrete wax).
- B. Bony part (inner 2/3):** The narrowest portion is at the bony-cartilaginous junction. The skin is thin and easy to be injured during examination.



### Nerve Supply of External Ear:

- Cervical **II & III** (greater auricular and lesser occipital).
- **V** cranial nerve (auriculotemporal).
- **X** cranial nerve (auricular or Arnold's).
- Fibers from **VII** cranial nerve.



#### Key:

1. Great auricular nerve
2. Lesser occipital nerve
3. Auricular branch of vagus nerve
4. Auriculotemporal nerve

**Tympanic membrane:**

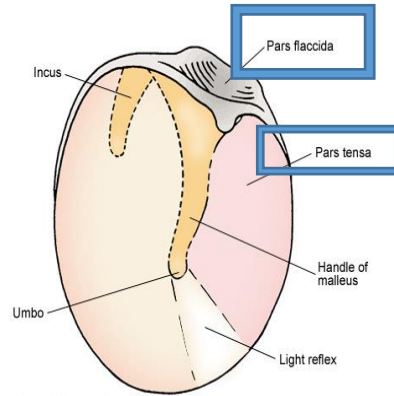
It forms the partition between the external auditory canal and the middle ear.

**Parts:**

A. Pars Tensa. B. Pars Flaccida.

The Tympanic membrane consist of three layers:

1. Outer layer **stratified squamous** epithelium (skin), **ectodermal origin**.
2. The middle layer or lamina propria fibrous layer, **mesodermal origin**. (present only in pars tensa which make pars flaccida more prone for perforation )
3. The inner layer, of **endodermal origin**, comprising the middle ear mucosa.



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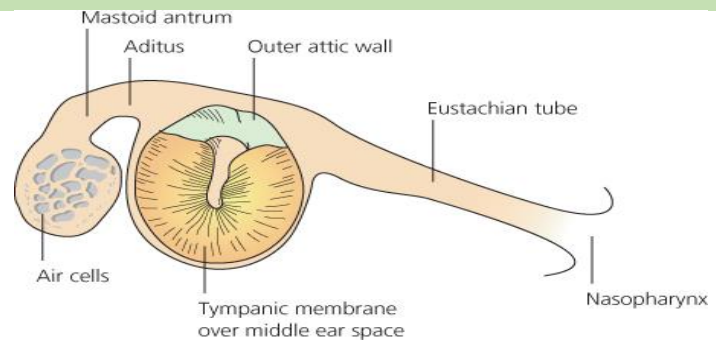
**B: Middle Ear**

**Formed of:**

1. Eustachian (Pharyngo-tympanic) Tube.
2. Tympanum (Middle Ear Cavity).
3. Mastoid Antrum and Air Cells.

**Lining of the middle ear:**

Mucous membrane of the middle ear space consists of **stratified cuboidal epithelium**, which changes to pseudostratified ciliated epithelium around the mouth of the Eustachian tube.



**1: Eustachian (Pharyngo-tympanic) Tube:**

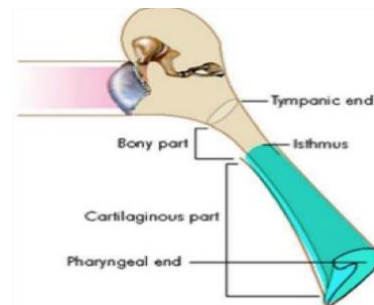
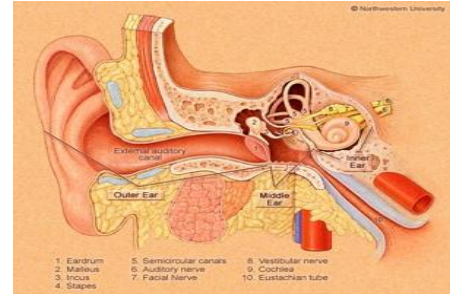
- ✓ Connect the middle ear cavity with nasopharynx.
- ✓ Lies adjacent to the ICA (internal carotid artery).

**Parts of Eustachian Tube:**

- A. Lateral 1/3 is bone.
- B. Medial 2/3 is fibro-cartilaginous.
- \* Junction between 2 parts is isthmus, **narrowest part of the tube**.

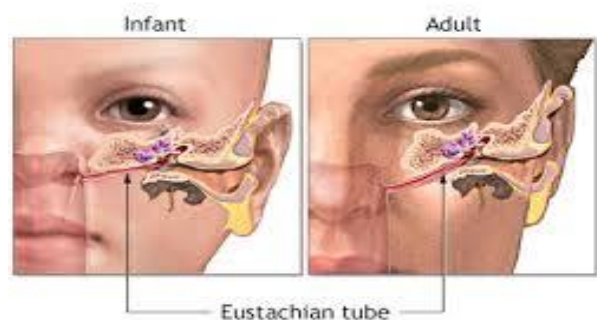
**Physiology of Eustachian tube:**

- Opens actively by contraction of tensor veli palatine and passively by contraction of levator veli palatine (it releases the tension in tubal cartilage).
- Closed by elastic recoil of elastin hinge + deforming force of Ostmann's fat pad.



**Adult vs INFANT**

	ADULT	INFANT
<b>Length</b>	36 mm	18 mm
<b>Angle with horizontal</b>	45 °	10 °
<b>Lumen</b>	Narrower	Wider
<b>Angulation at isthmus</b>	Present	Absent
<b>Cartilage</b>	Rigid	Flaccid
<b>Elastic recoil</b>	Effective	Ineffective
<b>Ostmann's fat</b>	More	Less



## 2: Tympanic cavity (Middle ear cavity):

### • Contents of tympanic cavity:

- ✓ **Ossicles:** the malleus, incus and stapes.
- ✓ **Intratympanic muscles:** "Tensor tympani, Stapedius"
- ✓ **Chorda tympani.**
- ✓ **Tympanic plexus.**

The Stapes receives the insertion of stapedius muscle. Handle of Malleus receives the insertion of Tensor tympani muscle. Contraction of the stapedius muscle restrict the movement of the stapes (this is considered as a physiologic reflex that protects the inner ear from very loud sounds (Attenuation reflex). (Team 431)

### **LINING OF THE MIDDLE EAR:**

Mucous membrane of the middle ear space consists of **stratified cuboidal epithelium**, which changes to pseudostratified ciliated epithelium around the mouth of the Eustachian tube.

### **Nerve supply:**

#### **Sensory nerve supply of the middle ear mucosa:**

- ✓ Tympanic branch of the glossopharyngeal nerve.
- ✓ Auriculotemporal branch of the trigeminal nerve.

