

EAR: 3 regions – external ear located mostly outside body; middle and inner areas housed w/in petrous portion of temporal bone

External ear:

1. Pinna (auricle): cartilage & soft tissue cartilage shaped to collect & funnel sound into ear
→ sensory apparatus locates direction/source of sound
2. External auditory meatus (outer ear canal)

Middle ear: starts at eardrum at end of ear canal & ends at oval window

Tympanic cavity has auditory ossicles (malleus, incus, stapes) that move when eardrum vibrates from sound

- Mechanical stimulation transmits to perilymph of inner ear through oval window

Eustachian tube: connects tympanic cavity to upper throat

- Air movement through this tube opens & pressure equalizes on both sides of tympanic membrane
- Permits fluid to drain from ear to throat

Inner ear:

1. Bony (osseous) labyrinth: network of passages w/ bony walls lined w/ periosteum

Cochlea: auditory spiral of ear

- Receives sound in form of vibrations in perilymph, causing stereocilia to move
- Stereocilia convert these vibrations into nerve impulses to brain via auditory nerve

Vestibular system: maintain balance & motion

- Stereocilia provide attitude, rotation & linear motion
- Type of motion detected by hair cell depends on location & involvement of **otoliths** (small calcium deposits in perilymph)

Semicircular canals

2. Membranous labyrinth: membrane-lined, fluid-filled tubes & spaces inside bony labyrinth
→ Perilymph fluid layer separates bony from membranous (equilibrium)

Otitis media: ear infection (peak incidence in 1st two years of life (6-12 mo); boys > girls; 90% by age 6)

S/S:

Neonates/infants: change in behavior, irritability, tugging at ears, decreased appetite, vomiting

Children (2-4): otalgia, fever, noises in ears, can't hear properly, changes in personality

Children (>4): complain of ear pain, changes in personality

Pathogenesis of OM:

Infection (viral vs. bacterial)

Abnormal Eustachian tube function

Via Eustachian tube:

- Upper respiratory infection
- Upper respiratory communicative disease
- Swimming & dive in (dirty) water
- Age related anatomy (in infant is wide & short)

Allergy (minor)

Neoplasm (nasopharyngeal carcinoma)

Sinusitis

Obliterative tympanosclerosis: no tympanic membrane

Infectious agents in OM: S. pneumonia, H. influenza, M. catarrhalis

Risk factors in OM:

- Upper respiratory infections
- Allergies
- Craniofacial abnormalities (cleft palate)
- Down's syndrome
- Passive smoking

Age – Eustachian tube compliance

Acute OM: tympanic membrane is opaque, bulging/injected, reduced mobility, purulent effusion

Otitis Media with effusion: tympanic membrane is translucent or opaque; gray/pink; reduced mobility; effusion present +/- air

Chronic Mucoïd OM (glue ear): tympanic membrane is opaque/grey; retracted/reduced mobility; thick effusion, no air; hearing loss (> 20 dB HL)

Tympanosclerosis: white plaques in lamina propria; hyaline deposition; conductive hearing loss possible

Nose: external cartilaginous nose/nares; internal nasal cavity; sinuses

Function:

Provides airway for respiration
Moistens and warms air
Filters inhaled air
Resonating chamber for speech
Houses olfactory receptors

Respiratory epithelium: ciliated pseudostratified columnar epithelium

→ 2 layers of mucus: thick basement layer & thin less viscous layer (cilia moves to ostia)
→ Goblet cells for mucus

Vestibule: air enters here through nostrils

Sebaceous glands: greasy secretion, collect dirt, lubricate, kill bacteria

Sweat glands: acidic, slows growth of bacteria

Vibrissae: nose hairs, filter large particles (insects)

Nasal cavity: continuous with nasopharynx (drains to upper throat); divided in 2 by nasal septum; bordered by palates

Epithelial structure:

Olfactory Mucosa:

→ small receptors (olfactory nerve)
→ Bowman's gland secretes enzymes to clean lamina propria mucosa of chemicals (smells)

Respiratory mucosa: pseudostratified columnar epithelium with goblet cells
→ heavy venous blood flow (filter & warm inhaled air)

3 Turbinates (conchae): scroll-like bones of skull covered in mucous membrane
→ superior, middle & inferior of ethmoid bone

Functions:

Filters air
Heats air
Moistens air
Reclaim heat & moisture during exhalation

Sinuses: largest is maxillary sinus; all connected to nasal cavity; lined with respiratory epithelium

→ sound resonance; lightens skull

Sinusitis S/S:

- Pain and/or pressure
- Fever
- Nasal congestion and/or drainage
 - Rhinorrhea: postnasal drainage; purulent; COLOR ≠ INFECTION
- Obstruction
 - Deviated septum
 - Hypertrophy of turbinates
 - Polyps

