Pathology of respiratory system

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LEC 1

Objectives :

- 1.To know the types of lesions affecting this system
- 2. To study the gross & microscopical features of these lesions
- 3. To correlate the signs & symptoms

Anatomy

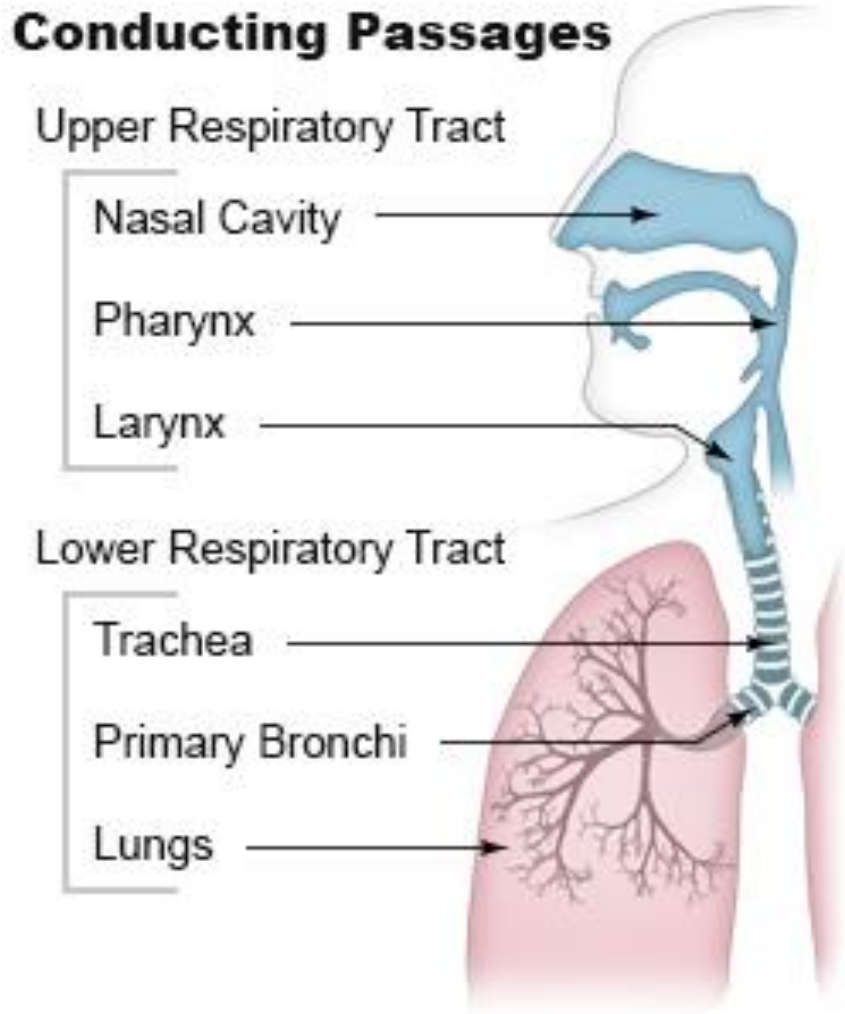
- Respiratory tract consist of:
- Nose,nasopharynx,larynx,trachea,right & left bronchi.
- The bronchi lead to respiratory lobule or acinus

Respiratory system divided into two parts:

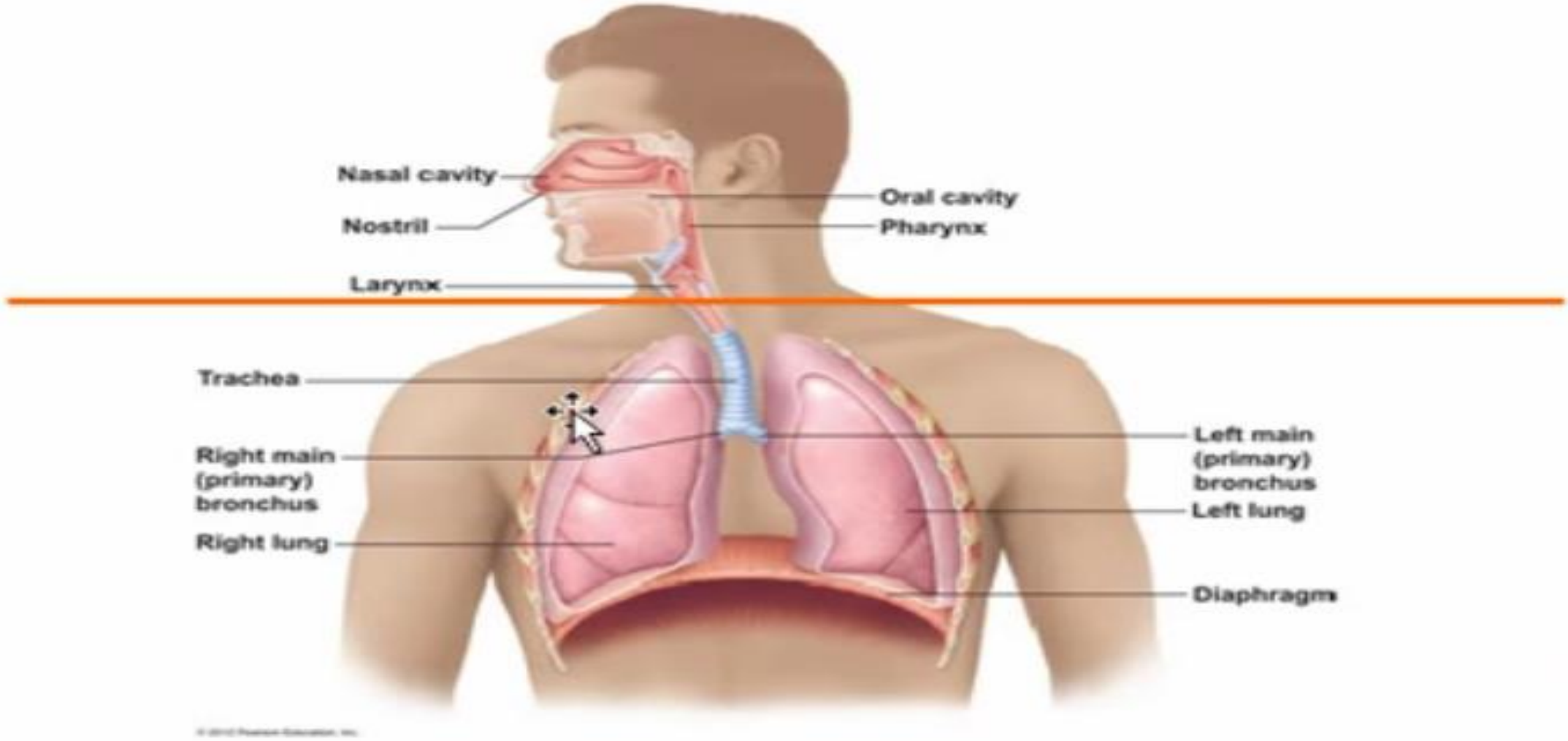
The respiratory tract are roughly divided in to

Upper respiratory tract : Above cricoid cartilage

Lower respiratory tract : Below cricoid cartilage



ANATOMY REVIEW



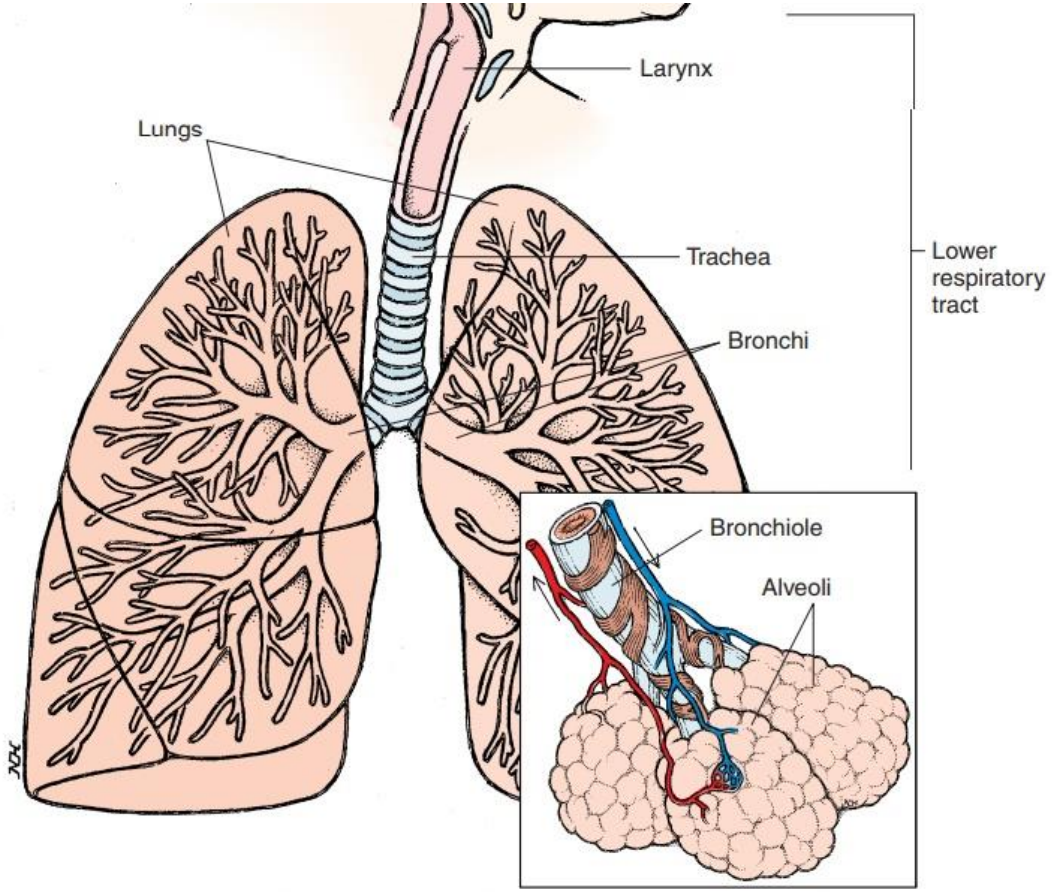
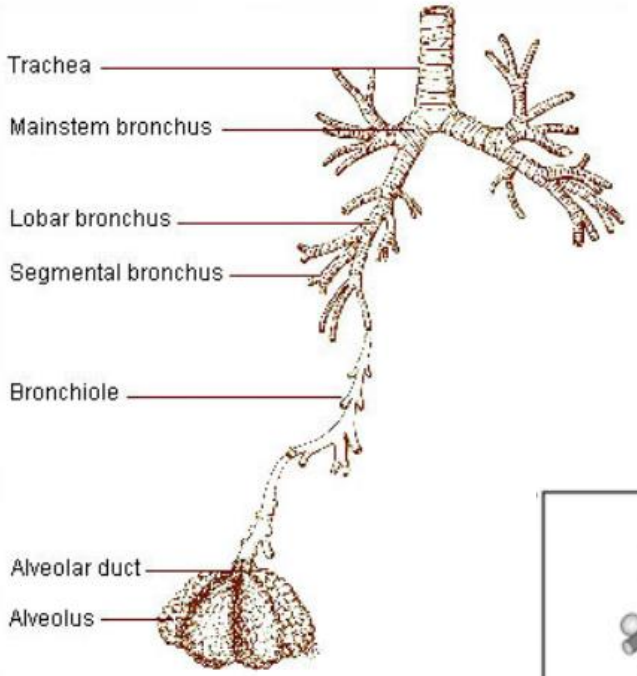
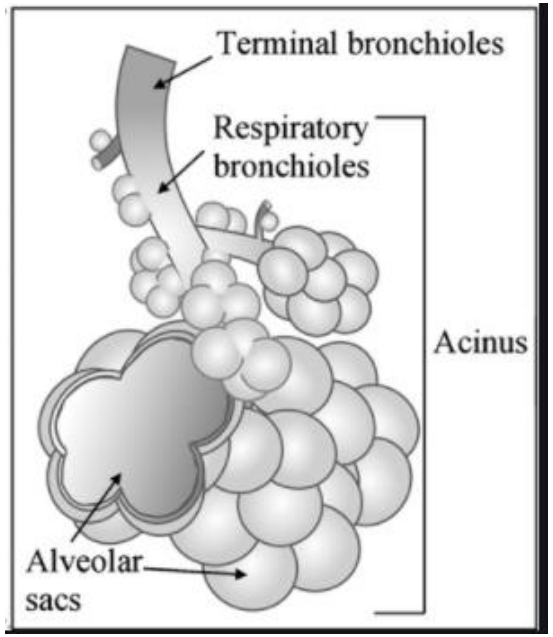


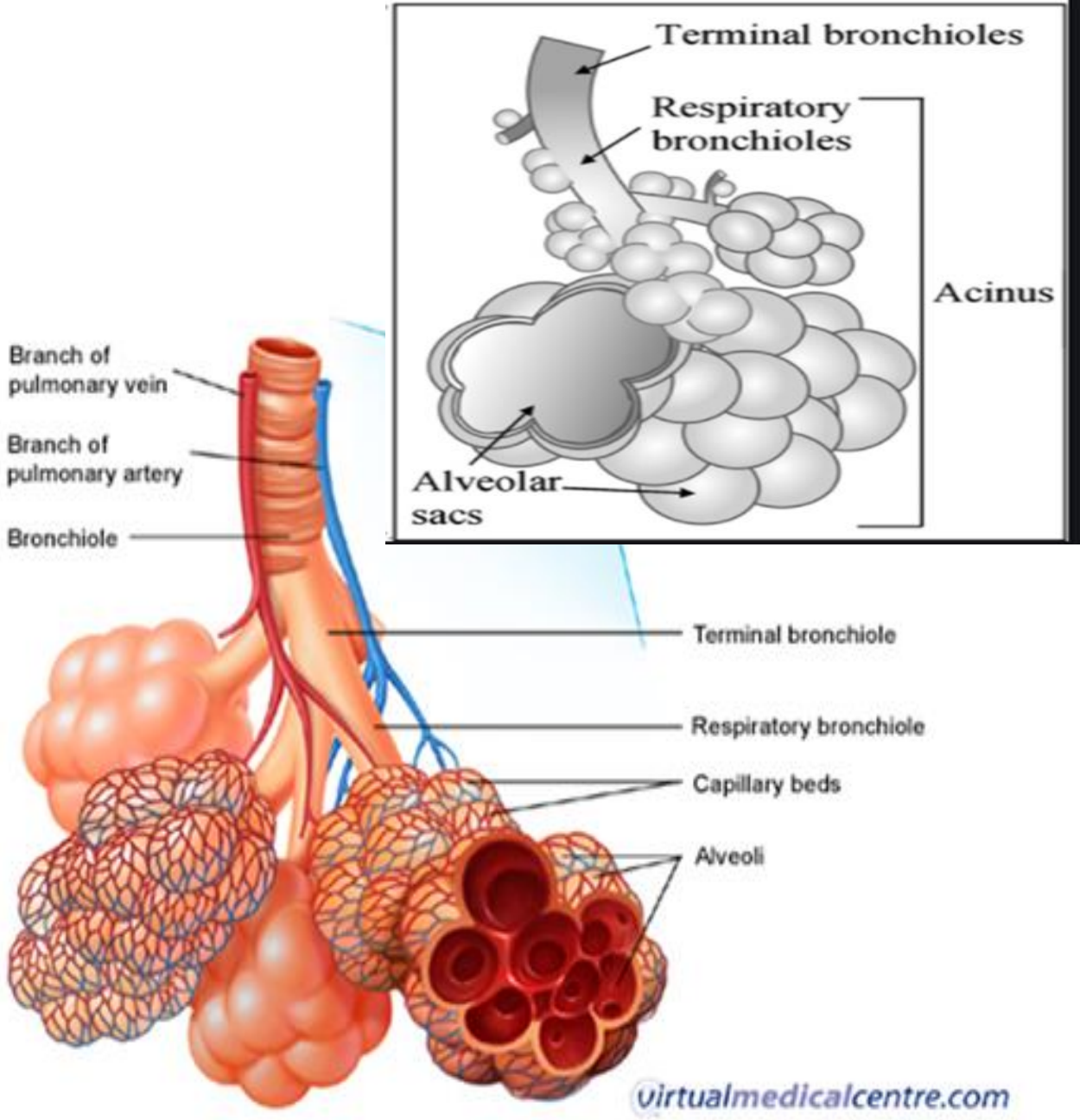
FIGURE The Structures of the Respiratory System (Anterior View)



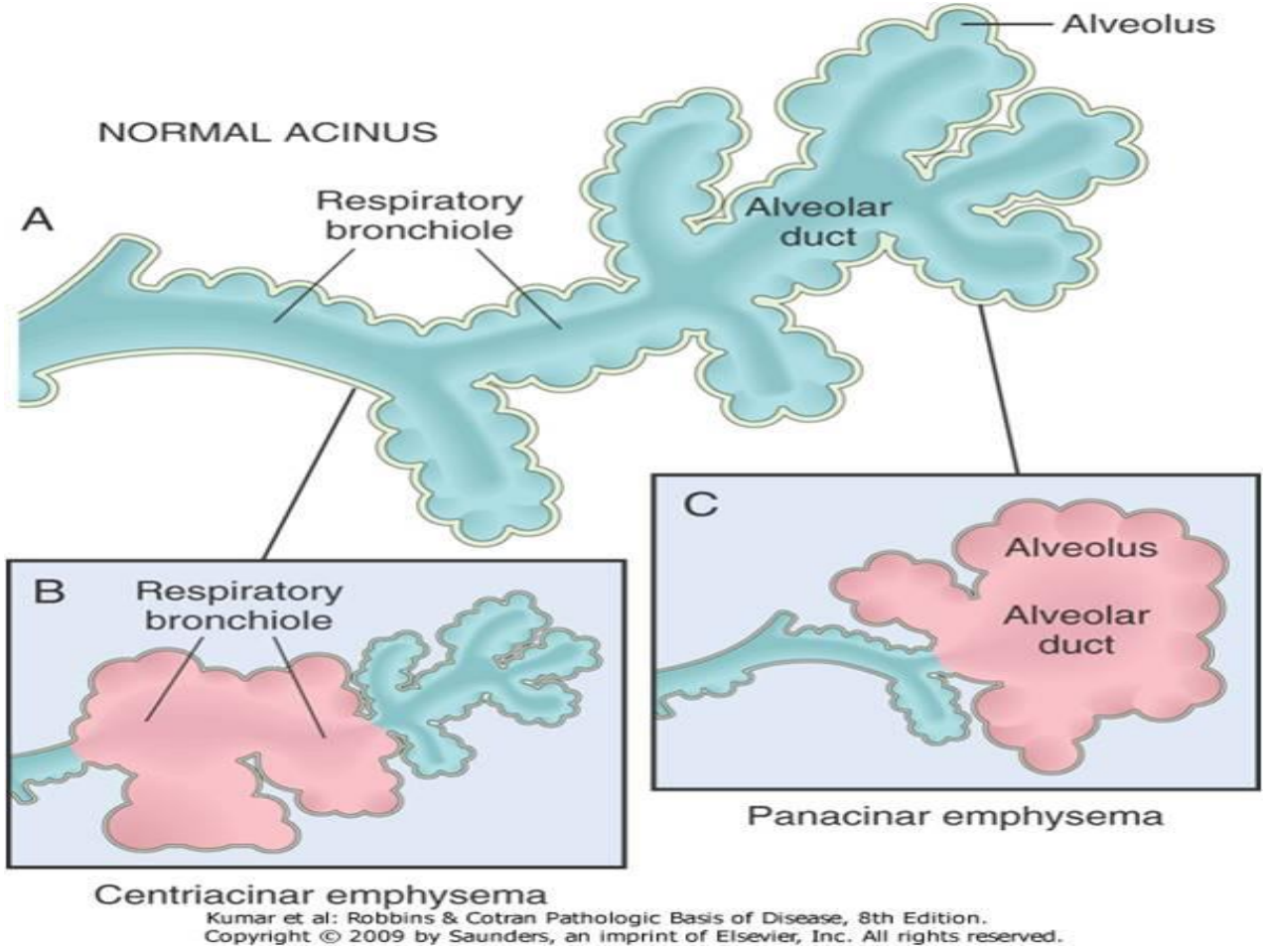


Acinus

- the structure **distal to terminal bronchiole** is called **acinus** .
- and a cluster of 3 to 5 acini is called a **lobule**
- Acinus : Consist of **respiratory bronchioles** and **alveolar ducts** and **alveoli** .
- Alveoli arise from both respiratory bronchioles and alveolar duct .