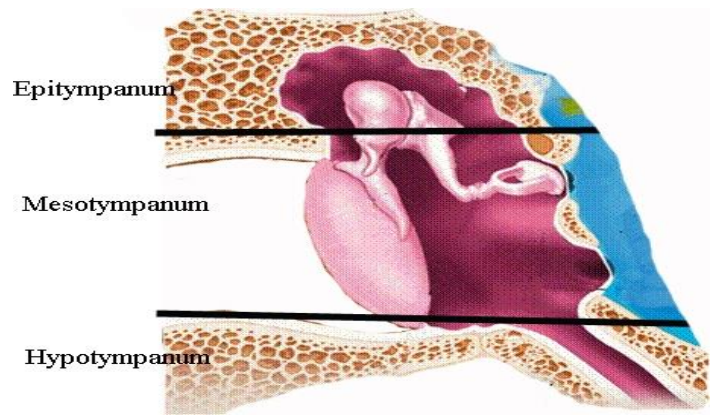
#### **Motor nerve supply of the middle ear muscles :**

- ✓ Stapedius muscle supplied by the stapedial branch of the facial nerve.
- ✓ Tensor tympani muscle supplied by the mandibular division of the trigeminal nerve.

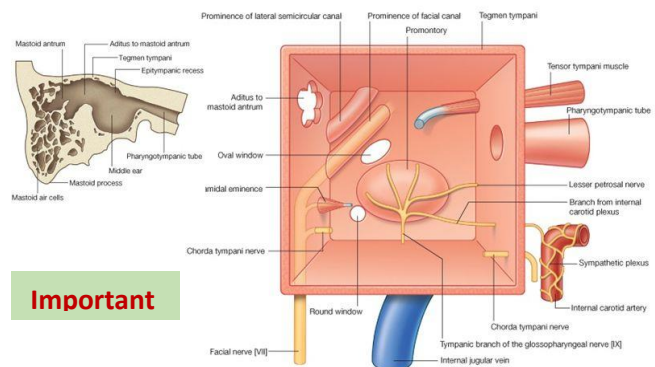
### • **Clinical importance of walls of middle ear :**

- ✓ Fracture of temporal bone (roof of middle ear cavity) will be presented by either CSF otorrhea or rinhorrhea .
- ✓ Lateral sinus thrombosis secondary to otitis media (posterior wall).

## **Middle ear cavity divided into three parts:**



## **Boundaries of Middle Ear**



### **Important**

**Roof:** tegmen tympani; separates tympanic cavity from MCF.

**Floor:** Thin bone separates tympanic cavity from superior bulb of IJV.

**Anterior wall:** Thin bone; separates tympanic cavity from ICA and at its upper part are openings into two canals (auditory tube & canal for tensor tympani).

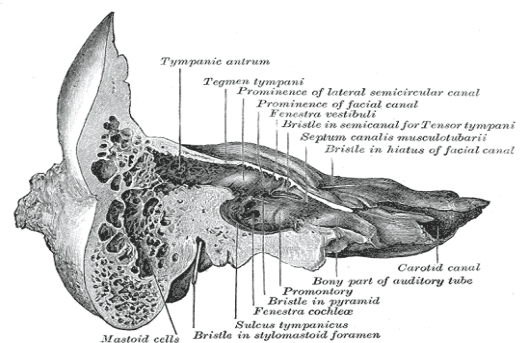
**Posterior wall:** Aditus to the mastoid antrum superiorly & Pyramid inferiorly ( for stapedius)

**Lateral wall:** tympanic membrane inferiorly & Lateral wall of attic superiorly.

**Medial wall:** Lateral wall of the inner ear.

## 3: Mastoid antrum and air cells:

- Air-containing cells of the mastoid process are continuous with the air in the middle ear.
- Pneumatization is complete between the sixth and twelfth years of life.
- Normal tubal function is a prerequisite for biologically active, healthy middle ear mucosa, and thus for the normal process of pneumatization.



## C: Inner Ear

• Consists of:

### 1. Labyrinth:

#### A. Bony Labyrinth, its parts:

- Bony Cochlea
- Vestibule
- Bony semicircular canals

Its contents:

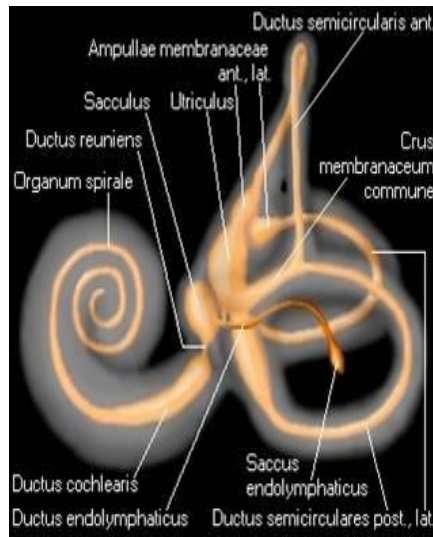
- Perilymph fluid
- Membranous labyrinth

#### B. Membranous Labyrinth, its parts:

- Cochlear duct
- Sacculle and utricle
- Membranous semicircular ducts

Its contents:

- Endolymph
- Sensory epithelium:
- Cochlea: **organ of Corti**
- Utricle & sacculle: **maculae**
- Semicircular canals: **cristae**



**Bony Labvrinth**

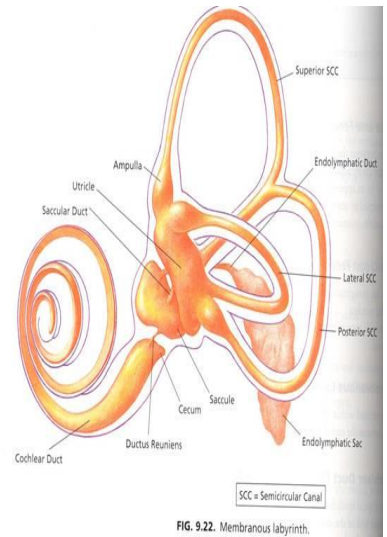
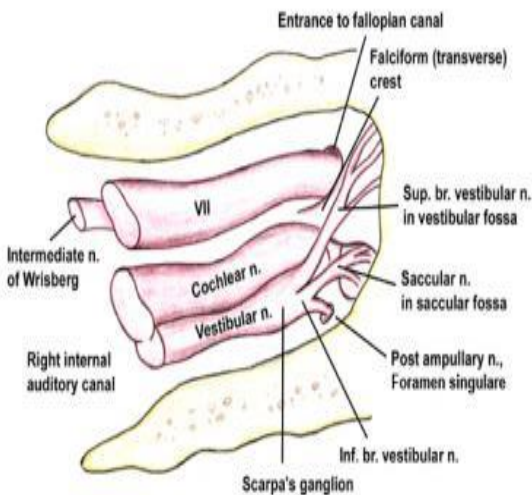


FIG. 9.22. Membranous labyrinth.