Sinusitis pathogens: S. pneumonia, H. influenza, M. catarrhalis

Acute bacterial sinusitis: less than one month duration

- Purulent drainage, fever, sinus **pain** and pressure
- Isolated acute infection w/o recurrent sinus symptoms
 - Most commonly secondary to upper respiratory viral infection or other inflammatory condition
 - Perennial allergic rhinitis w/ inflammation
 - Obstruction of ostia/drainage passage of sinuses
 - **Neutrophilic inflammation** w/ eosinophils

Subacute bacterial sinusitis: lasting b/w 30-90 days (sx resolve completely)

Recurrent acute bacterial sinusitis: each episode lasting less than 30 days and separated by intervals of at least 10 days during which patient is asymptomatic

Allergic Fungal Sinusitis (AFRS):

Non-invasive: local fungal hyphae in mucin → allergic response to fungus → polyps with thick grey-brown "greasy" mucin drainage

Invasive: microscopic invasion of fungus in mucosa → necrotic black tissue w/ non-painful debridement = EMERGENCY LIFE THREATENING FUNGAL INFECTION

Chronic rhinosinusitis: > than 3 months duration

- Multiple tx or infxn within one year
- Multiple year history of recurrent infections or episodes of sinus pain & pressure
- Sx coincide with changes in altitude or weather
- Chronic nasal congestion & drainage

w/o polyps: neutrophilic inflammation

w/ polyps: IgE mediated response

Allergic rhinitis: rhinitis sx (itching, nasal discharge, sneezing & nasal airway obstruction) after allergen exposure by IgE-mediated immune reaction

Allergic rhinitis classification:

Intermittent: Sx <4 days/wk or < 4 wks (mild)

Persistent: Sx > 4 days/wk or > 4 wks (mod-severe)

Pharynx: connects the nasal cavity and mouth to larynx and esophagus; common passage for food & air (regulated by epiglottis); lined with skeletal muscle
→ extends from base of skull to C6 vertebra

Nasopharynx: posterior to nasal cavity (respiratory epithelium = ciliated pseudostratified epithelium)

Tonsils: lymphoid organs (swellings of mucosa) form ring around entrance to pharynx
→ palatine, lingual, pharyngeal (adenoid), tubal

Functions:

- Major drainage path for lymphatic fluids & sinuses
- Part of respiratory system (breath through nose)
- Part of auditory system (drainage from Eustachian tube)
- Closes off during swallowing to prevent reflex (drink up nose)

Oropharynx: posterior to oral cavity; extends to esophagus = stratified squamous epithelium

Function: transit of food & respiratory gases

Epiglottis: flap of connective tissue closes over glottis (larynx) when food is swallowed to prevent aspiration

Laryngopharynx (hypopharynx): posterior to larynx; continuous with esophagus & larynx = stratified squamous epithelium

→ common passageway for food & air

Larynx: voice box; attaches to hyoid bone and trachea
→ superior part: stratified squamous epithelium
→ below vocal cords: ciliated pseudostratified columnar

Functions: vocalization & provides open airway

Pharyngitis: inflammation of pharynx secondary to an infection agent

Many causes:

Group A streptococcus
Various viral agents
Candida (oral thrush)
Opportunistic bacteria
Environmental pollutants
Granulomatous disease
Chemical & physical

S/S:

Sore throat
Difficulty & painful swallowing
SIRS (fever)
Swollen lymph nodes in neck

OFTEN CO-EXISTS WITH TONSILITIS

Eye: functions in vision/sight; internal space divided by lens into 2 separate cavities (anterior/posterior cavity)

- Eyebrows: capture dust/particles
- Eyelashes: sebaceous ciliary glands at base of hair follicles
- Eyelids (palpebrae): protection (sleep/light); lubrication
- Conjunctiva: inner lining of eyelids & lines external eyeball
→ mucous membrane with vascularization
- Eyeball (3 layers)
 1. Fibrous tunic (outer tunic): cornea (clear; avascular) & sclera (white; hard)
 2. Vascular tunic (iris): focuses light on retina
 - a. Choroid – blood vessels & pigment
 - b. Ciliary body: ciliary processes make aqueous humor & ciliary muscles accommodate/refract
 - c. Nervous tunic (retina): pigmented epithelium (rods & cones; bipolar cells; ganglion cells; vitreous humor)

Anterior cavity: contains aqueous humor

1. Maintains IOP
2. Maintains shape of eyeball
3. Refractory medium
4. Supplies nutrition
5. Drains metabolic end products

Aqueous humor flow

Epithelial cells covering ciliary body secrete aqueous humor into posterior CHAMBER (iris to lens) → flows through pupil into anterior CHAMBER (cornea to iris) → trabecular outflow (into scleral venous sinus) or atypical uvoscleral (pressure dependent) outflow → venous bloodstream