Respiratory Acinus

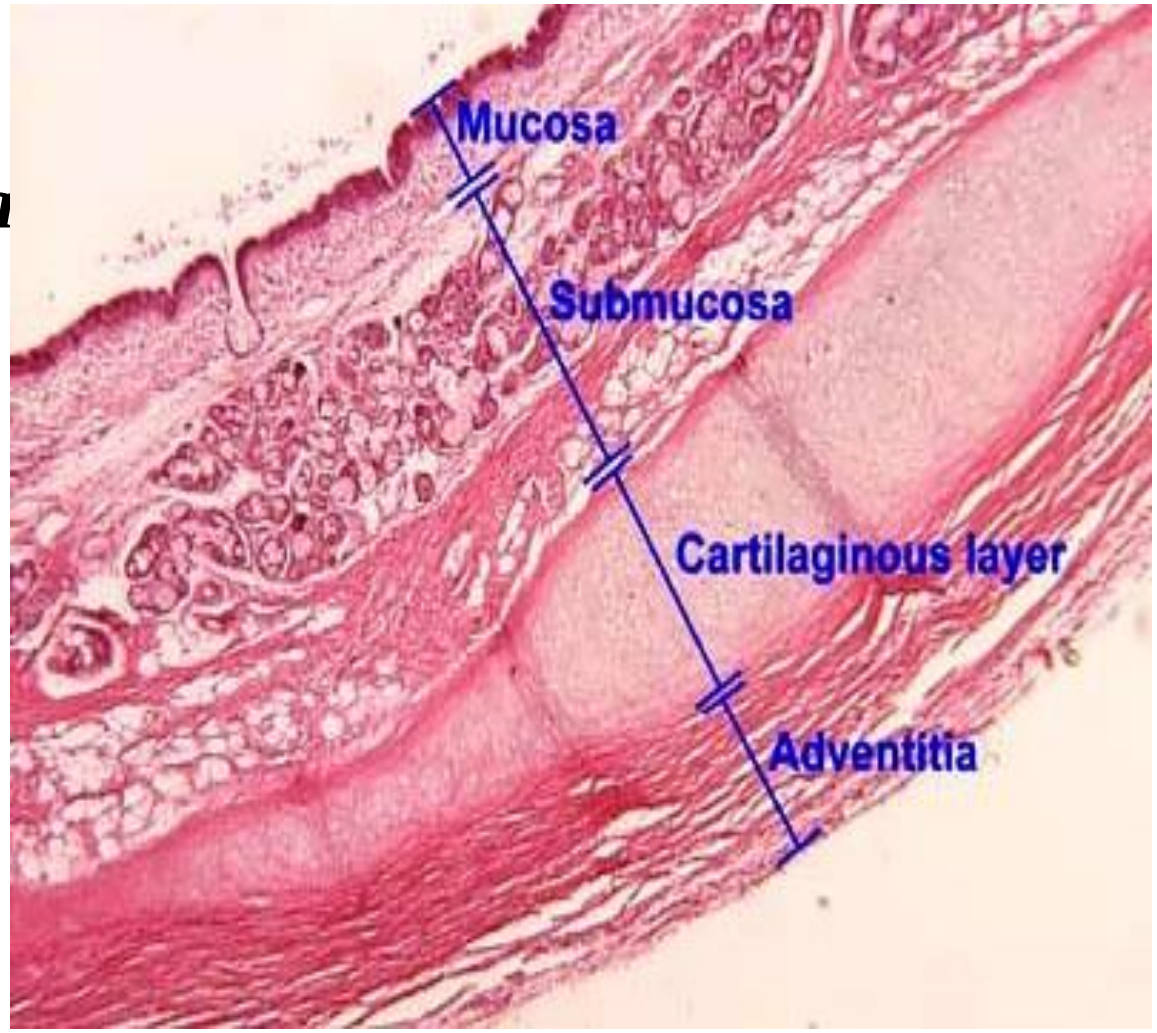


Histology

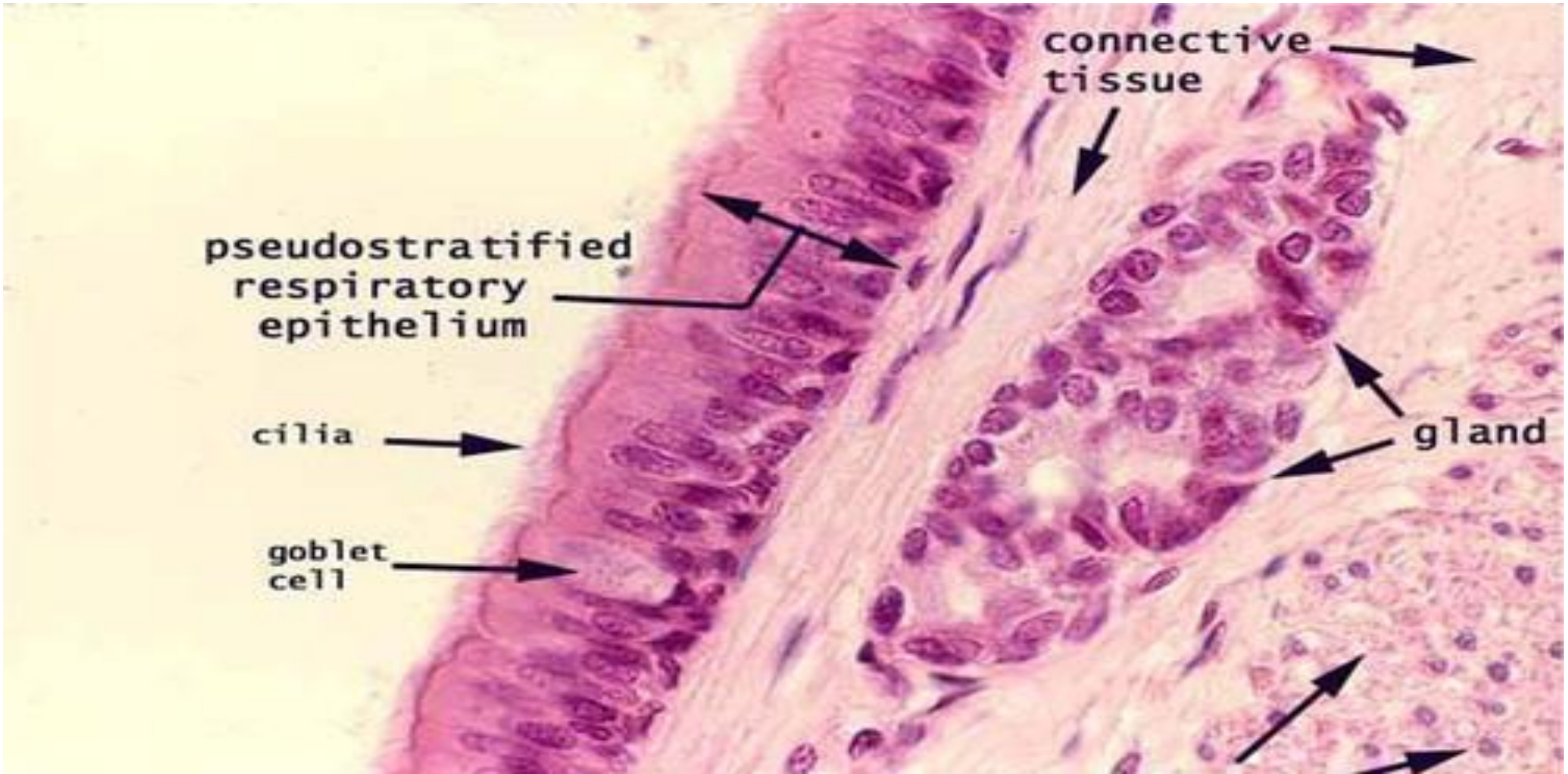
- **The nose, nasopharynx, bronchi** are lined by pseudo stratified tall columnar ciliated epithelium &contain **goblet cells** and **neuroendocrine cells**.
- **True vocal cord** are lined by **squamous epithelium**.
- **Submucosa** contain **mucus glands**.
- **The alveoli are lined by:**
- **Type I pneumocytes**: Flattened cells
- **Type II pneumocytes** :Rounded. It is the source of pulmonary **surfactant** & repair of type I pneumocytes

Trachea

- **Mucosa**
  - ***-Epithelium***
  - ***-Lamina propria***
- **Sub mucosa**
- **Cartilage &muscle layer**
- **Adventitia**



RESPIRATORY EPITHELIUM

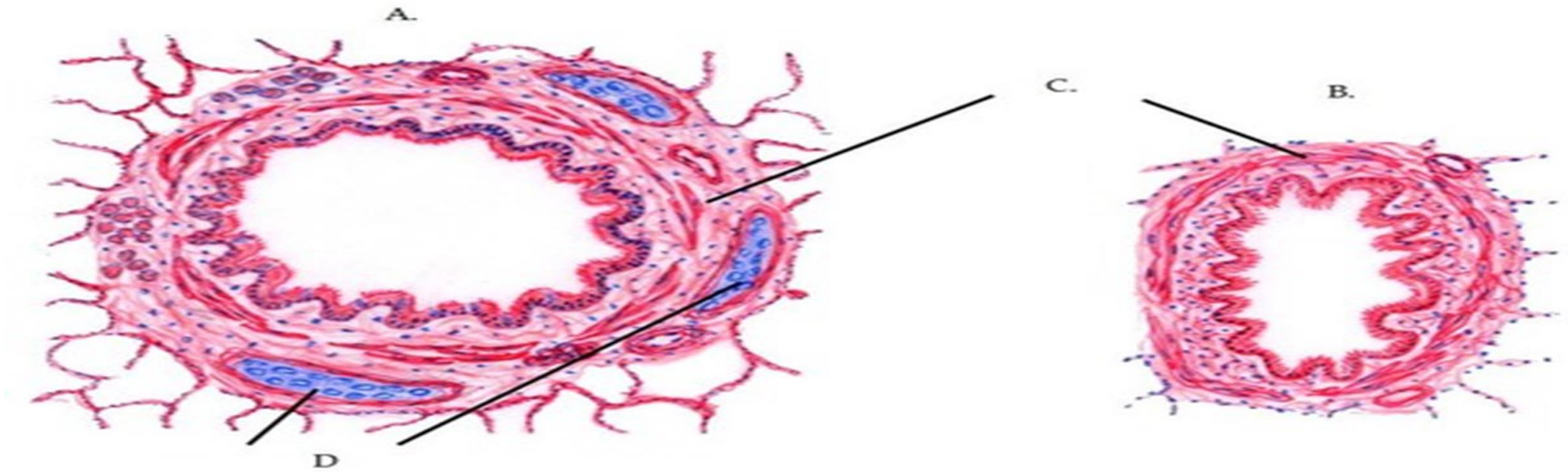


DIFFERENCES BETWEEN BRONCHI AND BRONCHIOLES

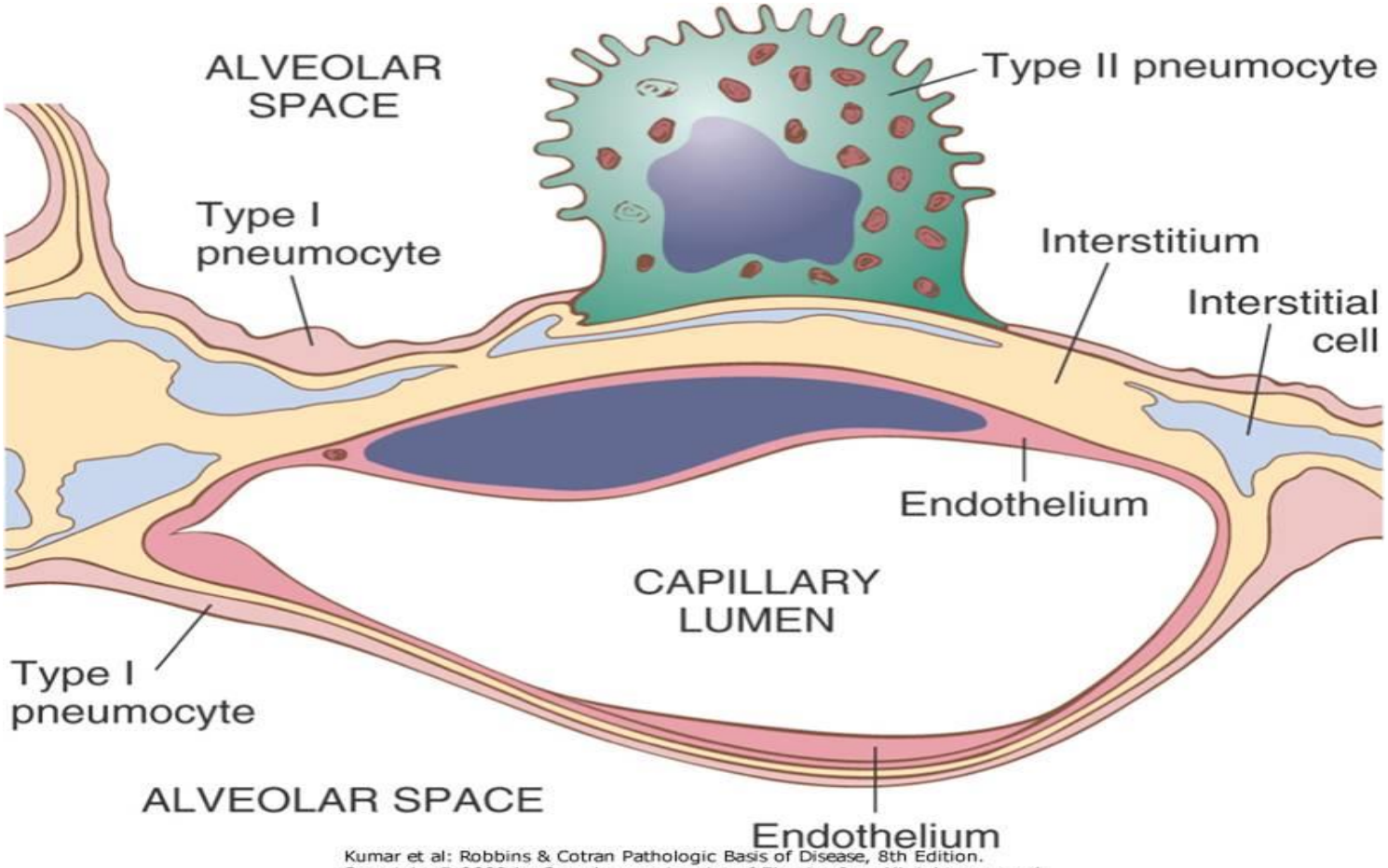
- Bronchus
- **Glands** are present.
- Presence of **cartilage.**
- **Goblet cells** are present.

Bronchioles

- **No glands**
- **No cartilage**
- **No goblet cells**



The wall of Alveolus



THE UPPER RESPIRATORY TRACT infection:

Infections of upper respiratory tract:

- Upper respiratory tract infection (**URI**): represents the most common acute illness seen in the outpatient.

- URIs range from the **common cold**,(a **mild** self-limited catarrhal syndrome of the nasopharynx)……. to **life-threatening** illnesses such as **epiglottitis.**

- It includes: rhinitis, sinusitis, pharyngitis, laryngitis, and epiglottitis.

.Most of these inflammatory conditions are **viral in origin,** -

but they are often **complicated by superimposed bacterial infections** .

Nose inflammation:

Rhinitis: is inflammation of mucous membranes of the nose.