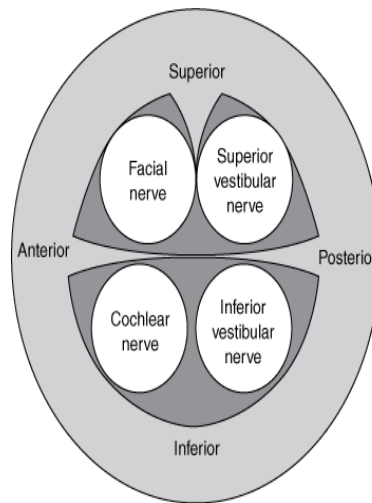
**Membranous Labyrinth**

### 2. Internal Auditory Canal, Contains:

- Cochleovestibular nerve
- Facial nerve

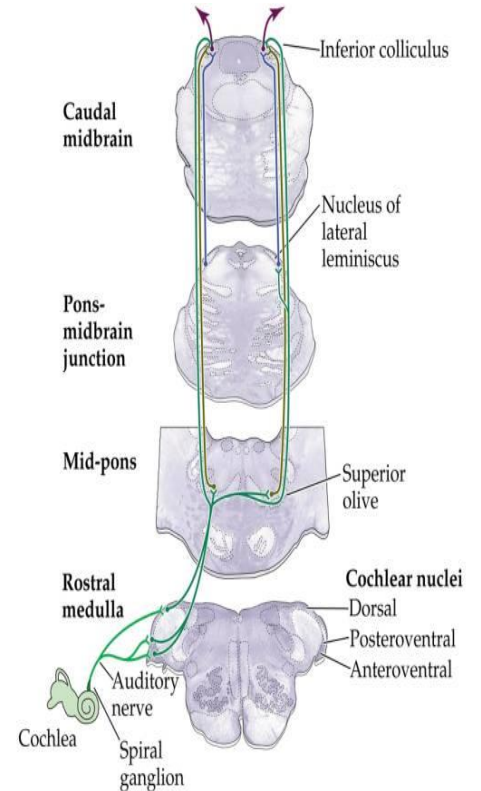


**Internal Auditory Canal**



Source: Lalwani AK: *Current Diagnosis & Treatment in Otolaryngology—Head & Neck Surgery*, 2nd Edition: <http://www.accessmedicine.com>  
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**Internal Auditory Canal**



**Central connections of cochlear nerve**

### • Referred Earache:

Pain in the ear referred from a territory sharing its sensory innervation with the external or middle ear.

- Cervical II & III => **Cervical spondylosis, neck injury etc.**
- V cranial nerve => **Dental infections, sinonasal diseases etc.**
- IX cranial nerve => **Tonsillitis, post-tonsillectomy, carcinoma etc.**
- X cranial nerve => **Tumors of hypopharynx, larynx & esophagus**

## Physiology of the ear

### Functions of the external ear:

- ✓ **Protection of the middle ear:**
  - Curvature
  - Cerumen
- ✓ **Auditory functions:**
  - Sound conduction
  - Increase sound pressure by the resonance function

### Functions of the Eustachian tube:

- **Protection**
- **Ventilation**
- **Drainage**

(The tube is shorter, wider and more horizontal in the infant than in the adult. Secretions or food may enter the tympanic cavity more easily when the baby is supine particularly during feeding and they may develop otitis media as it is more common in children. The tube is normally closed and opens on swallowing because of movement of the muscles of the palate. (Lecture Notes Diseases of the Ear, Nose and Throat, 11th Edition - Clarke, Ray)

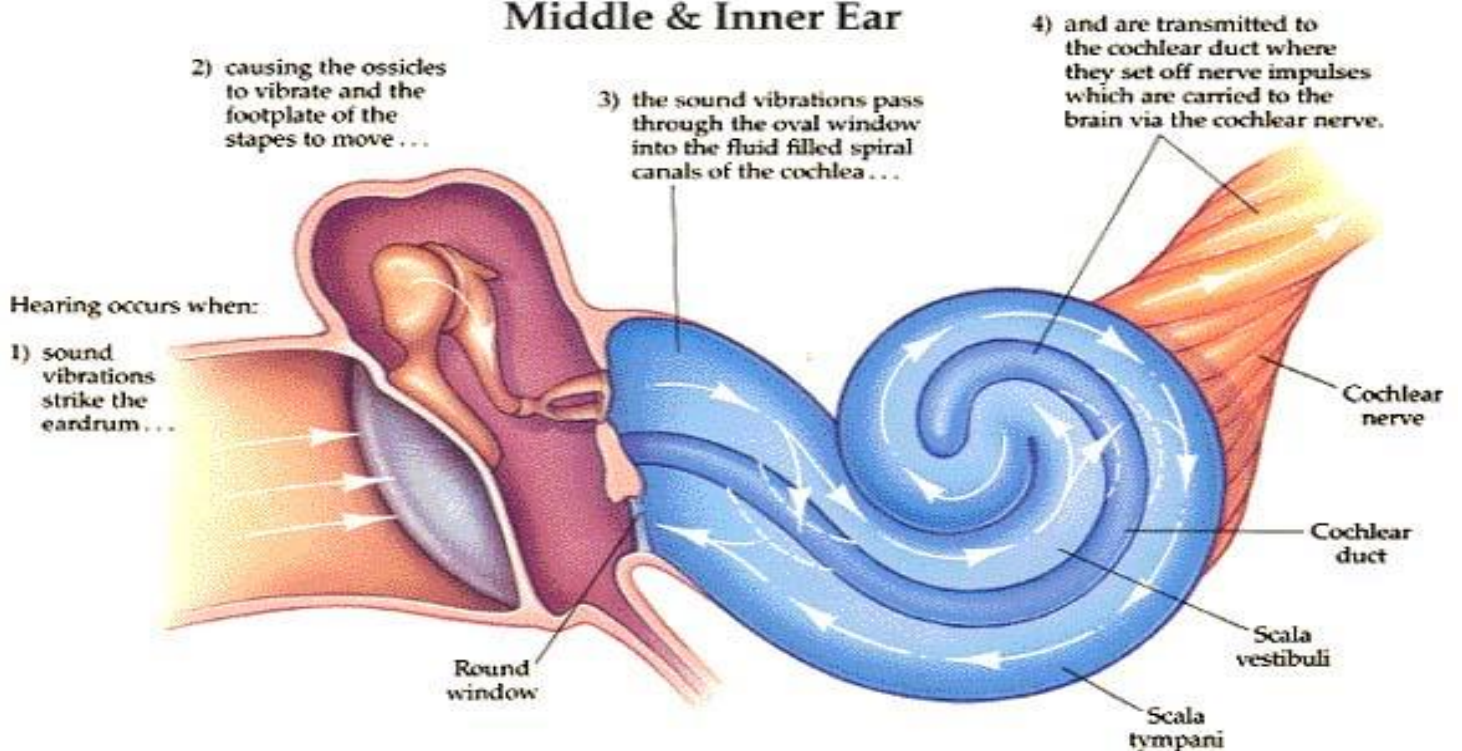
### Functions of the middle ear:

- **Conduction of sound**
- **Protection to the inner ear**
  - Stapedial reflex. If the sound very loud it contract to reduce the sound energy

### Functions of the inner ear:

- **Hearing Function:**
  - Transduction of sound to action potentials
- **Vestibular Function:**
  - Participate in maintaining body balance, the mechanisms of maintaining body balance: Brain stem: is the center of balance. It's connected to: Cerebellum to coordinate muscle tone and Cerebral cortex for the feeling of space. Input: Proprioceptive (sensation) Visual Vestibular. Output: gives information to: Postural muscles Ocular muscle. (Team 431)

## Middle & Inner Ear



## Diseases of External Ear:

### 1: Congenital Malformations:

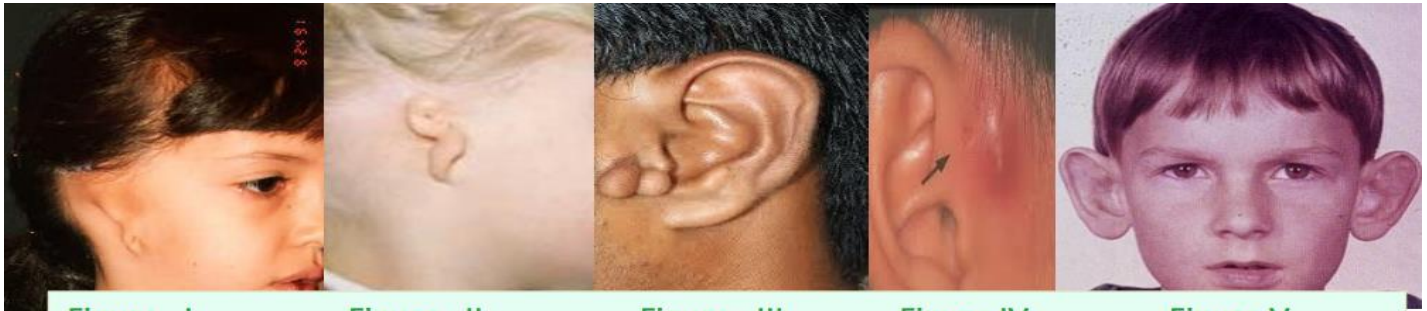


Figure I

Figure II

Figure III

Figure IV

Figure V

**1: Anotia (Atresia)**

It's the total absence of the auricle most often with narrowing or absence of the external auditory meatus.

**2: Microtia:**

It's a condition in which the external portion of the ear (the auricle) is malformed. There is also narrowing or absence of the external auditory canal.

**3: Accessory auricle**

It's a type of ear anomaly in the tragus area. Treatment: Plastic reconstruction, B.A.H.A (bone anchored hearing aid).

**4: Pre auricular sinus**

• It's a common congenital malformation characterized by a nodule, dent or dimple located anywhere adjacent to the external ear.  
 • Susceptible to infection  
Management: systemic antibiotics. If an abscess is present, it must be incised and drained.

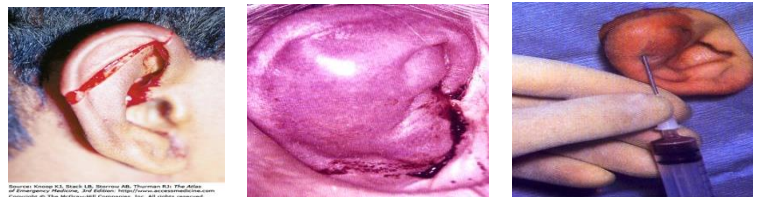
**5: Protruding Ear: Bat Ear.**

Management: Pinnaplasty or otoplasty. (Do it after the age of school)  
Note: There is no direct blood supply to the cartilage!

### 2: Trauma to The Auricle:

- Lacerations - Hematoma auris

Treatment: Excise fibrous tissue - Apply pressure dressing - drain.



### 3: PERICHONDritis OF THE PENNA:

Perichondritis is inflammation of the perichondrium, a layer of connective tissue, which surrounds cartilage.

- Usually follow trauma (hematoma auris, surgical, frostbite, burn) or otitis externa & piercing
- Commonly caused by Pseudomonas
- Fever, pain, redness and swelling
- Treatment immediately by antibiotics & Evacuation (Any cartilaginous organ that forms a hematoma must be drained as early as possible)

**Tx:** Abx, incision & drainage, removal of necrotic tissue.



### Complications of Perichondritis or Trauma:

Cauliflower ear (End stage of untreated haematoma).

The ear can be exposed to trauma and lacerations leading to the formation of Hematoma, so if anything happens between the skin and cartilage → Hematoma (Number 1 killer of the cartilage, why? Because the blood will not be able to reach the cartilage) → Ischemia → Necrosis → Ear deformity





#### 4: Otitis Externa:

An acute (Less than 3 months) or chronic (more than 3 months) infection of the whole or a part of the **skin** of the external ear canal. **Any pathology affecting skin can also affect external ear.**

##### 1. Infective:

- Bacterial: **Staphylococcus aureus** (furuncle), **Pseudomonas** (Most common)
- Fungal: Aspergillus Niger, Candida albicans
- Viral: **Herpes Zoster**... Others

##### 2. Reactive:

- Seborrhea: A disease of the sebaceous glands characterized by excessive secretion of sebum or an alteration in its quality, resulting in an oily coating, crusts, or scales on the skin. It's usually painless
- Eczema or Dermatitis: A noncontagious inflammation of the skin, characterized chiefly by redness, itching

#### Clinical features of Otitis Externa:

##### 1. Itching

**2. Pain:** could be very severe because of under lying cartilage, evoked by movement of the jaw, because the ear auricle and external canal is attached to the TMJ (temporomandibular joint) **pain can radiate to the throat!**

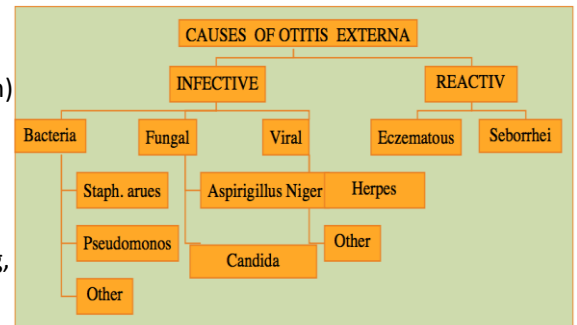
**3. Tenderness and swelling**, absent in otitis media.