Posterior cavity: posterior to lens & anterior to retina; contains vitreous humor (transparent, gelatinous)

- 1) Transmits light w/in posterior seg.
- 2) Supports lens posteriorly
- 3) Holds retina in place
- 4) Contributes to IOP

Dry eye: multifactorial disease of tears & ocular surface (not lack of sufficient tears); can cause potential damage to ocular surface

Pathophysiology:

- 1) Increased osmolarity of tear film
- 2) Inflammation of ocular surface
- 3) Disturbance of ocular functional unit

Symptoms:

Irritation, redness, burning/stinging, itchy eyes, sandy-gritty feeling (foreign body sensation), blurred vision, tearing, contact lens intolerance, increased blinking, mucous discharge, photophobia

Sx worsen in windy or air-conditioned environments, as day progresses, after prolonged reading/working on computers

Increased prevalence of dry eye:

- Increasing life-span of population
- Expansion of consumption of meds
- Increase in contact lens wearers
- Increase in computer usage
- Increase in patients undergoing LASIK
- Increase in pollution (air borne)

Chronic allergic conjunctivitis: 36% dry eye
→ results in loss of goblet cells, destabilization of tear film & damage to ocular surface

VKS 38% incidence of dry eye

Lacrimal system

1. Tears produced in lacrimal gland and secrete into upper fornix of conjunctival sac
2. Tears disperse across eye surface (cornea) by blinking of eyelids
3. Tears accumulate at inner canthus & drain into lacrimal sac via puncta and canaliculi
4. Fluid from lacrimal sac drains through nasolacrimal sac
5. Fluid enters nasal cavity (just beneath inferior turbinate)

Components of tears (aka tear film):

- Mucous layer: innermost; mucin produced by conjunctival goblet & corneal epithelial cells
 - Lubrication of ocular surface; tear film spreading
 - Provides adsorbent interface b/w aqueous layer & hydrophobic ocular surface epithelium
 - Traps foreign debris, cells, pathogens for removal
- Aqueous layer: middle; produced by lacrimal glands
 - Water, electrolytes, antibacterial proteins (lysozyme, igA), vitamins (A = retinol), growth factors (epidermal GF)
 - Hydration of mucous layer
 - Renewal/maintenance of ocular surface = promotion of wound healing (supplies O₂ & antibacterial defense)
- Lipid layer: outermost; produced by Meibomian glands; helped by glands of Zeis
 - Slows tear evaporation
 - Enhances tear film stability & spreading
 - Aids in sharp retinal image formation via smooth optical surface
 - Seals lid margins during sleep

Dry eye: main causes

Aqueous tear deficiency (ATD) = tear deficient dry eye (keratoconjunctivitis sicca) most common

- Sjogrens: accompanies other immune system disorders (RA & lupus)
→ mucus membranes & moisture-secreting glands of eyes & mouth have decreased production
- Non-Sjogrens: ageing, menopause, medicamentosa, cicatricial disease, neurotrophic keratitis

Evaporative dry eye:

- Meibomian gland disease
- Lid surfacing/blinking anomalies
- Contact lens related
- Chronic allergy/toxicity

Glaucoma: progressive optic neuropathy

- High IOP causes loss of retinal neurons & their axons
- Congenital: inherited condition in infants (incomplete development of drainage canals during prenatal period)
- Secondary: drugs, injury, tumor, inflammation

S/S: acute angle closure

Sx: severe pain; headache; NV; blurred vision; halos around lights; conjunctival injection

Signs: ciliary flush; corneal edema; fixed mid-dilated pupil; shallow anterior chamber; elevated IOP; sometimes glaukomflecken; closed-angle on gonioscopic examination

Dx: acute closure glaucoma

Gonioscopy of both eyes mandatory to assess depth of anterior chamber & presence of PAS

Multiple types of glaucoma:

- Primary/open angle: most common – correct amount of fluid can't drain out of eye (clogged pipe)
- Closed angle glaucoma: rare; pressure rises quickly when drainage canals are blocked/covered (sink stopper)

Three parameters of glaucoma:

1. Origin: primary (idiopathic) vs. secondary
2. State of anterior chamber angle: open vs. closed
3. Chronicity: acute vs. chronic

Pathophysiology:

- Cellular changes: immunocompetent cells; inflammatory cells
- Biochemical changes: proteins; PGs; inflammatory mediators (cytokines) & toxic agents (O₂ free radicals)
- Morphological changes in anterior chamber angle
 - Closed angle: posterior synechiae & pupillary block; peripheral anterior synechiae; forward rotation of ciliary body
 - Open angle: aqueous hypersecretion; mechanical blockage; trabeculitis; damage to trabeculum & endothelium secondary to inflammation; corticosteroid-induced
- Combined mechanism