- It is **either infectious or allergic**
- **Infectious rhinitis (common cold)** in most instances caused by viruses (adenoviruses, echoviruses, and rhinoviruses).
- They cause a profuse **catarrhal inflammation** during the initial acute stages, the **nasal mucosa** is **thickened**, **edematous**, **red , increased mucous secretion** and**;** the **nasal cavities are narrowed**.
- These changes may extend, producing a concomitant **pharyngotonsillitis.**
- **Secondary bacterial infection** enhances the inflammatory reaction and produces an essentially **mucopurulent** or sometimes frankly **suppurative exudate**.
- Most cases are self-limiting disease .

Fate of Acute infectious Rhinitis

- Resolution
- Secondary bacterial infection and suppuration
- sinusitis or otitis media
- Chronic atrophic Rhinitis
- development of nasal polyps

- **Allergic rhinitis (hay fever)**

- is an Type I immediate hypersensitivity reactions to one of a large group of allergens
- the most common allergen：**plant pollens**, **fungi**, **animal allergens**, and **dust mites**.
- Associated with asthma and eczema.
- The allergic reaction is characterized by marked **mucosal edema**, **redness**, and **mucus secretion**, accompanied by a leukocytic infiltration in which **eosinophils** are prominent.

complications: over time, can lead to

1-**chronic rhinitis**,

2-sinusitis,

3- **development of nasal polyps.**

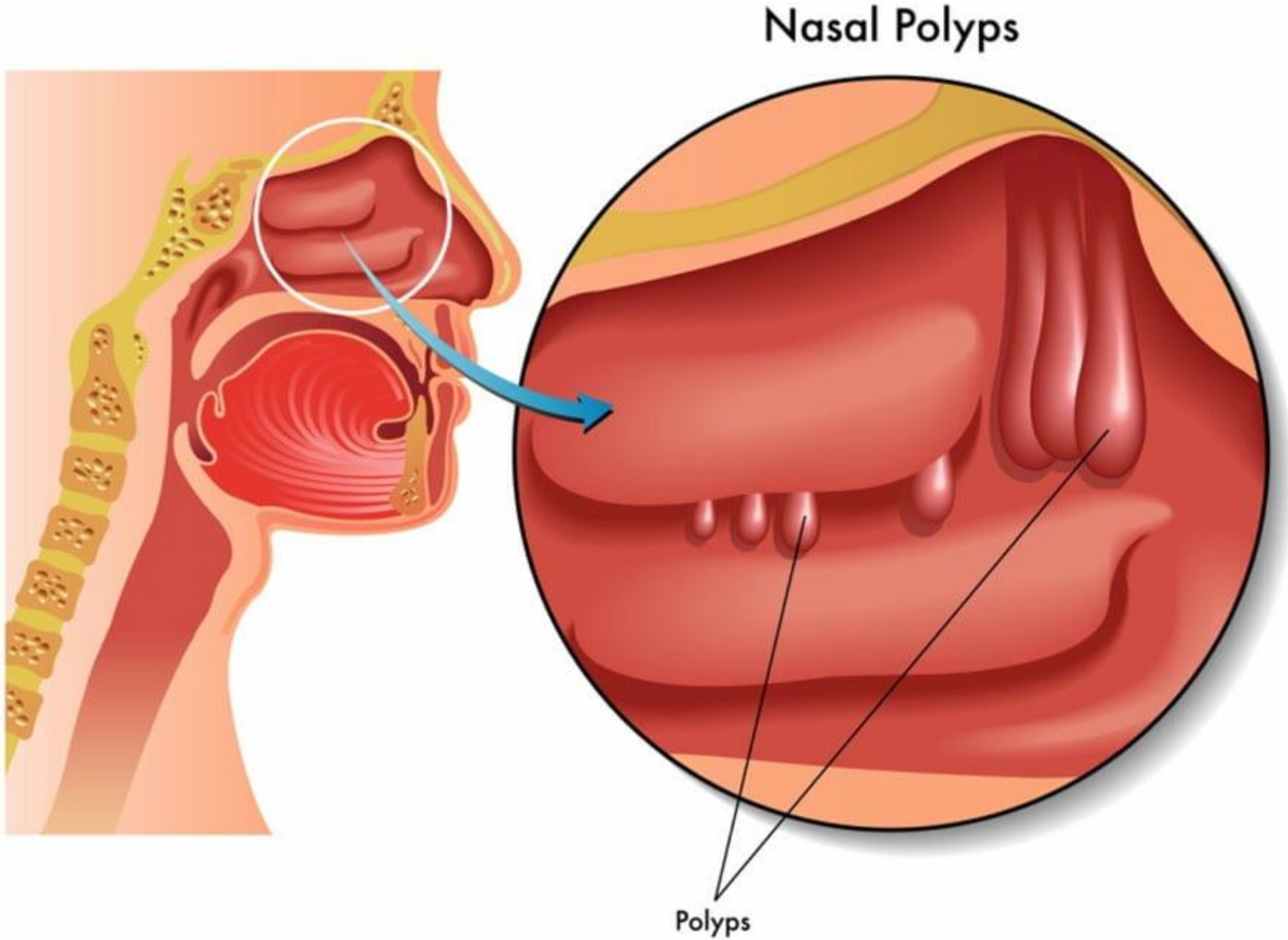
Nasal polyps:

- It is focal protrusion of the mucosa, secondary to recurrent attacks of rhinitis.
- **Not true neoplasms**, they are associated with i**nflammation** and **allergy.**
- Generally, they are multiple, and **nearly always bilateral.**
- **Microscopically:**
  - consists of **edematous stroma**,
  - **hyperplastic** or **cystic mucous glands,**
  - Infiltrated by variety of **inflammatory cells** including neutrophils, eosinophils, and plasma cells with occasional clusters of lymphocytes.

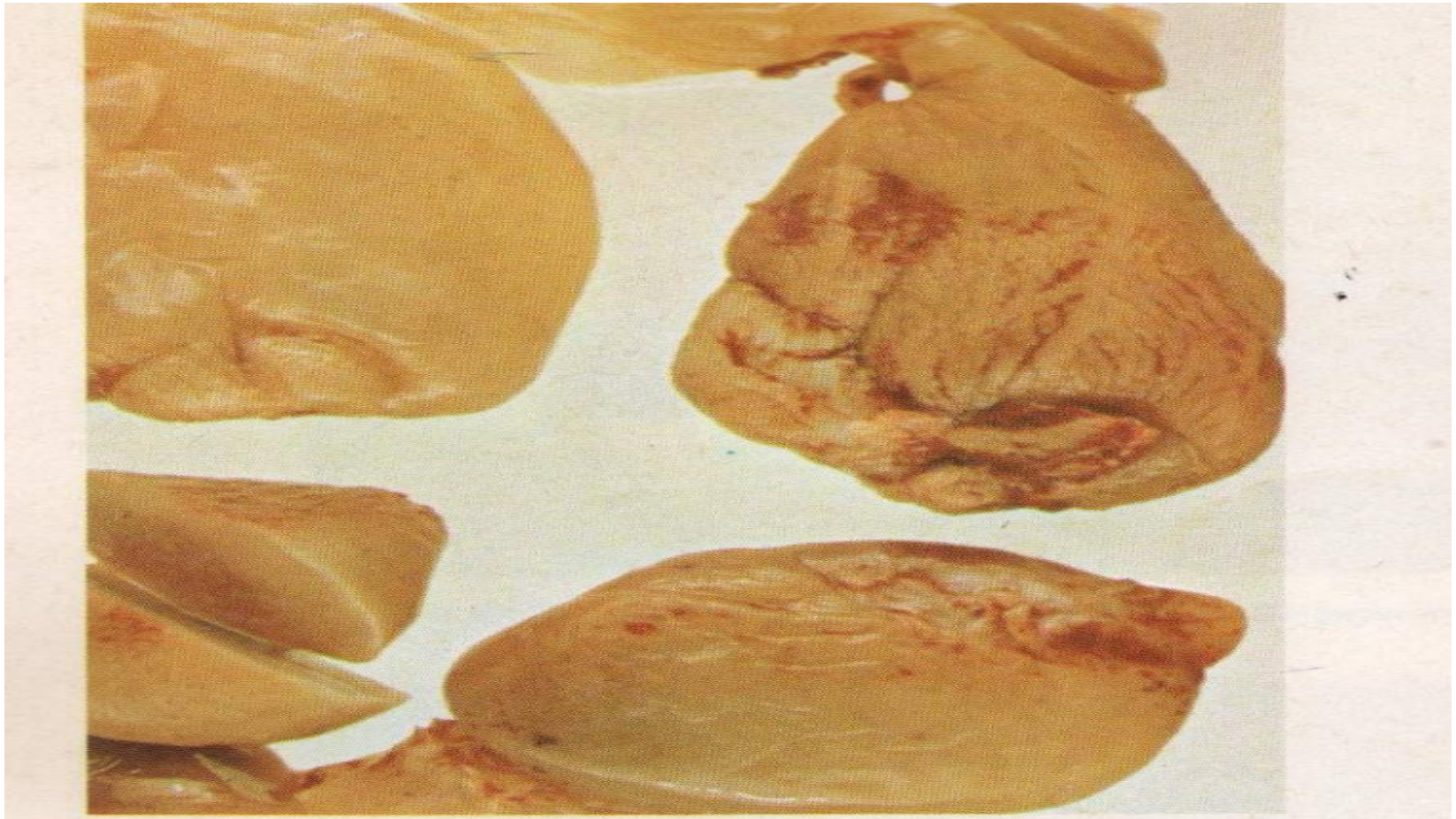
Complication:

1-When multiple or large it may obstruct airway or impair sinus drainage.

2-it may become ulcerated or infected.