**4. Otorrhea:** No discharge or very little and scanty, not muciod. Large discharge in otitis media. *(Not mucus discharge because the skin does not contain mucus-secreting cells. If the discharge doesn't contain mucus, then it is from the External ear however if it contains mucus it is originating from the middle ear)*

**5. Deafness:** *deafness caused by external ear needs to be completely obstructed, which is rare in otitis externa.*

**6. Changes in the lumen and skin of EAM**(external auditory meatus)

- **Pathophysiology:** -Aggressive washing of wax or retention water -Microtrauma (cotton swabs, fingernails).



### Clinical Types of Otitis Externa:

#### 1: Localize O.E (furuncle):

- small rounded swelling in the external canal.



#### 2: Diffuse infective O.E.

- General narrowing of the canal. The canal will close and you will not be able to pass anything through it.



#### 3: Otomycosis: fungal infection.

- Fungal vs. Bacterial
- Fungal: Less pain, more itching & NO fever.



White = Candida Albican Black= asperigillous niazar

**4: Bullous myringitis:**

- viral infection, painful for few Hours, then ends with Blood drops.

Myringitis = infection of eardrum.



**5: Herpetic O.E: MCQ** herpes zoster oticus is a specific form of herpes zoster that presents with pre-eruptive ("pre-herpetic") lesion reactivated from either the trigeminal or cervical ganglions **characterized by: PAINFUL vesicles**



**6: Eczematous and seborrheic O.E. painless.**



### 7: Acute necrotizing (malignant) otitis externa / Skull based Osteomyelitis:

An acute Pseudomonas infection of the skin of the external ear canal, which spread to the adjacent bone. (Deep seated pain for more than a month).

1. It occurs mostly in elderly diabetic patients. (Immunocompromised) Important!
  2. Severe otalgia. Earache in early stage.
  3. Lower Cranial nerve palsies (VIII, IX, X, XI, XII) and sometimes VII
  4. No signs of acute inflammation & No swelling
  5. Foul smelling discharge from the floor of the external Auditory canal
  6. Granulation tissue & sequestra
  7. It can infect the base of the skull, the cranium Causing meningitis, brain abscess.
  8. Radiology. Bone scan to rule out osteomyelitis.
- Granulation tissue at the junction of the bony and cartilaginous portions of the canal + immunocompromised pt → Dx as Malignant Otitis Externa!

**Treatment:**

- Control of diabetes
- Anti-Pseudomonas antibiotics,
- Local treatment and debridement. The role of surgery remains controversial

**Management of Otitis Externa (to all clinical types):**

- History and Physical examination
- Swab for culture and sensitivity for ABx
- Ear toilet: cleaning the ear.
- Keep the ear dry. Suction cleaning
- Local Medication and analgesia. Ear wick (best tx)
- Systemic medications: as in diabetics
- Surgery may be required in chronic cases and failure of treatment because there is usually thickening in of the skin and closure of the canal.

**IN CASE OF:**

- Aspergillus niger → Give antifungal drops
- Herpetic O.E Tx: → Acyclovir if < 3 days , Steroids to reduce inflammation.

## Acute Otitis Media

- Acute infection of the mucous membrane lining of the middle ear cleft.
- The definition is specific to infection because in chronic Otitis media it can be due to infection of normal inflammation

### Predisposing factors:

- Age: **common in children** as the Eustachian tube is more horizontal, wider and shorter.
- Males
- Bottle feeding: more likely to have milk regurgitation in middle ear
- Climate
- Crowded living conditions
- Heredity
- Associated conditions: **cleft palate**, immunodeficiency, ciliary dyskinesia, **Down syndrome**, and cystic fibrosis.

### Pathophysiology:

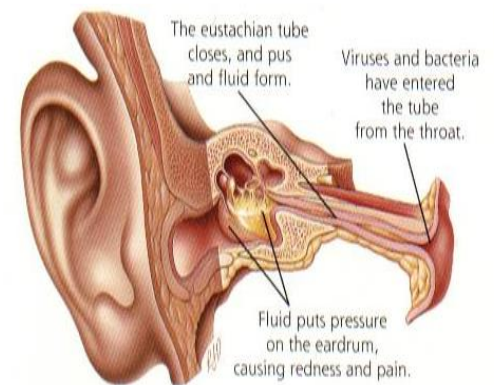
The patient has an antecedent event (viral URI or allergy) → the event results in Congestion of the respiratory mucosa of the nose, nasopharynx, and Eustachian tube → Congestion of the mucosa in the Eustachian tube obstructs the narrowest portion of the Tube, the isthmus → obstruction of the isthmus causes negative pressure followed by Accumulation of secretions produced by the mucosa of the middle ear → these secretions Have no egress and accumulate in the middle ear space → viruses and bacteria that Colonize the upper respiratory tract can reach the middle ear via aspiration, reflux, or Insufflation → microbial growth in the middle ear secretions may result in suppuration.

### ➤ Route of infection:

- Eustachian tube
- External auditory canal: rare.
- Blood born

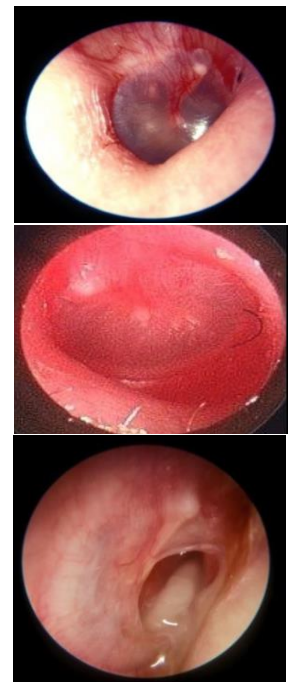
### ➤ Bacteriology:

- **Streptococcus pneumoniae**
- **Haemophilus influenzae**
- **Branhamella catarrhalis**
- Streptococcus pyogens
- Staphylococcus aureus



### Clinical picture:

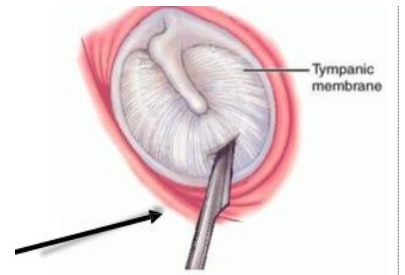
1. **Tubal occlusion:** produces early signs of acute otitis media. Discomfort, **autophony** (feeling own sounds), retracted drum (opposite of bulging) caused by pressure difference.
  - There is mild deafness. Tinnitus in children, not adults.
2. **Supportive inflammation:** of the middle ear: **Fever**, severe earache, deafness, bulging drum.
3. **Tympanic membrane rupture:** Otorrhea, Temperature subside. & earache subside (pain relief), perforated drum and Mucopureulent discharge.
4. **Resolution:** Either it will continue discharging from time to time (chronic otitis media) Or close spontaneously (common)
  - The patient can present to you at any stage and the treatment will be the same. However, the complications are different.
  - The patient will be in severe pain before the rupture of tympanic membrane due to the nerve stimulation and irritation by tension.