Blepharitis: inflammation/infection of eyelid margins

Pathophysiology: bacterial lipase digestion impacts sebaceous gland secretions → ocular surface irritation/inflammation

NOTE: change in tear film phospholipid that acts as a surfactant → increased tear evaporation & unstable tear film

Anterior blepharitis:

- Staph may alter Meibomian gland secretion (direct infection, exotoxin, allergic response) → fibrinous scales & crusts around eyelashes
- Seborrheic variant: dandruff-like skin (greasy scales around eyelashes)

Posterior blepharitis:

Meibomian sebaceous glands secrete oily layer of tear film
→ pouting, recession or plugging of Meibomian gland orifices
→ fluid that may appear like tooth paste
→ tear film is oily & foamy (froth may accumulate)

Sx: burning, grittiness & mild photophobia w/ remission & exacerbation
→ worse in morning (except w/ comorbid dry eye - ↑ in day)

Conjunctivitis: acute inflammation of conjunctiva
→ most common cause of pink eye

Causes:

- Viral (most common): adenovirus, Herpes simplex
- Bacterial: S. pneum, Staph aureus, H. flu
- Ophthalmia neonatorum: secondary to gonorrhea or chlamydia in 1st mo of life
- Allergic: hypersensitivity type I (igE)

S/S: red eye; eye discomfort (burning, gritty, non-painful); minimal pruritus; vision normal (smearing upon waking common); mild photophobia

- Uni or bilateral (usually starts in 1 eye)
- Association with URTI, watery discharge & preauricular lymphadenopathy = viral
- Purulent discharge = bacterial

History of contact with similarly affected person is common

Mouth and buccal (oral) cavity: lips, cheeks, palate = thick stratified squamous epithelium; jaws (mastoid) & teeth (dentition); salivary glands

- Lips:** close mouth, keep food in, make speech sounds, tactile/sensory
- Core of sphincter-shape skeletal muscle (orbicularis oris)
 - Red vermillion margin (transition from keratinized skin to oral mucosa)
 - Clear color lets underlying vascular vessels show through epithelium → RED
 - Skin on lips much thinner to face
 - Low blood oxygen (cyanosis) causes lips to be blue
 - No sweat or sebaceous glands in lips (requires lubrication and moisturization)
 - Dermis is bulk of cosmetic fullness in lips

Palate:

1. Hard palate anterior (maxilla, palatine)
 2. Soft palate posterior (soft tissue)
- Palatoglossal arch (palate to tongue)
 - Palatopharyngeal arch (palate to pharynx)
 - Tonsils b/w arches

Jaws: upper jaw (maxillary) & lower jaw (mandible)

Function: hold teeth & occlude in chewing

Teeth

1. Deciduous teeth (milk/baby emerge at 6 mo – 12 yo)
2. Replaced by permanent teeth 6-12 yo
3. Wisdom teeth (3rd molar) erupts 17-25 yo or remains in jaw

Salivary glands:

- Intrinsic: all over mucous membranes of tongue, palate, lips, lining of cheek
- Extrinsic: secrete more saliva when eating (or anticipating) = parotid, submandibular, sublingual

Saliva:

- Moistens mouth
- Dissolves food to be tasted
- Wets and binds food
- Contains amylase to start starch digestion (saline to sugar experiment)
- Contains bicarbonate to neutralize cavity-causing acids produced by bacteria
- Contains anti-bacterial and anti-viral enzymes and cyanide-like compound to kill harmful micro-organisms
- Contains proteins that stimulate growth of beneficial bacteria in the mouth

Cheeks: form side of mouth & provide movement to mastoid bones and oral structures

- Masseter, temporalis – elevate mandible (close jaw)
- Medial pterygoid – lateral chewing
- Lateral pterygoid – translates mandible anteriorly (part of opening)
- Digastric – depresses mandible (opens jaw)
- Chewing is circular motion

Tongue (glossus): position food b/w teeth & forms words in speech

- Intrinsic muscles (shape change w/ fibers in various directions)
- Extrinsic muscles (attach tongue to skeleton)

Gustatory receptors: in specialized taste buds on dorsal surface of tongue

4 types of papillae:

- Filiform: anterior 2/3 of tongue (do not house taste buds; no sensory role in gustation)
- Fungiform: tip & sides of tongue; few taste buds each
- Vallate (circumvallate): least numerous yet largest; inverted V shape on posterior dorsal surface of tongue each surrounded by deep, narrow depression; most taste buds housed within these
- Foliate: not well developed on human; extend on ridges on posterior lateral sides; house few taste buds during infancy & childhood