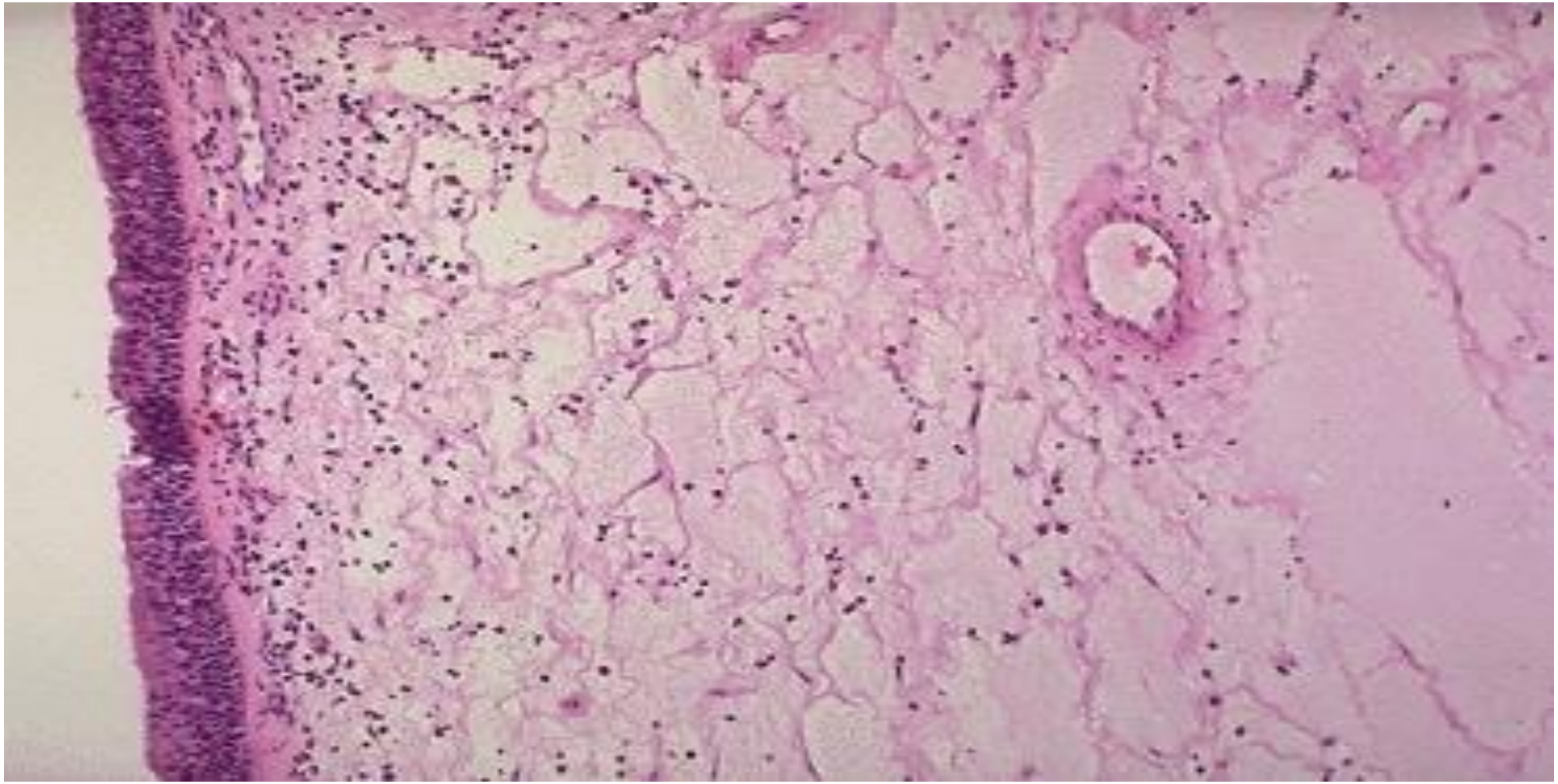

Nasal Polyps
Polyps

Gross appearance of Nasal polyp

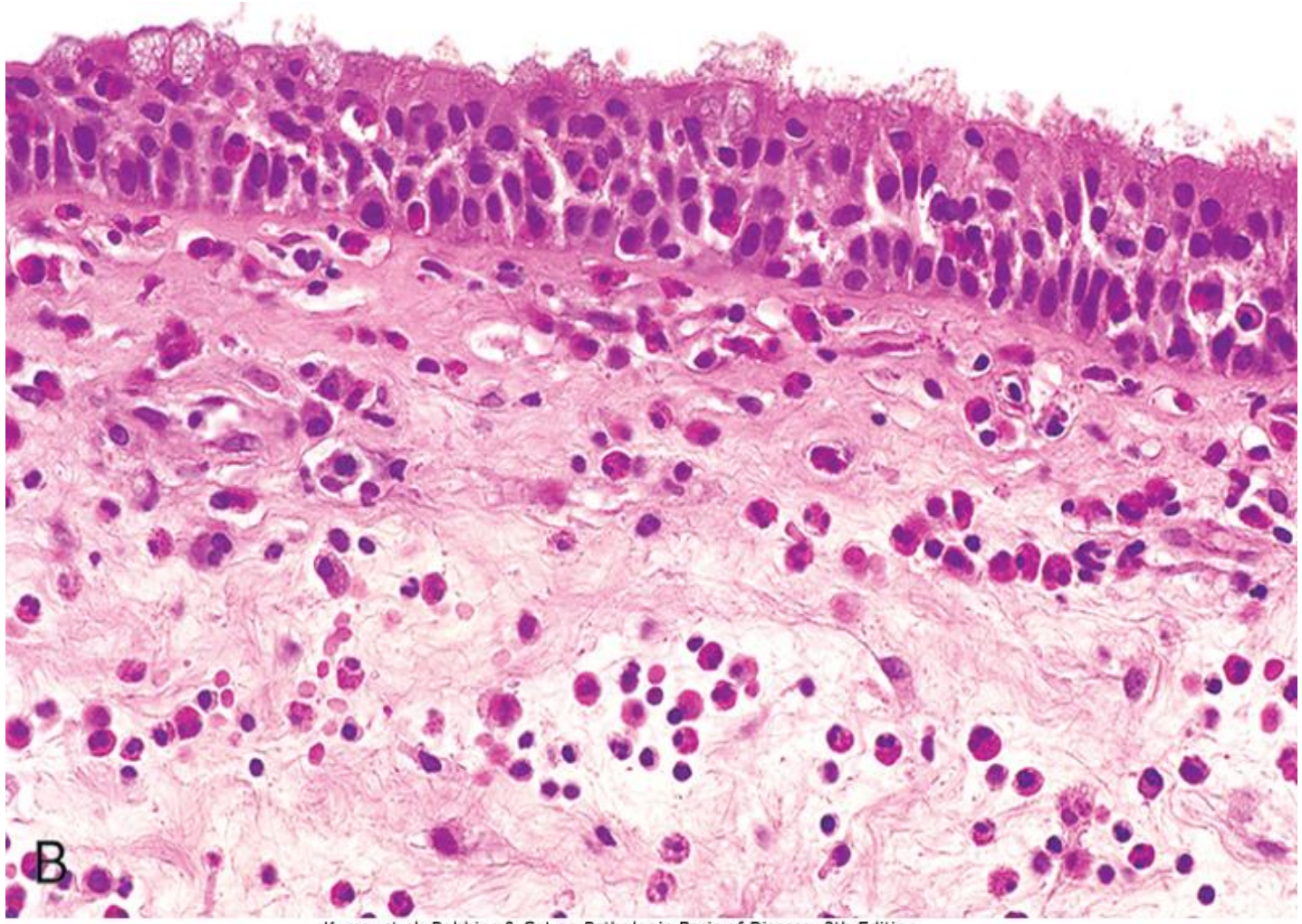


3.1 Nasal polyps

Microscopic picture of nasal polyp



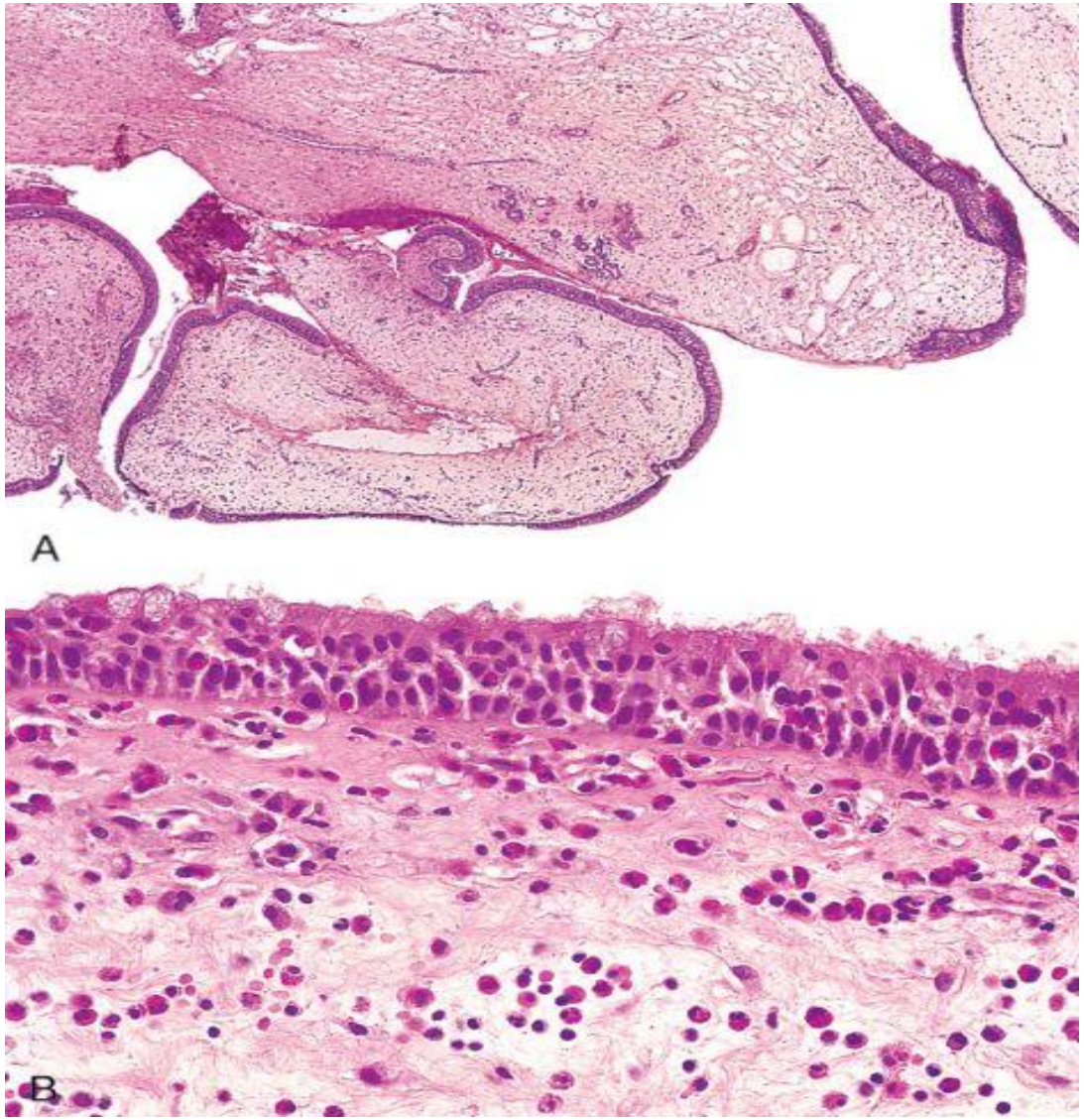
Nasal polyp

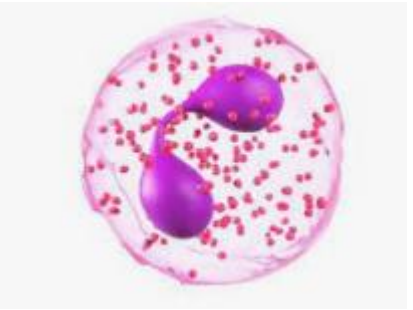


Nasal polyps.

A -Low-power magnification showing edematous masses lined by epithelium.

B, High-power view showing edema and eosinophil-rich inflammatory infiltrate.





Sinusitis.

- **Acute sinusitis**

Acute inflammation of the nasal sinuses.

Usually follow extension of infection from the nose.

there is **congestion &edema** lead to obstruction of sinus opening resulting in **accumulation of mucus secretion(mucocele**) followed by bacterial infection & **suppuration(empyema**).

Acute sinusitis may, in time, give rise to **chronic sinusitis.**

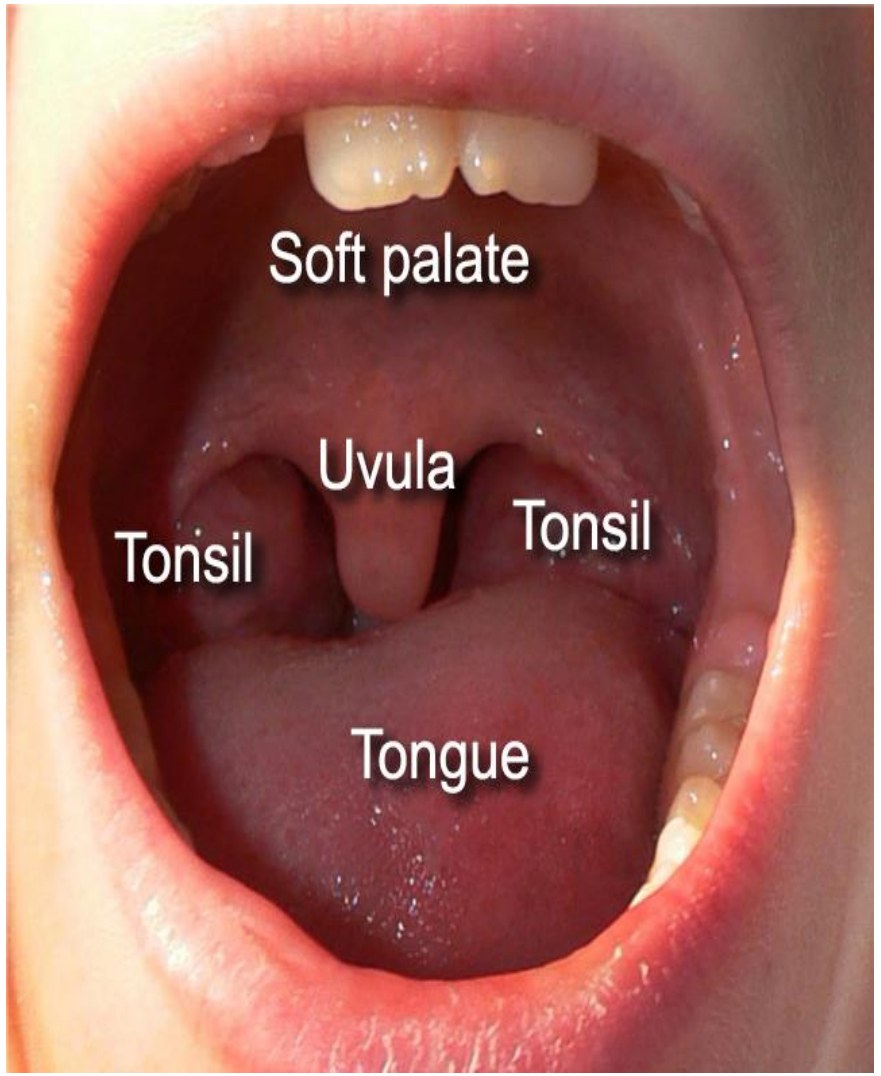
Etiology :Viral, **Bacterial, Allergic**. **Fungi** may cause severe chronic sinusitis (e.g., in mucormycosis), especially in diabetic patients.

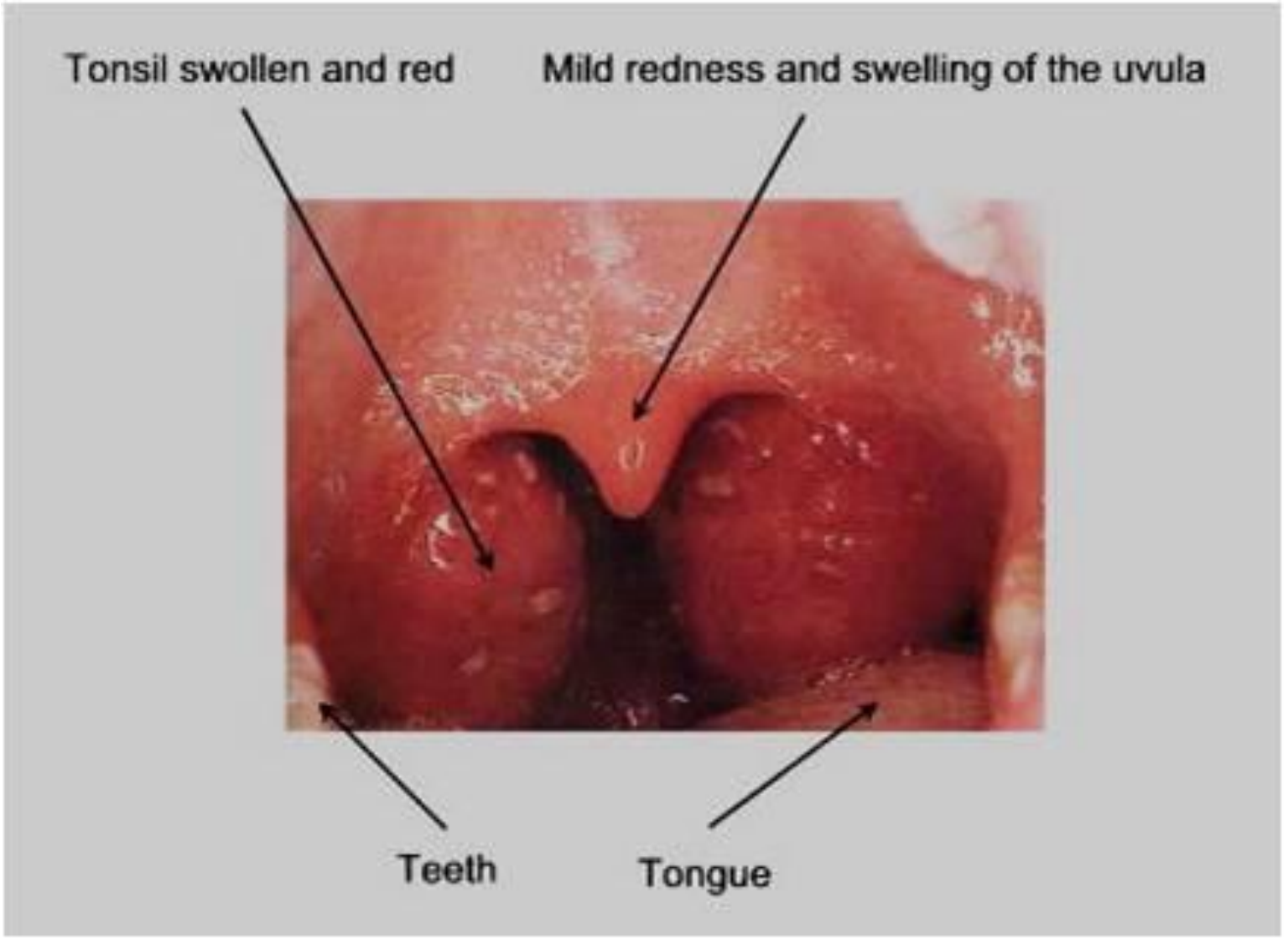
NASOPHARYNX

Inflammations: *Pharyngitis* and *tonsillitis*

- Either **mild pharyngitis**: commonest & usually associated with common cold).
- Or **severe pharyngitis** (associated with **tonsillitis)**
- viruses are the most common causes.
- **Bacterial infections** may be superimposed on these viral involvements, or may be primary invaders.
- nasopharyngeal mucosa appear red with slight edema, with reactive enlargement of nearby tonsils and lymph nodes .
- An exudative membrane (pseudo-membrane) may cover the inflamed nasopharyngeal mucosa and the enlarged tonsils.

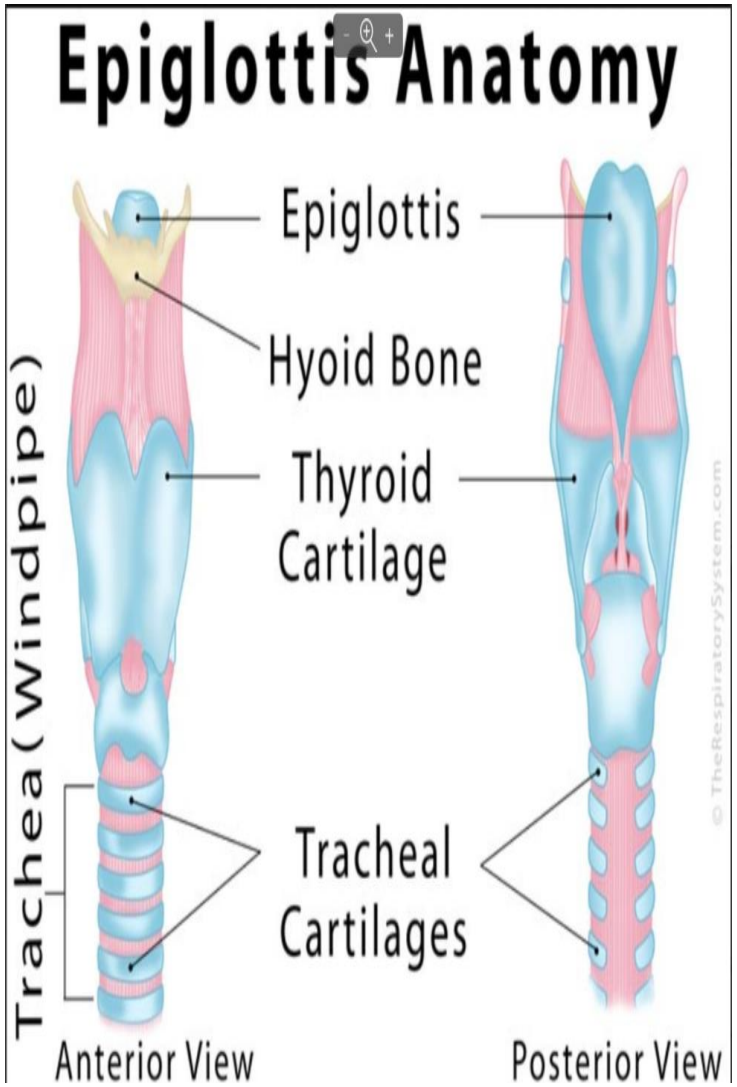
The major importance of **streptococcal infection** is the possible development of late sequelae, such as **:** **peritonsilar abscess, rheumatic fever** and **glomerulonephritis**


Soft palate
Uvula
Tonsil
Tonsil
Tongue


Tonsil swollen and red
Mild redness and swelling of the uvula
Teeth
Tongue

Epiglottitis: inflammation of epiglottis

- Mostly affect children.
- Due to **bacterial infection** Hemophilus influenzae.
- Regard as **medical emergency** present with fever , difficulty in breathing and swallowing ,abnormal high pitched sound during inspiration (stridor)
- May lead to fatal outcome (due to obstruction of upper airways by edematous epiglottis).
- **Oropharyngeal examination using a tongue depressor can provoke laryngospasm. Therefore, in suspected epiglottitis, limit the examination to observation and an assessment of the vital signs**.



Laryngitis: Inflammatory lesion of larynx

Causes:

1-The most common cause is **viral, bacterial infection**

that **associated** with generalized upper respiratory tract infection (**URTI**).

In children may be caused by **diphtheria**

2-**Allergy**.

3- Heavy **environmental toxin** exposure (e.g., tobacco smoke)

Prognosis

most infections are self-limited.

- the **sequelae** can be serious, especially in infancy or childhood (6 months to 3 or even to 6 years), when mucosal congestion, exudation, or edema may cause laryngeal obstruction.
- **Clinical features**: acute laryngitis present with **hoarseness of voice** or **even voice loss**.

•Laryngo epiglottitis

- caused by **respiratory syncytial virus**, ***Haemophilus influenzae***, or **β-hemolytic streptococci** may induce such sudden swelling of the **epiglottis and vocal cords** in the small airways of infants and young children as to constitute a **medical emergency.**

This is uncommon in adults because:

1- of the larger size of the larynx

2- **stronger accessory respiratory muscles.**

Croup(LTB)

refers to acute **laryngotracheobronchitis** in children that produces a characteristic **inspiratory stridor** , **hoarse voice** and **seal barking cough** due to upper airway narrowing.

When a cough forces air through this narrowed passageway, the swollen vocal cords produce a noise similar to a seal barking.