**Treatment:**

Symptomatic

- Antimicrobials for 1 month in pediatric patients
  - Amoxicillin/clavulanic acid
  - Tri-methoprim-sulphamethoxazole
  - Cefaclor, cefixime
  - Erythromycin-sulfisoxazole
- Decongestant → for Eustachian tube
- Myringotomy to drain, relief pain and take culture
- Ear toilet and local antibiotics → **only effective if the tympanic membrane is ruptured.**



**Recurrent Acute Otitis Media:**

- **Three or more attacks** over a 6-months period or **(six attacks in a year).**

Treatment:

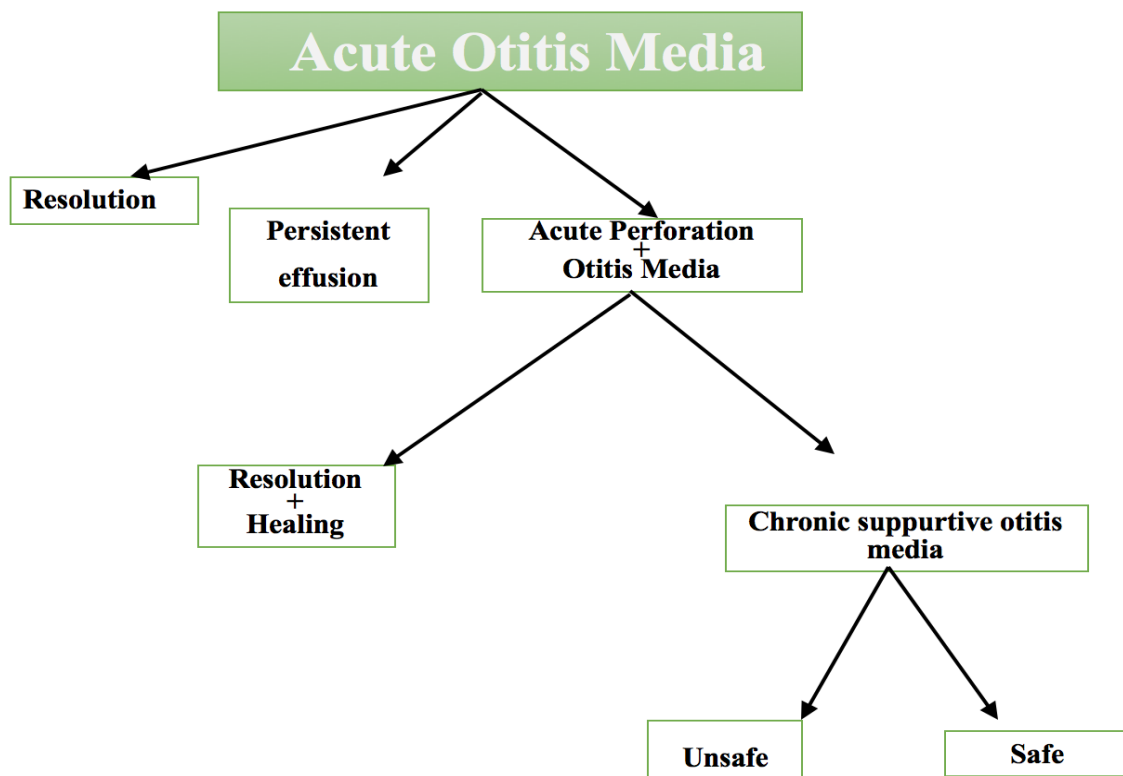
- ✓ Long-term low dose antimicrobials
- ✓ Ventilation tube insertion (Myringotomy with pressure equalization tube)



**Note:** In Recurrent otitis media, requirement for intervention with increase in frequency to avoid Intra temporal Complications: mastoiditis & facial nerve palsy. Extra temporal Complications: Meningitis

Complications of Ventilation tube:

- Irritation
- Otorrhea
- Inserting in the middle ear
- Blockage – losing its function
- Expulsion



## Chronic otitis media

- Chronic Otitis Media is an infection involving a part of the middle ear cleft or all its components that is persistent for more than 3 months.
- The tympanic membrane is intact (not perforated) in Chronic non-suppurative otitis media, while in chronic suppurative otitis media it is not intact (perforated).
- To have a discharge coming through the external canal the membrane has to be perforated.

### Classifications of Chronic Otitis Media

#### A. Chronic Non suppurative otitis media

- **Otitis media with effusion (OME).** If not treated properly or not cured by itself it could lead to adhesion in the tympanic membrane in middle ear (adhesive otitis media).
- **Adhesive otitis media**

#### B. Chronic suppurative otitis media (CSOM)

- **TuboTympanic**, which is also known as the **Safe type**, has no risks of serious complications. the perforation is toward the Eustachian tube or in the middle of tympanic membrane.
- **AtticoAntral**, which is also known as the **Unsafe type**, has a high risk of developing complications.

### A: 1. Otitis Media with Effusion:

- Middle ear filled with serous or mucoid fluid
- No purulence
- Often present after acute otitis media is treated appropriately with antibiotics
- Most will clear within 3 months
- Previously thought sterile
- 30-50% grow in culture
- over 75% PCR +
- Usual organisms

#### Estimates of residual effusion:

- 70% @ 2 wks
- 40% @ 4 wks
- 20% @ 8 wks
- 10% @ 12 wks

#### Diagnosis

- History
- Clinical Examination
- Tuning fork tests  
- (**Weber and Rinne test**)
- Audiological assessment –  
**Tympanometry - Pure tone audiogram.**

#### Etiology :

##### Bacteria

- **Strep pneumonia.**
- **Moraxella cat.**
- **Haemophilus influ.**

##### Virus

- RSV
- Rhinovirus
- Parainfluenza virus
- Influenza virus

#### Management of otitis media with effusion:

- ✓ Observation – many European countries wait 6-9 months prior to placement of ear tubes
- ✓ Antibiotics: Meta-analysis shows beneficial short-term resolution of OME
- ✓ Audiogram at 3 months with persistent effusion to determine impact on hearing

#### Surgical treatment: Tympanostomy Tubes.

- chronic OME >3mos with hearing loss and/or speech delay is an indication for tympanostomy tube placement
- Bypass Eustachian tube to ventilate middle ear

### A: 2. Adhesive otitis media

#### Adhesive Otitis Media:

Formation of adhesion in the middle ear after reactivation and subsequent healing of either CSOM or OME.