Likewise, taking a breath often produces a high pitched whistling sound (stridor)

Tumors of the Nose, Sinuses, and Nasopharynx

NASOPHARYNGEAL CARCINOMA:

- This rare neoplasm has a strong association with **EBV** & a high frequency in **China**.
- These facts raise the possibility of viral oncogenesis on a background of genetic susceptibility.
- It is usually **clinically occult** until they present **at advanced stages** with nasal obstruction, epistaxis, and metastases to the cervical lymph nodes in up to 70% of patients.
- **Radiotherapy** is the standard treatment

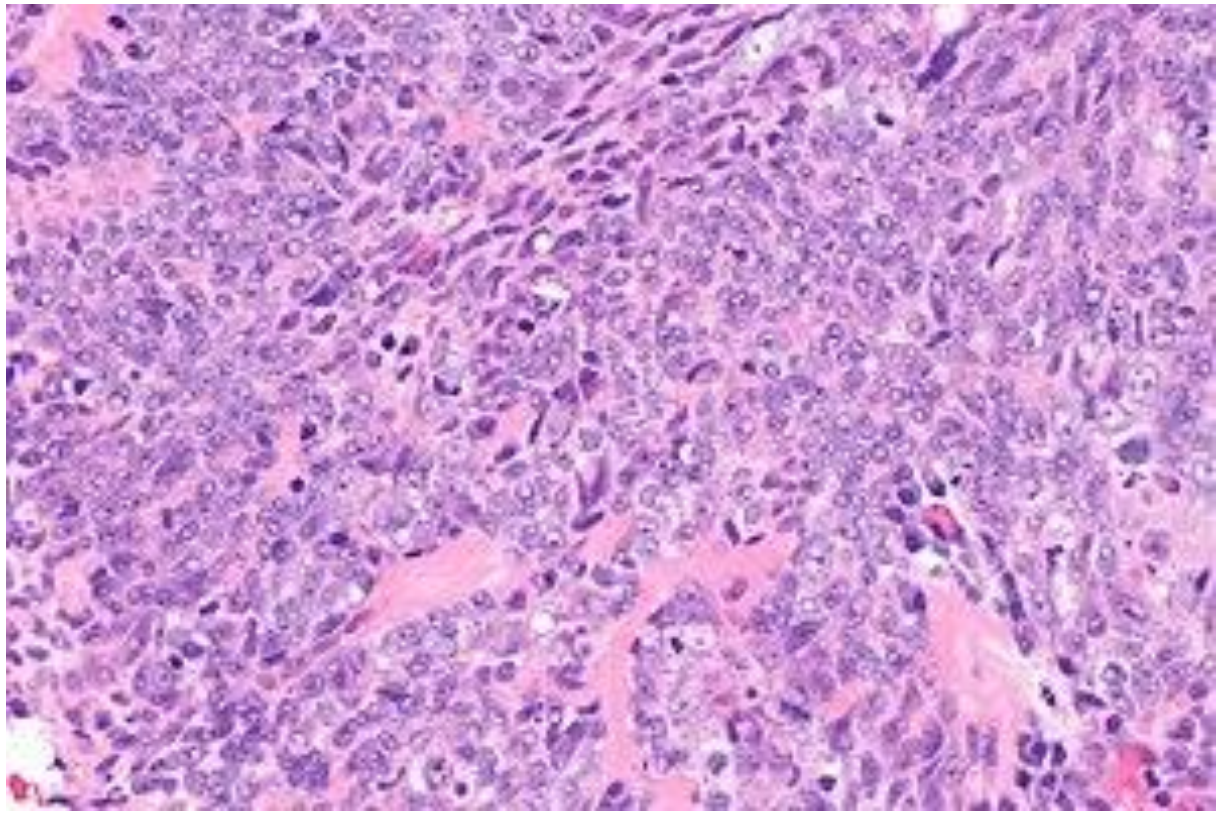
- **The histological subtypes:**

1. **Squamous cell carcinoma** (keratinizing or nonkeratinizing)
2. **Undifferentiated carcinoma: is the most common** and the on**e most closely linked with EBV**, characterized by syncytial growth(sheet like) with prominent eosinophilic nuclei

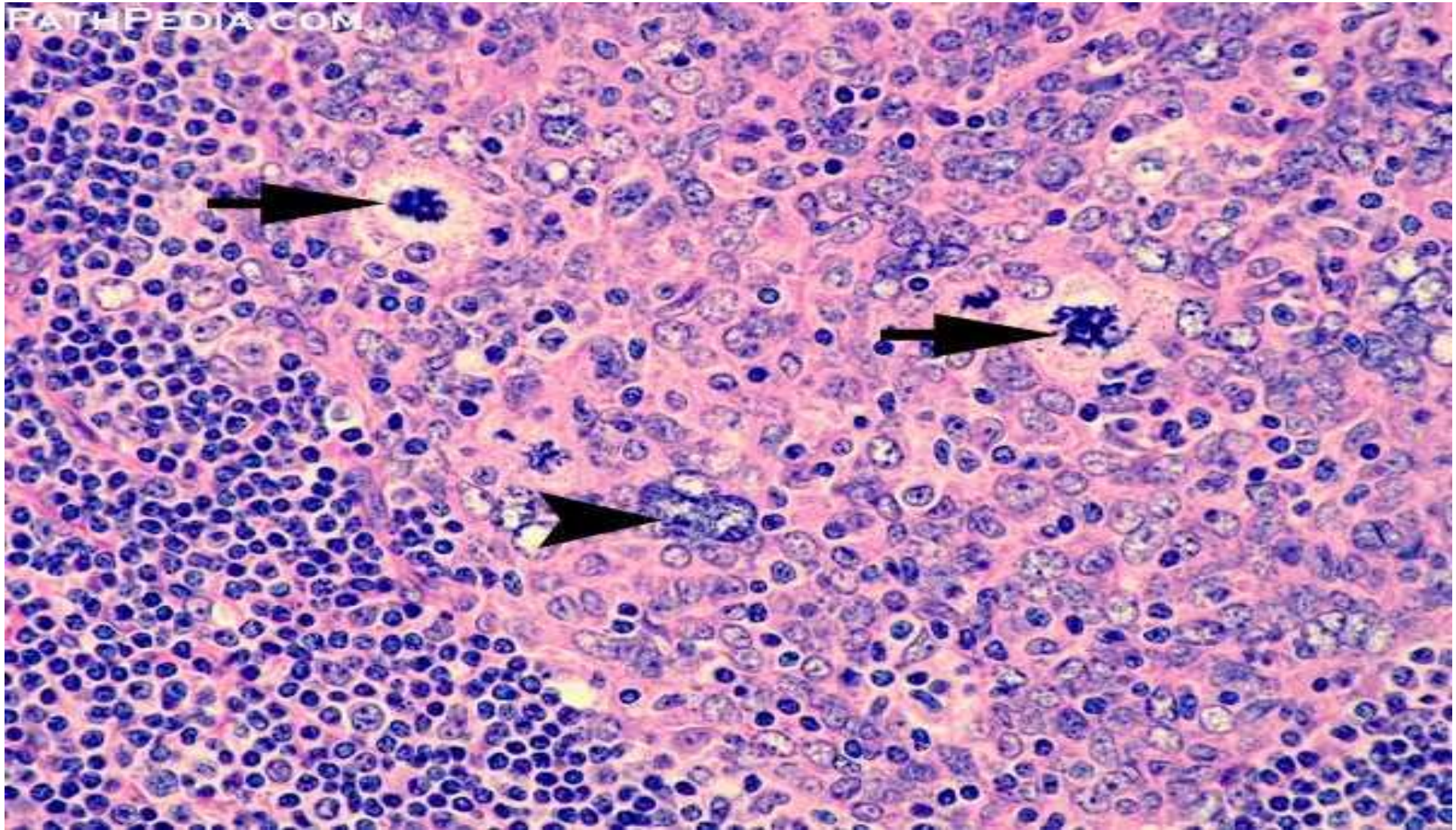
- Nasopharyngeal carcinomas **invade locally**, **spread to cervical lymph nodes**, and then **metastasize to distant sites.**

Nasopharyngeal carcinoma, undifferentiated type.

The syncytium-like nests of epithelium are surrounded by lymphocytes



Nasopharyngeal carcinoma



LARYNGEAL TUMORS :

Benign Lesions :

Vocal cord nodules

Laryngeal papilloma (*squamous papilloma)* of the larynx

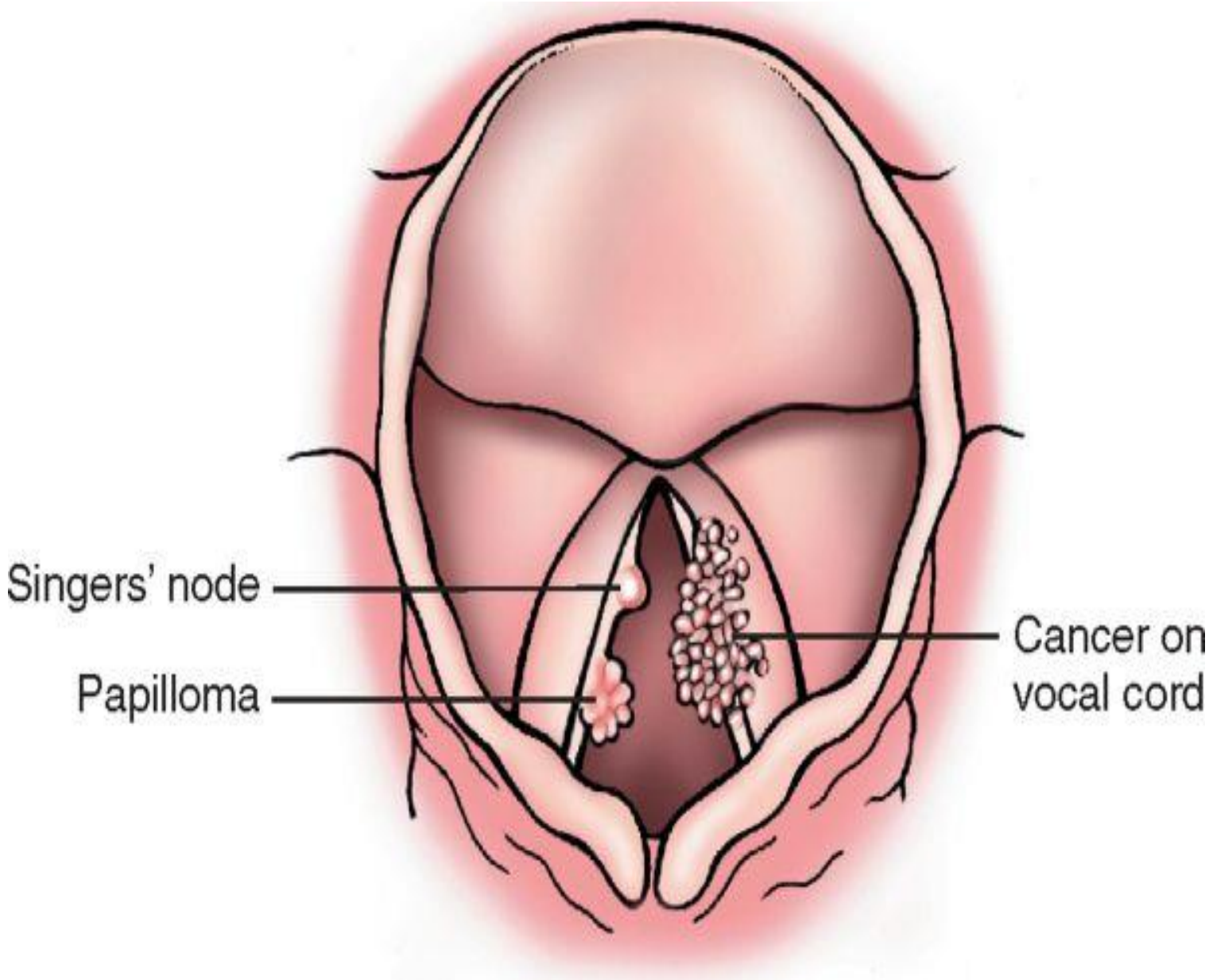
Malignant Lesions :

Carcinoma of the Larynx

- ***I. Non malignant tumors:***
- 1**-Reactive nodules (vocal cord nodules and polyps).**
- are smooth rounded protrusions

- usually less than 0.5 cm in diameter
- located on the **true vocal cords**.
- composed of fibrous tissue and covered by stratified squamous mucosa.
- occur chiefly in **heavy smokers** or
- in individuals who impose great strain on their vocal cords ***(singers' nodules)***.
- suggesting that they are the result of **chronic irritation** or **voice abuse.**

- Because of their strategic location and accompanying inflammation, they characteristically change the character of the voice and often cause progressive hoarseness.

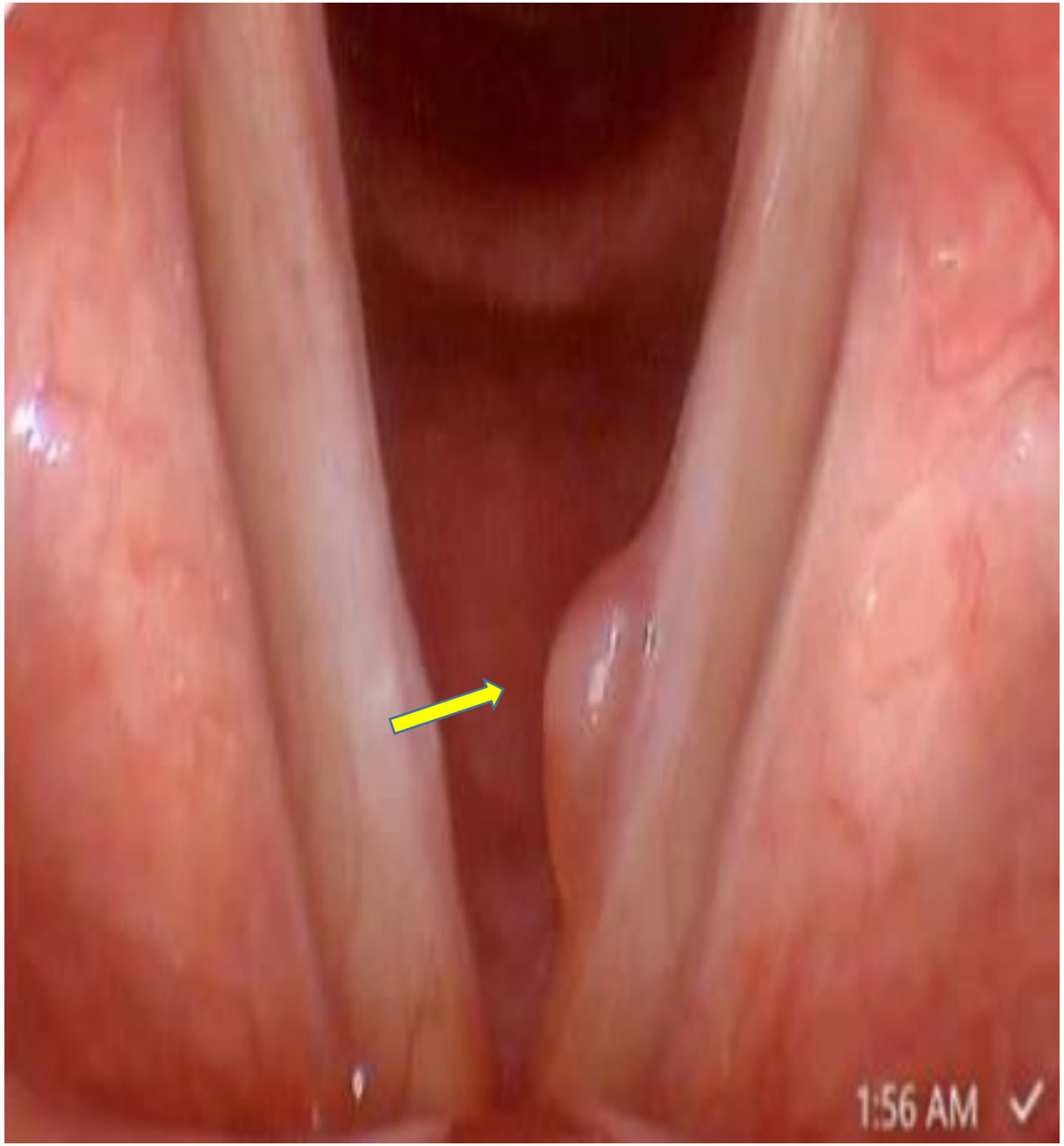

Singers' node
Papilloma
Cancer on vocal cord

Laryngeal nodule

it **is NOT a neoplasm**

It is a small nodule at the vocal cord ,

Grossly these localized swellings are pale and translucent or bluish in colour



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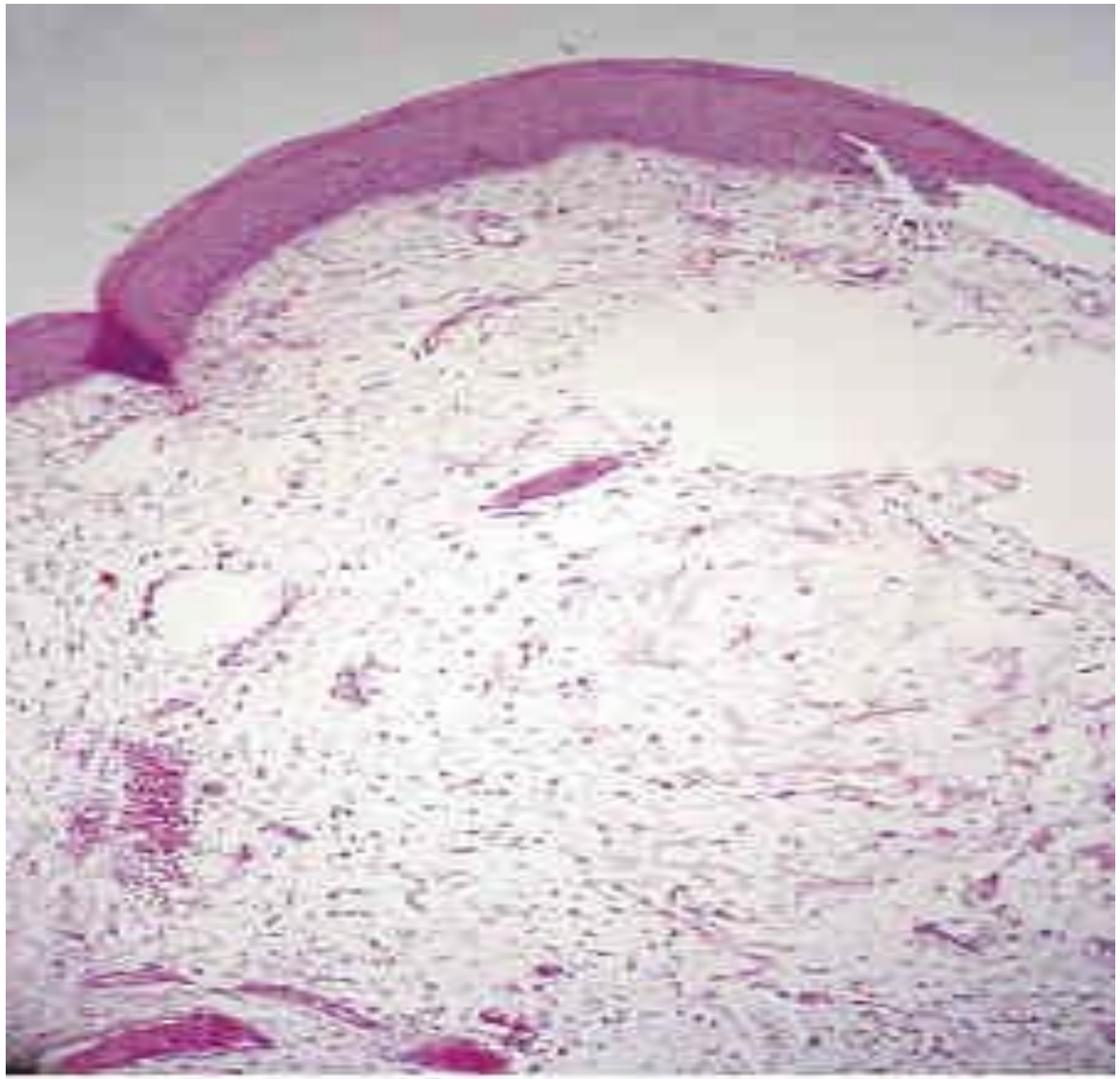
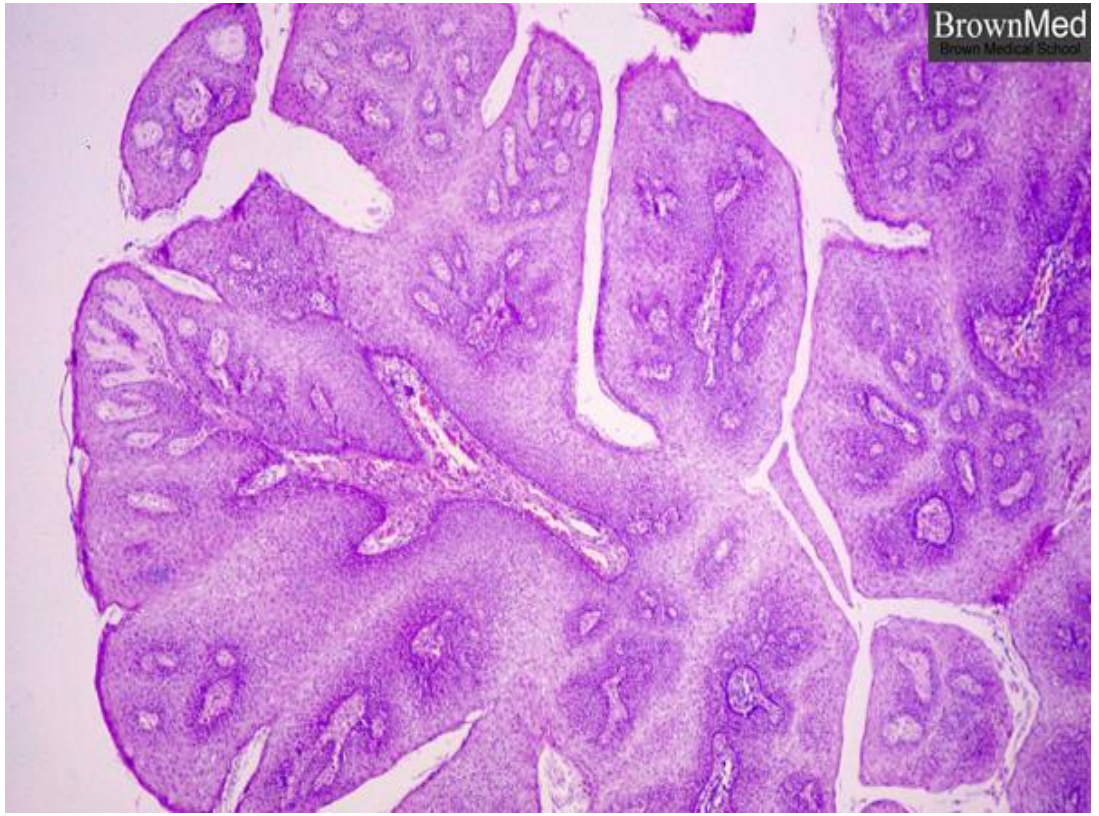
Microscopically
has smooth surface covered by normal stratified squamous epithelium core consist of loose, edematous and often myxoid mass of subepithelial connective tissue.



2-Squamous papilloma and papillomatosis:

- are **benign neoplasms**,
- usually located on the **true vocal cords**,
- that form soft, **raspberry-like mass** rarely more than 1 cm in diameter.
- **Mic.**, multiple slender, finger-like projections supported by central fibrovascular cores and covered by an orderly stratified squamous epithelium.
- Papillomas are usually **solitary in adults** but are often **multiple in children**, a condition referred to as **juvenile laryngeal papillomatosis**.
- The lesions are caused *by* ***HPV types 6 and 11***.
- They **DO NOT** become malignant, but **frequently recur**.
- They often spontaneously regress at puberty.
- The regularity of recurrence requires some children to undergo numerous surgeries.

Laryngeal papilloma



II- Malignant carcinoma of larynx

Most commonly occurs within the **6th decade** of life

- more common in **men** than in women.
- Nearly all cases occur in **smokers**, **alcohol** , asbestos , exposure **irradiation** and **infection with HPV** and may also play roles.

Morphology.

Grossly: fungating mass , focal thickenings, or ulcerated lesions.

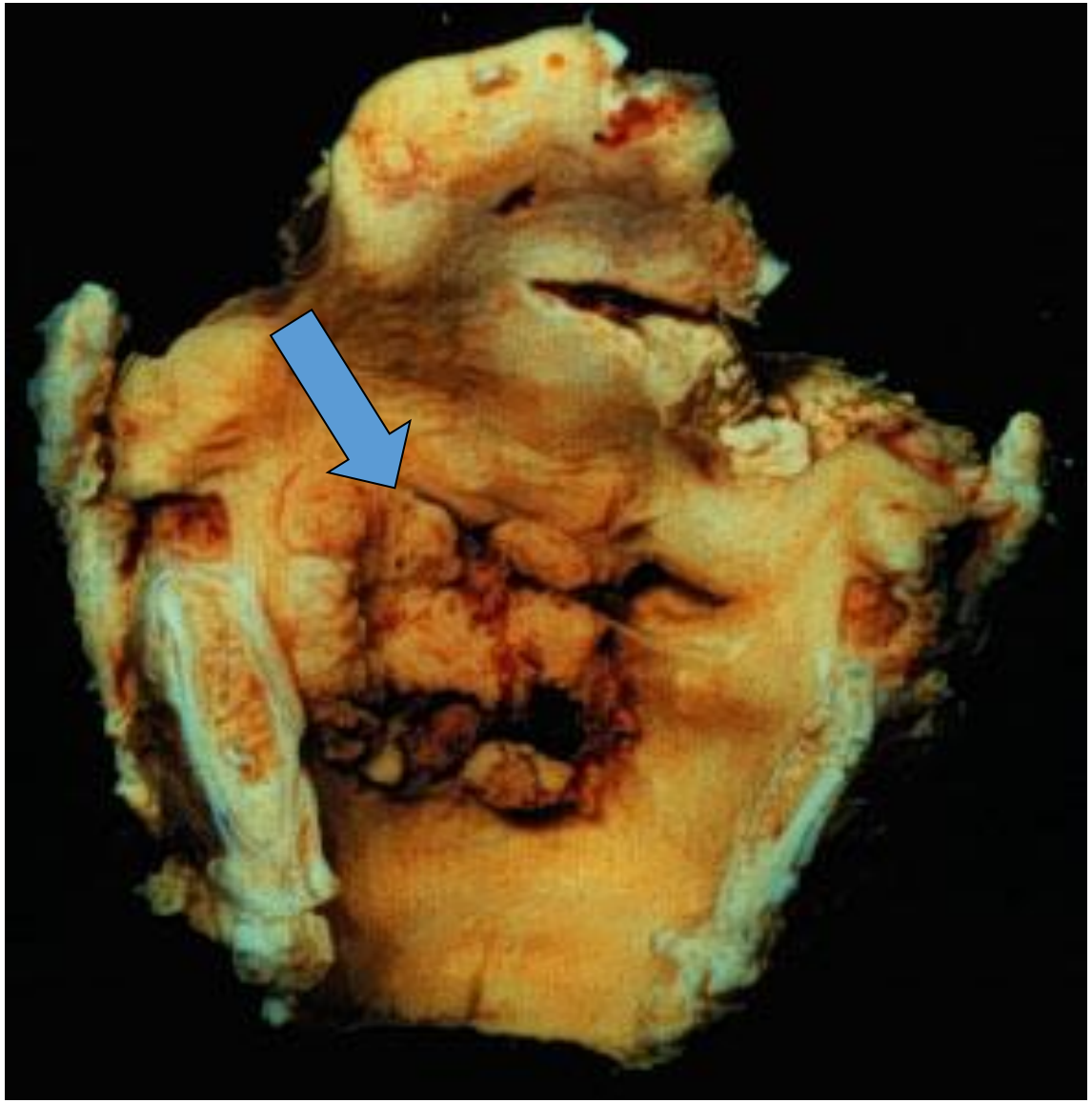
- Types according to the **sites**:

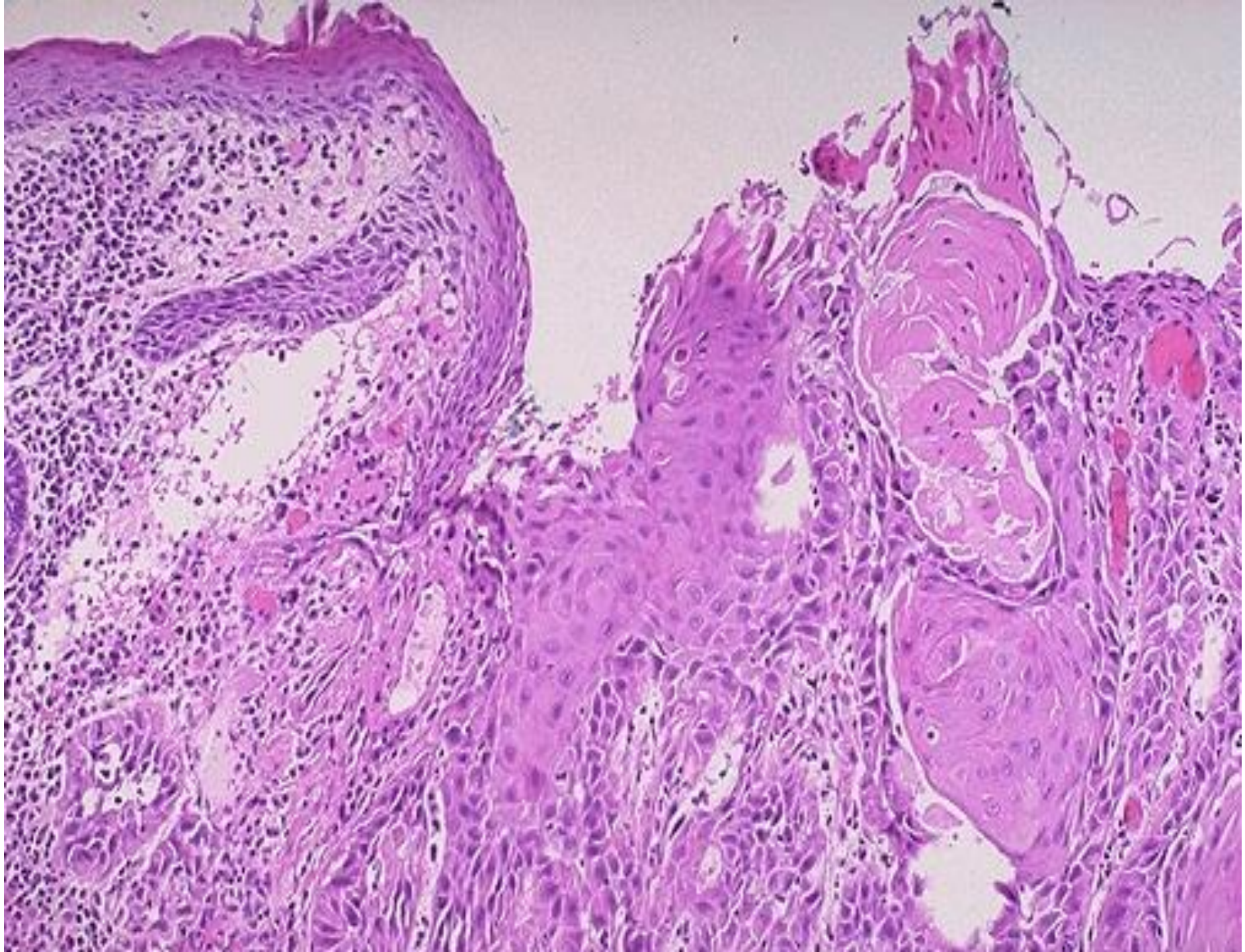
1. **Glottic carcinoma**: (on the vocal cord), 60-70% 0f cases.
2. **supraglottic carcinoma**: above the vocal cord 25%
3. **subglottic**: below the vocal cord less than 5% of cases.

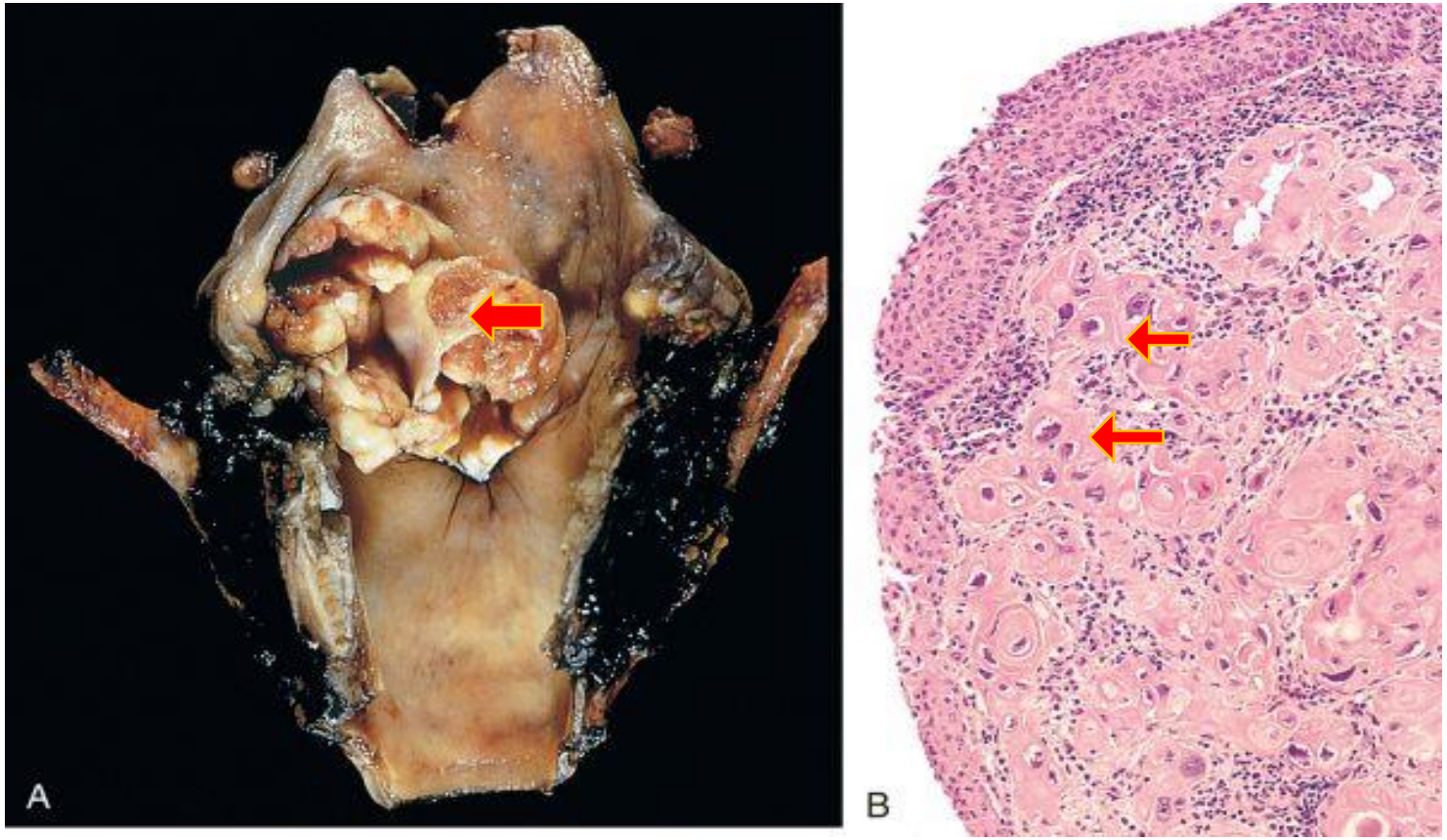
- **Mic.** :the vast majority (95%) are **squamous cell carcinomas,** which started as mucosal hyperplasia, dysplasia & carcinoma in situ .
- **Clinically** The initial manifestation is often persistent **hoarseness of voice** , **dysphagia, and dysphonia**.

Prognosis

- ✓ is directly related to **clinical stage** and **tumor site**
- ✓ **Glottic carcinomas** are **confined to the larynx (good prognosis),** this is due to the fact that this area has sparse lymphatic supply.
- ✓ **Supraglottic carcinomas** in one third of cases showing cervical lymph nodes metastases.
- ✓ **The cause of death is:**
- ✓ infection of the distal respiratory passages or
- ✓ widespread **metastases** and **cachexia.**







A, Laryngeal carcinoma. Note the large fungating lesion involving the vocal cord
B, Histologic appearance of laryngeal squamous cell carcinoma. Note the atypical lining epithelium and invasive keratinizing cancer cells in the submucosa.

Lung

Lung Pathology Outline

- **Congenital anomalies**
- Atelectasis
- Obstructive lung diseases
- Restrictive lung diseases
- Infections
- Carcinoma

•LUNGS

• ***Congenital Anomalies***

• 1-Agenesis or hypoplasia of both lungs, one lung, or single lobes.

• **Pulmonary hypoplasia.** is the defective development of both lungs resulting in: Decreased weight, volume, and acini compared to the body weight and gestational age

• 2-Tracheal and bronchial anomalies (stenosis, tracheoesophageal fistula)

• 3- Vascular anomalies

• 4- Lung cyst

• 5- cystic fibrosis

• Cystic fibrosis

- Cystic fibrosis (CF) is an **inherited disorder , Autosomal recessive** Defect in gene on **chromosome 7.**

- disorder of **exocrine gland function** that involves **multiple organ systems** but mainly results in **chronic respiratory infections, pancreatic enzyme insufficiency,** and associated complications in untreated patients.
- The defect appears in: **ion transport** that affects fluid secretion in exocrine glands and in the epithelial lining of the **respiratory**, **GIT** , and **reproductive tracts**.
- Pulmonary involvement occurs in 90% of patients surviving the neonatal period.
- End-stage lung disease is the principal cause of death.