- Lack of middle ear ventilation results in negative pressure within the tympanic cavity.
- The ear drum retracts onto structures within the middle ear.
- The result of long standing Eustachian tube dysfunction
- The drum loses structural integrity and becomes flaccid
- Contact between the drum and the incus or stapes can cause bone erosion at the IS joint
- Can sometimes be treated with tympanostomy tubes

#### Middle Ear Atelectasis

- The result of long standing Eustachian tube dysfunction.
- The drum loses structural integrity and becomes flaccid.
- Contact between the drum and the incus or stapes can cause bone erosion at the IS joint.
- Can sometimes be treated with tympanostomy tubes.



## B: Chronic suppurative otitis media with and without cholesteatoma

Chronic suppurative otitis media is a long standing infection of a part or whole of the middle ear cleft characterized by ear discharge (Otorrhea) and permanent perforation of tympanic membrane.

### 3D:

- **Duration** > 3 months despite treatment
- **Discharge** mucopurulent otorrhea
- **Deafness** Perforation /Ossicular chains

### Etiology:

- **Pseudomonas aeruginosa**
- **Staphylococcus aureus**
- **Proteus species**

### Pathogenesis:

- ET dysfunction
- Poor aeration
- Mucosal edema and ulceration
- Capillary proliferation
- Osteitis;

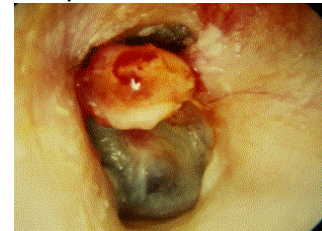
### 1. Tubotympanic type (Safe):

- Simple perforation
- Intermittent non offensive non bloody ear discharge
- On examination (central perforation )



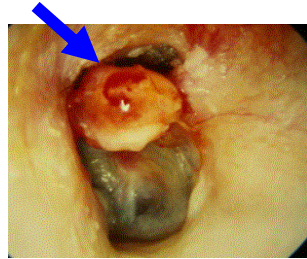
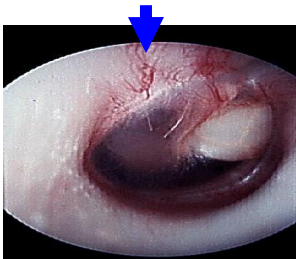
### 2. Attico-antral (unsafe):

- Chronic ,Scanty, offensive and bloody ear discharge
- On examination marginal perforation
- You may see cholesteatoma



### Cholesteatoma:

- Cholesteatomas are epidermal inclusion cysts of the middle ear and/or mastoid with a squamous epithelial lining
- Contain keratin and desquamated epithelium
- Can be congenital or acquired



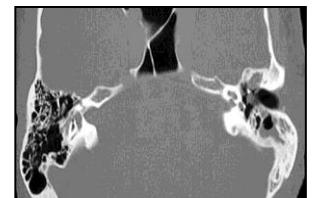
### Pathogenesis of cholesteatoma

Natural history is progressive growth with erosion of surrounding bone due:

- Pressure effects
- Osteoclast activation

### Diagnosis

- ✓ History
- ✓ Examination
- Otosopic - Microscopic - Tuning fork test
- ✓ Investigation
- Audiological assessment
- Radiological assessment



Cholesteatoma Imaging

### Treatment:

Chronic suppurative otitis media **without** cholesteatoma  
**(safe)**

#### A. Otological Medications

- **Antibiotic only otic drops**  
Floxin (*ofloxacin*)
- **Antibiotic with steroid otic drops**  
Ciprodex (*ciprofloxin and dexamethasone*)  
Cipro HC (*ciprofloxin and hydrocortisone*)

#### B. Surgical repair of the TM perforation

- Myringoplasty
- Tympanoplasty

#### C. Ossicular Chain Reconstruction

Chronic suppurative otitis media **with** cholesteatoma  
**(Unsafe)**

#### A. Cholesteatoma Surgery

#### B. Mastoidectomy

## The complications of acute and chronic otitis media

### Predisposing factors:

- ✓ Virulent organisms
- ✓ Chronicity of disease
- ✓ Presence of Cholesteatoma and bone erosion. (cholesteatoma: the presence of skin “white keratin material” in abnormal location that will secrete enzymes and eat up the bone, causing a pathway for disease to spread. Anatomically there is no skin in the middle ear.)
- ✓ Obstruction of natural drainage e.g. by a polyp. (Natural drainage eustachian tube).
- ✓ Low resistance of the patient
  - Most of the times otitis media is cured without any complications

### Pathways of infection:

- ✓ Extension of infection is by bone erosion due to a cholesteatoma.
- ✓ Vascular extension (retrograde thrombophlebitis)
- ✓ Congenital dehiscence
- ✓ Fracture lines
- ✓ Round or oval window membrane to the labyrinth Dehiscence due to previous surgery

## A: Intracranial complication:

- Extradural Abscess
- Subdural Abscess
- Meningitis
- Venous Sinus Thrombosis can be classified as both intratemporal or intracranial but due to its manifestation its intracranial
- Brain Abscess
  - What are the natural barriers between brain and temporal bone?  
Bone and meninges

### 1: Extradural Abscess:

- Collection of pus against the dura
- Middle or posterior cranial fossa.
- Intracranial complication of otitis media
- Outside the dura of the lateral venous sinus is called perisinus abscess.

### Clinical Picture:

- ✓ Persistent headache on the side of otitis media. Not a symptom of otitis media. If a patient present with headache think of a possible complication of otitis media.
- ✓ Pulsating discharge.
- ✓ Fever
- ✓ Asymptomatic (discovered during surgery).

### 2: Subdural Abscess:

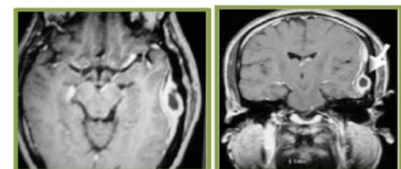
**Definition:** Collection of pus between the dura and the arachnoid. It's a rare pathology

### Clinical picture:

- Headache with signs of meningeal irritation
- Convulsions
- Focal neurological deficit (paralysis, loss of sensation, visual field defects)

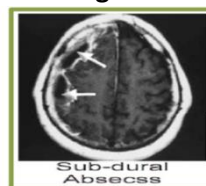
**Diagnosis:** CT scans reveal the abscess as well as the middle ear pathology.

**Treatment:** Mastoidectomy and drainage of the abscess + IV ABx for prevention.



- ✓ Axial and coronal MRI showing extradural abscess

### Investigation: CT scan & MRI



The subdural abscess is within the dura (a white thin line). It's a landmark to distinguish between extra and subdural abscess

### Treatment:

- Drainage (neurosurgeons)
- Systemic antibiotics – Mastoidectomy.