- **Pathogenesis:**

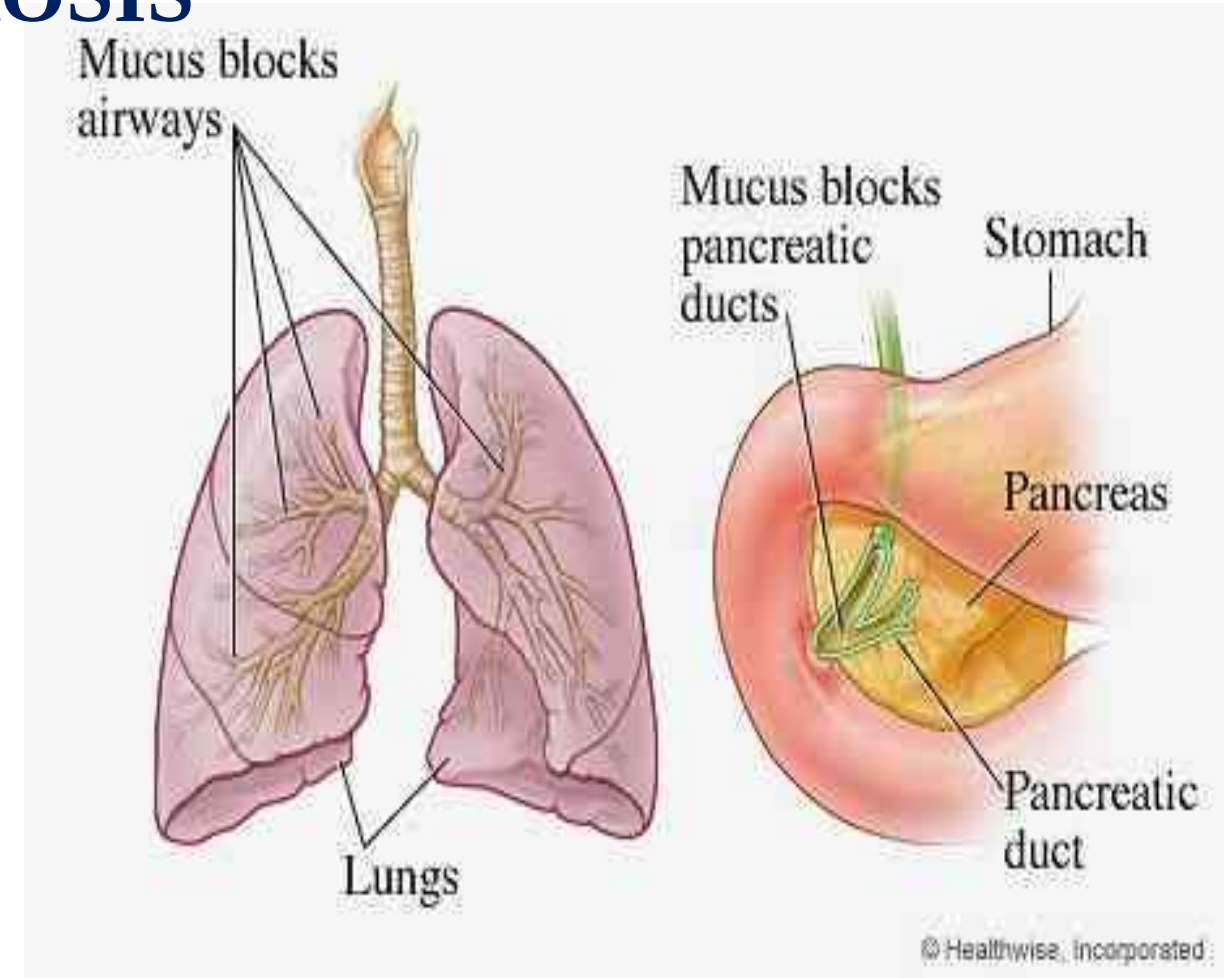
• Gene defect …….…. defect in cystic fibrosis transmembrane conductance regulator (**CFTCR**) ….. reduced chloride permeability across epithelial membrane …. Increase intracellular chloride….increase in sodium …increase in water inside the cells …. increase viscosity of mucus secretion …… obstruction of ducts …… atrophy & infection.

- **the pathogenesis In the lungs**, this dehydration leads to defective mucociliary action and the accumulation of hyperconcentrated, viscid secretions that obstruct the air passages and predispose to recurrent pulmonary infections
- The one exception to this is the **sweat ducts**, *CFTR* mutations; lead to formation of hypertonic fluid with high sodium chloride
- . This is the explanation for the "**salty" sweat** that mothers can often detect in their affected infants.
- **Diagnostic test:** Sweat test: excess sweat chloride and Na .

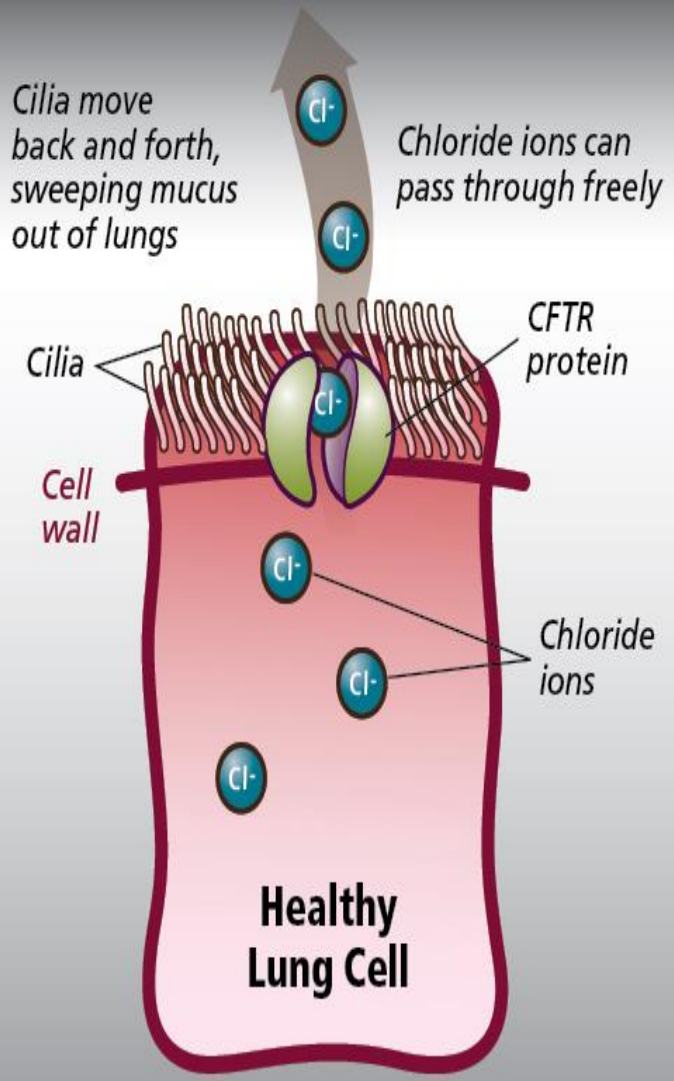
CYSTIC FIBROSIS

AR disease

Defect is of chloride ion transport

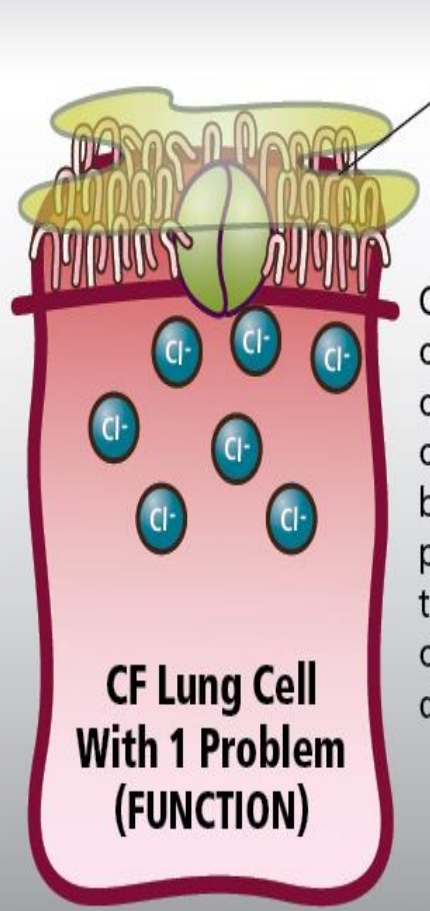


Gene Mutations in Cystic Fibrosis



Normal DNA:

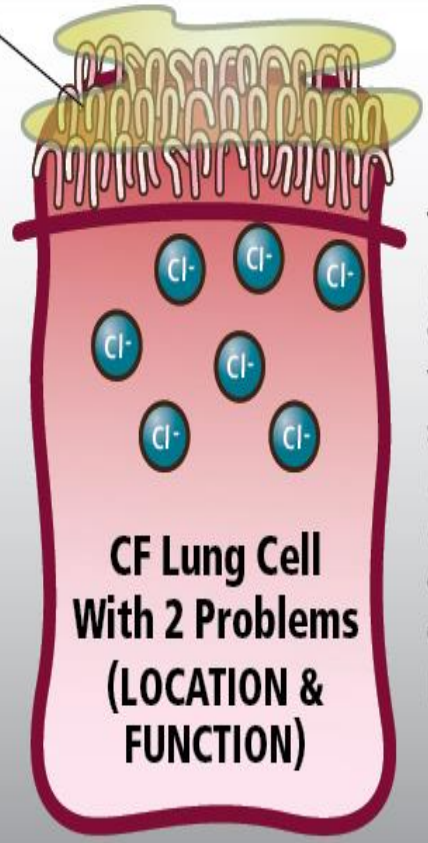
CFTR protein develops normally, reaches the cell surface and becomes an open channel ("door") for chloride ions.



Chloride ions can reach the channel at the cell surface but cannot pass through; this has been called the doorman problem

Door-jamming mutation, including G551D:

The mutation affecting Laura and Cate Cheevers disables function at the cell surface.

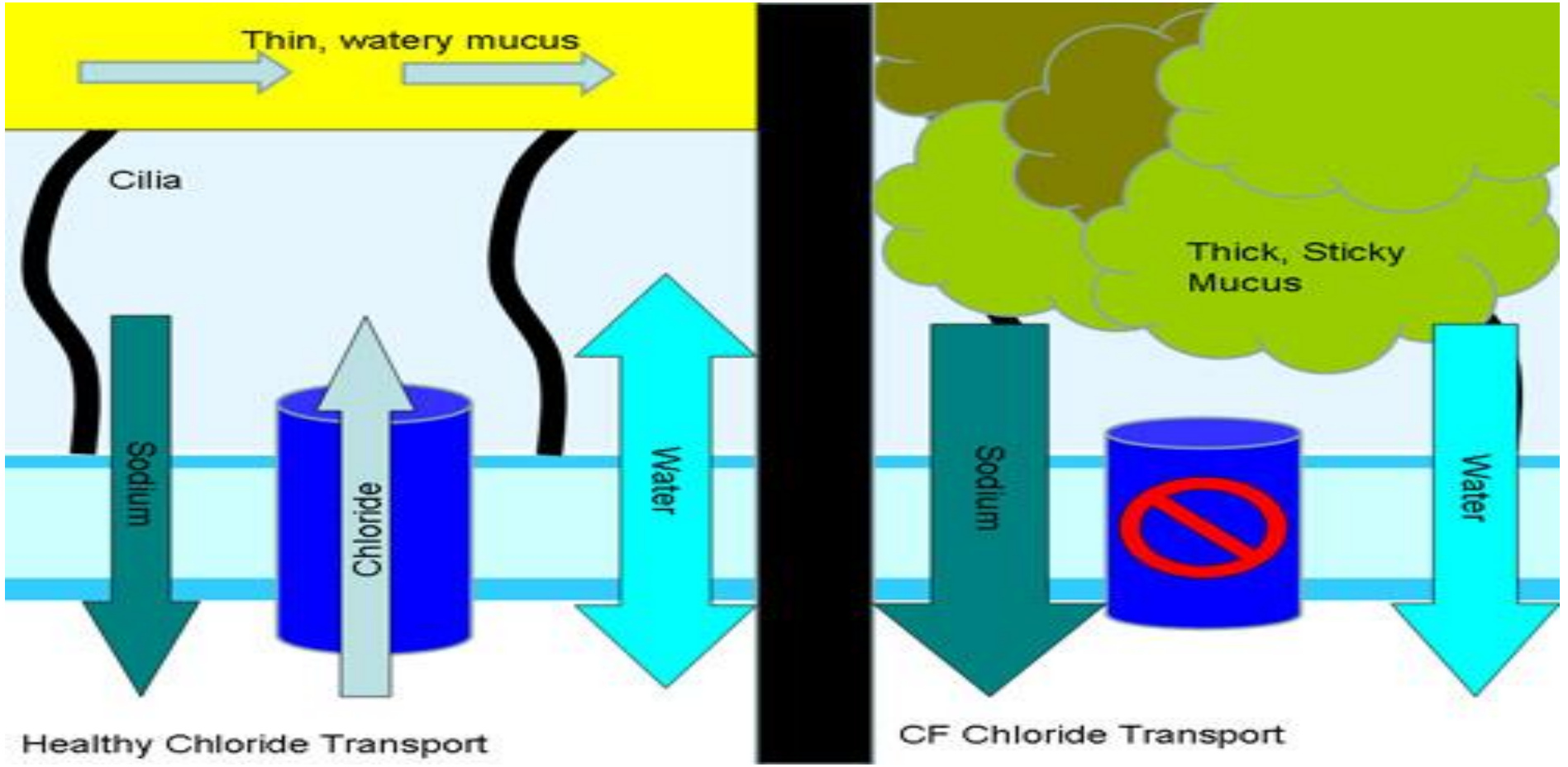


The mutant CF protein needs a corrector drug to boost it to the surface. It also needs a doorman drug to open the channel so that chloride ions can pass through.

Common Delta F508 mutation:

The CFTR protein is made, but it just floats around inside the cell without ever reaching the surface.

A diagram representing the most prevalent theory of the biologic basis of airway disease in cystic fibrosis. Although overly simplified, transport of sodium and chloride across the cell membrane works to maintain the hydration of the airway surface liquid. Loss of CFTR chloride channel function results in increased sodium absorption with passive water absorption. The net result is dehydration of mucus and poor mucociliary clearance.



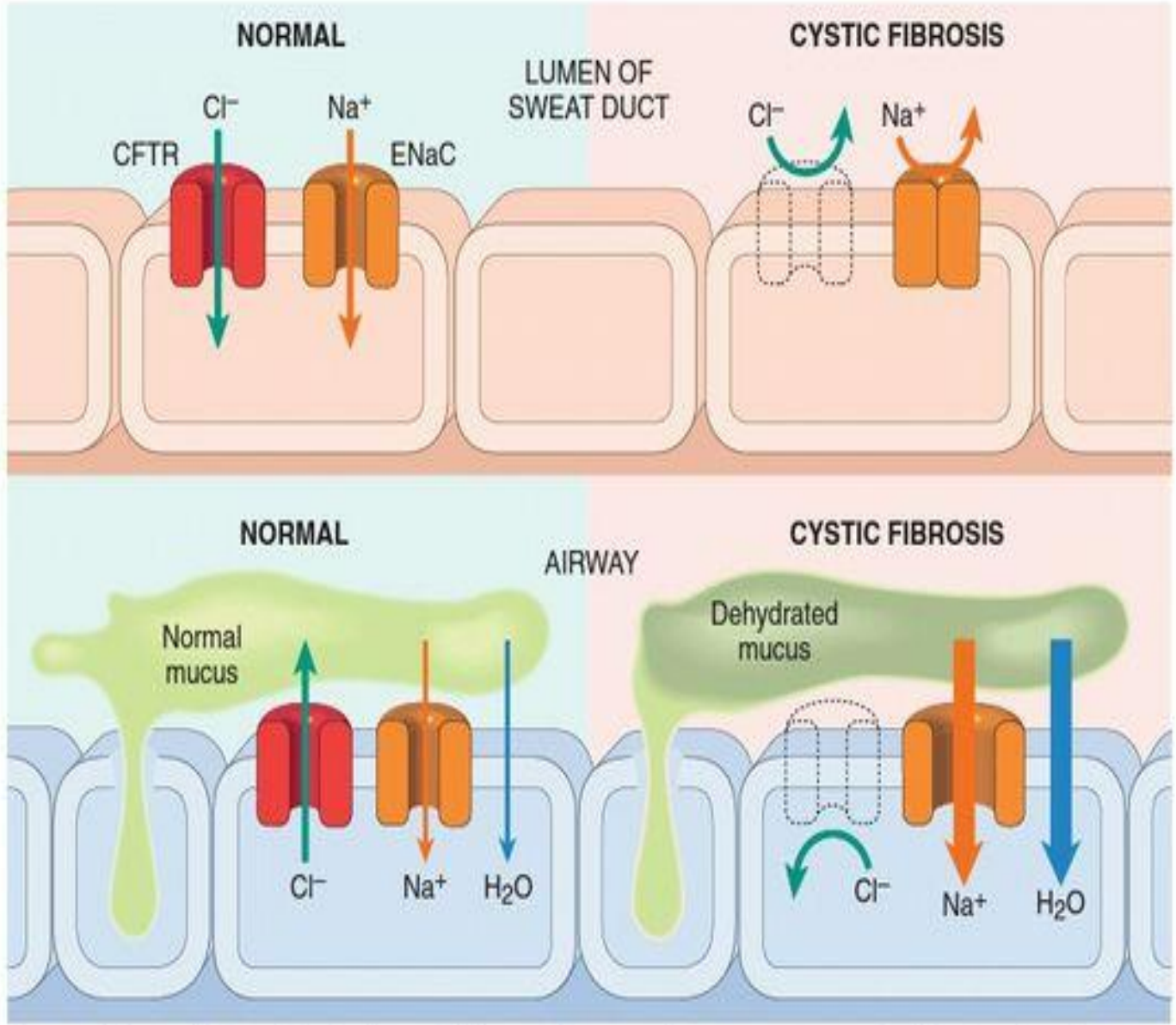


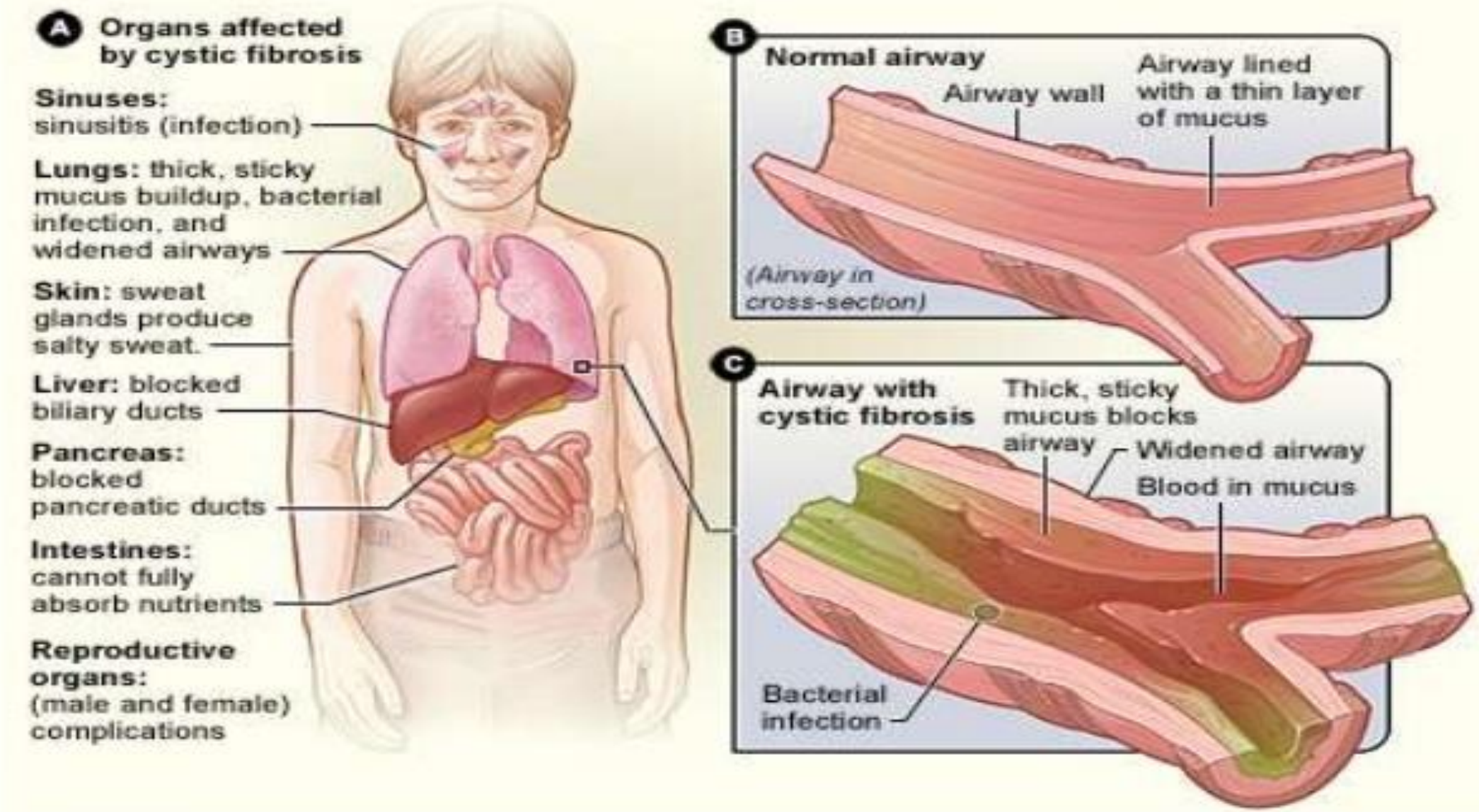
Figure 6–4 Top, In cystic fibrosis (CF), a chloride channel defect in the sweat duct causes increased chloride and sodium concentration in sweat. **Bottom,** Patients with CF have decreased chloride secretion and increased sodium and water reabsorption in the airways, leading to dehydration of the mucus layer coating epithelial cells, defective mucociliary action, and mucous plugging. CFTR, cystic fibrosis transmembrane conductance regulator; ENaC, epithelial sodium channel responsible for intracellular sodium conduction.

- **Complications**:
- abnormally viscous secretions that **obstruct organ passages**, resulting in most of the clinical features of this disorder:

1. Bronchiolitis.
2. Recurrent pneumonia (pseudomonas, staphylococci).
3. Obstruction of bronchi……. Bronchiectasis
4. Obstruction of **biliary system** ……..biliary cirrhosis.
5. Viscid secretion in **intestine**…… meconium ileus.(Thick viscid plugs of mucus found in the small intestine of infants)

- 7-Obstruction of **seminal vesicles**…… Male infertility
- 8- pancreatic duct obstruction …steatorrhea and malabsorption
-

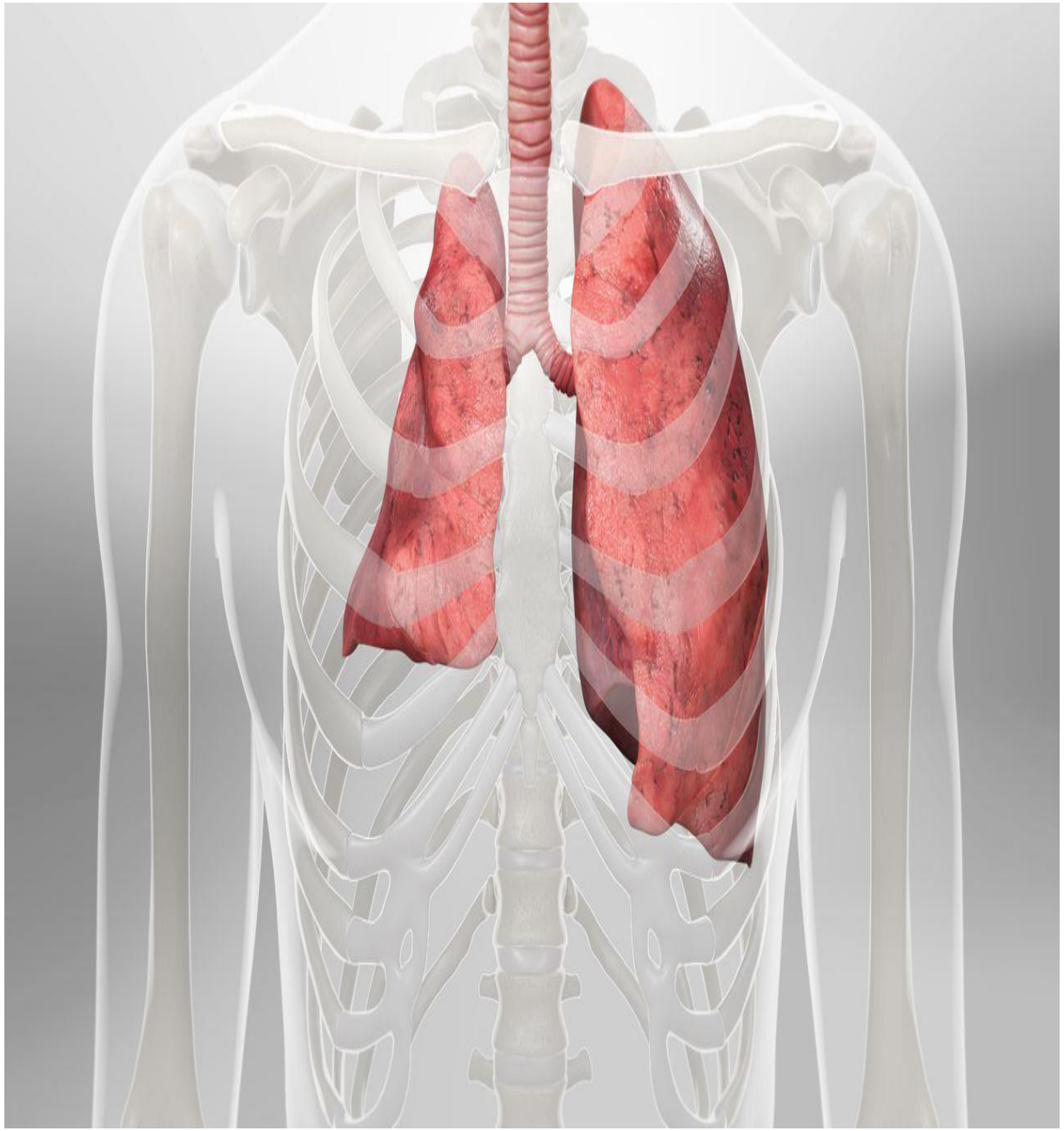
Systems affected by CF

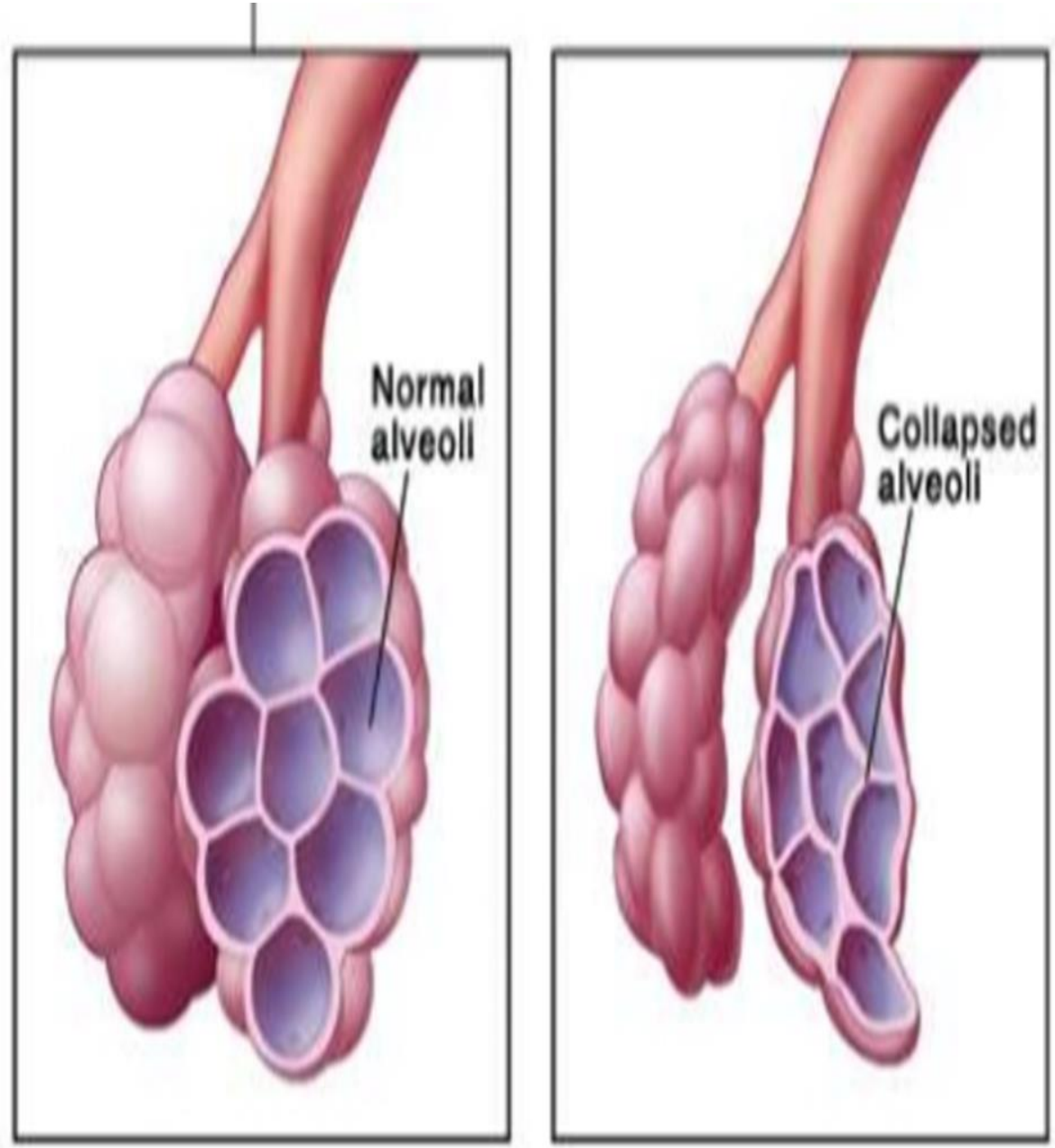


Lung Pathology Outline

- Congenital anomalies
- **Atelectasis**
- Obstructive lung diseases
- Restrictive lung diseases
- Infections
- Carcinoma

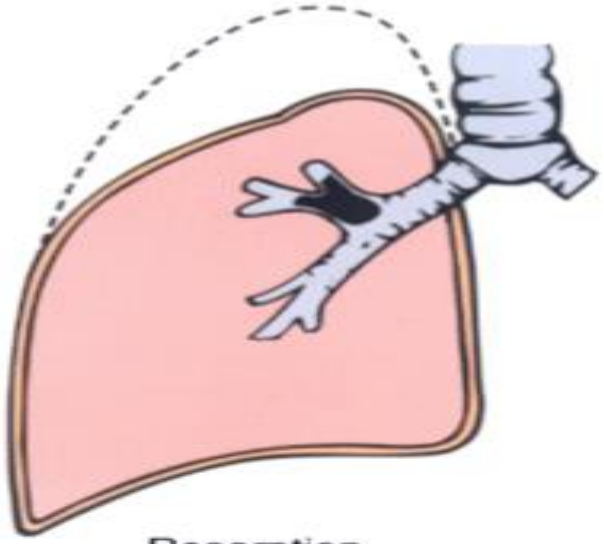
- **Ateletasis(Collapse):**
- **Greek word : incomplete expansion**
- Loss of lung volume caused by **inadequate expansion of airspaces,** associated with shunting of inadequate oxygenated blood from pulmonary arteries into veins…… ventilation / perfusion imbalance & **hypoxia**
- -It is either (**neonatal atelectasis**) (neonatal respiratory distress syndrome due to **loss of surfactant substance….** incomplete expansion of the lungs **)**
- -or (**acquired atelectasis :**collapse of previously inflated lung).



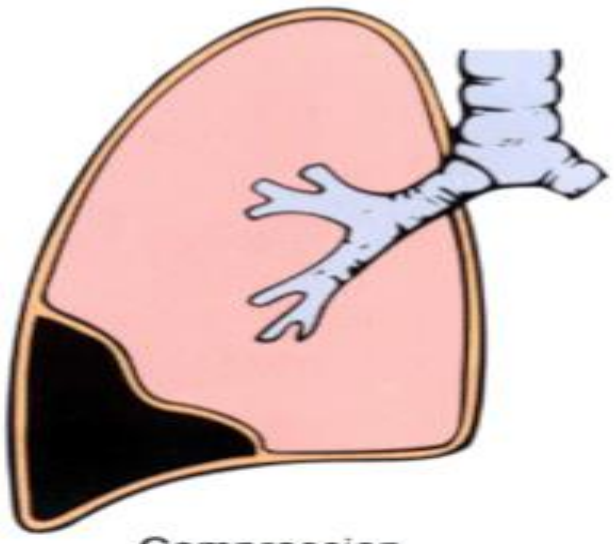

Normal alveoli
Collapsed alveoli

ATALECTASIS

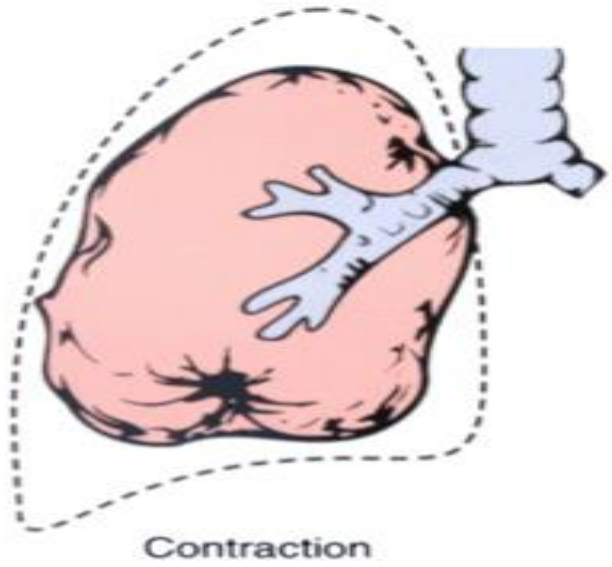
- **INCOMPLETE EXPANSION**
- **COLLAPSE**



Resorption



Compression



Contraction

- **The main types of acquired atelectasis**, which occur in adults, are the followings:
- **1- Resorption atelectasis**
- -occurs when an **obstruction** prevents air from reaching distal airways.
- -The air already present distally gradually absorbed, followed by alveolar collapse.
- Depending on the level of airway obstruction,
- an entire lung, a complete lobe, or a segment may be involved.

The most common cause of obstruction collapse is:

- **1-Postoperative collapse** (mucopurulent plug obstruct the bronchi), this is the most important cause.

2-Complicated **asthma.**

3- Bronchiectasis.

4-Chronic bronchitis.

5-Foreign body aspiration.

6-bronchogenic carcinoma.

7-Tuberculous lymph node.

- 2- **Compression atelectasis** is usually associated with accumulation of (fluid, blood, or air) within the pleural cavity.
- **Causes:**
- A- Congestive heart failure.
- B- Leakage of air into the pleural cavity (pneumothorax)

- 3- **Basal atelectasis** resulting from a failure to breathe deeply commonly occurs in :
- 1-bedridden patients,
- 2-in patients with ascites,
- 3-and during and after surgery.

- **4- Contraction atelectasis** : occurs when local or diffuse **fibrosis** affecting the lung or the pleura, in these situations, there is interference with normal lung expansion
- Atelectasis **(except when caused by contraction) is reversible**
- It should be **treated quickly** to prevent hypoxemia and infection of the collapsed lung.


Thank you