Lumbar puncture should not be done as it can cause herniation of the cerebellar tonsils. It is a neurological emergency. A series of burr holes or a craniotomy is done to drain subdural empyema. Intravenous antibiotics are administered to control infection. Once infection is under control, attention is paid to causative ear disease which may require mastoidectomy.

**3: Meningitis:**

**Definition:** Inflammation of meninges (pia & arachinoid)

**Pathology:** Occurs during acute exacerbation of chronic unsafe middle ear infection.

**Meningitis is the most common intracranial complication of Otitis Media**

**Clinical picture:**

**General symptoms and signs:** High fever, restlessness, irritability, photophobia and delirium.

**Signs of meningeal irritation:** **Kernig's and Brudzinski's sign**

**4: Venous Sinus Thrombosis:**

**Definition:** Thrombophlebitis of the venous sinus.

**Etiology:** It usually develops secondary to direct extension.

- **First irritation of the wall then progress to thrombus then either it will regress or causes symptoms of obstruction (increase ICP, central nerve palsy).**

**Clinical picture:**

- **Signs of blood invasion: (spiking) fever with rigors, chills and persistent fever (septicemia).**
- **Positive Greissinger's sign** which is edema and tenderness over the area of the mastoid emissary Vein. **(Pressing on the mastoid process will cause tenderness and edema because of small vessel blockage)**
- **Headache, vomiting, and papilledema (increase intracranial pressure)** The 6th cranial nerve might be affected because it is the longest cranial nerve passing through the cavernous sinus.

**5: Brain Abscess:**

Definition

- Localized suppuration in the brain substance.
- It is most lethal complication of suppurative otitis media

Incidence:

- 50% is Otogenic brain abscess

**Pathology:**

Site: Temporal lobe or less frequently, in the cerebellum (more dangerous).

**Clinical manifestations**

- General manifestations: fever, lethargy, headache sever generalized worse in the morning .
- Manifestation of raised IC pressure ( headach , N&V) the latter usually projectile seen more often in cerebellar lesions.
- Focal manifestations
  - Temporal: Aphasia, hemianopia, paralysis
  - Cerebellar: ataxia, vertigo, nystagmus, muscle incoordination

**Diagnosis: Lumbar puncture.**

**Treatment:**

*Treatment of the complication itself and control of ear infection:*

- Specific antibiotics.
- Antipyretics and supportive measures
- Mastoidectomy to control the ear infection.

**Diagnosis**

- **Clinical**
- CT scan with contrast
- MRI, MRA, MRV
- Angiography, venography
- Blood cultures is positive during the febrile phase. **Start clinical, blood culture then imaging.**

**Treatment**

– Medical:

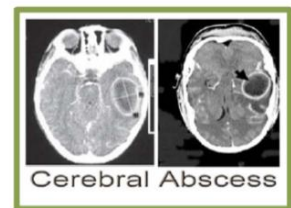
- Antibiotics and supportive treatment.
- Anticoagulants

– Surgical:

- Mastoidectomy with exposure of the affected sinus and the intra- sinus abscess is drained.

**Diagnosis:**

- CT scans.
- MRI.



**Treatment:**

Medical:

- Systemic antibiotics.
- Measure to decrease intracranial pressure.

Surgical:

- Neurosurgical drainage of the abscess .
- mastoidectomy operation after
- subsidence of the acute stage.



## B: Intratemporal complication:

**1 Labyrinthitis:** if the infection spread from the middle ear to the inner ear and would present with vertigo and sensory neuron loss.

**2 Ossicular fixation or erosions**

**3 Labyrinthine fistula**

**4 Facial nerve paralysis**

### 1. Labyrinthine fistula (most common)

- **Definition:** Communication between middle and inner ear.
- **Aetiology:** It is caused by erosion of bony labyrinth due to cholesteatoma (iatrogenic caused by surgeries)

#### Clinical picture:

- Hearing loss (may show a sensorineural hearing loss)
- Attack of vertigo mostly during straining, sneezing and lifting heavy object. (Pressure induced maneuver)
- Positive fistula test

Pressing on the tragus will cause pressure on the inner ear, the pressure difference will cause imbalance and nystagmus (positive in 70%)

### 2. Facial nerve paralysis:

- Congenital or acquired (inflammation and erosion) dehiscence of nerve canal
- It is possibly a result of the inflammatory response within the fallopian canal to the acute or chronic otitis media
- Tympanic segment is the most common site to be involved

#### Diagnosis:

- Clinical
- May occur in acute or chronic otitis media
- Ct scan



### 3. Mastoiditis:

**Definition:** It is the inflammation of mucosal lining of antrum and mastoid air cells system.

#### Pathology

- Production of pus under tension
- Hyperaemic decalcification
- Osteoclastic resorption of bony walls (causes bone fracture pus excrete outside "subperiosteal abscess").

#### Symptoms:

- Earache
- Fever
- Ear discharge

#### Signs:

- Mastoid tenderness
- Sagging of posterosuperior meatal wall
- TM perforation
- Swelling over mastoid
- Hearing loss

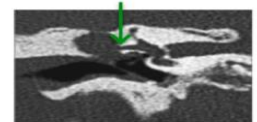
### 5 Mastoiditis /mastoid abscess

What are the vascular structures that pass through temporal bone? Carotid and internal jugular (vein more common than artery) may get affected from thrombophlebitis (inflammation of the lining wall of the vessels)

#### Diagnosis:

- High index of suspicion
- Longstanding disease
- Fistula test
- Ct scan of temporal bone

Most common lateral semicircular canal



#### Treatment:

Mastoidectomy

### How to differentiate between upper and lower Bell's palsy?

**Lower:** upper and lower parts of the face are affected

**Upper:** lower part of the face is affected (upper part has bilateral supply from both hemisphere)

#### Treatment:

- Acute otitis media and acute mastoiditis (cortical mastoidectomy + ventilation tube)
- chronic otitis media with cholesteatoma (mastoidectomy ± facial nerve decompression)

**Diagnosis:** (clinical + imaging)

#### Investigation:

- CT scan temporal bones
- Ear swab for culture and sensitivity

#### Treatment:

#### Medical treatment:

- Hospitalize • Antibiotics • Analgesics

#### Surgical treatment:

- Myringotomy (surgical incision into the eardrum).
- Cortical mastoidectomy

## C: Extracranial complication:

- Extension of infection to the neck
- Bezold abscess (extension of infection from mastoid to SCM). The sternocleidomastoid and digastric muscle are attached to the mastoid process and covered by a sheath, the mastoid abscess can drag through and extend down to the neck (rare).

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