

PATHOLOGY OF THE REPIRATORY SYSTEM

LEC 1

Dr. Raghad Hanoon

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

Conducting Passages

Upper Respiratory Tract

Nasal Cavity

Pharynx

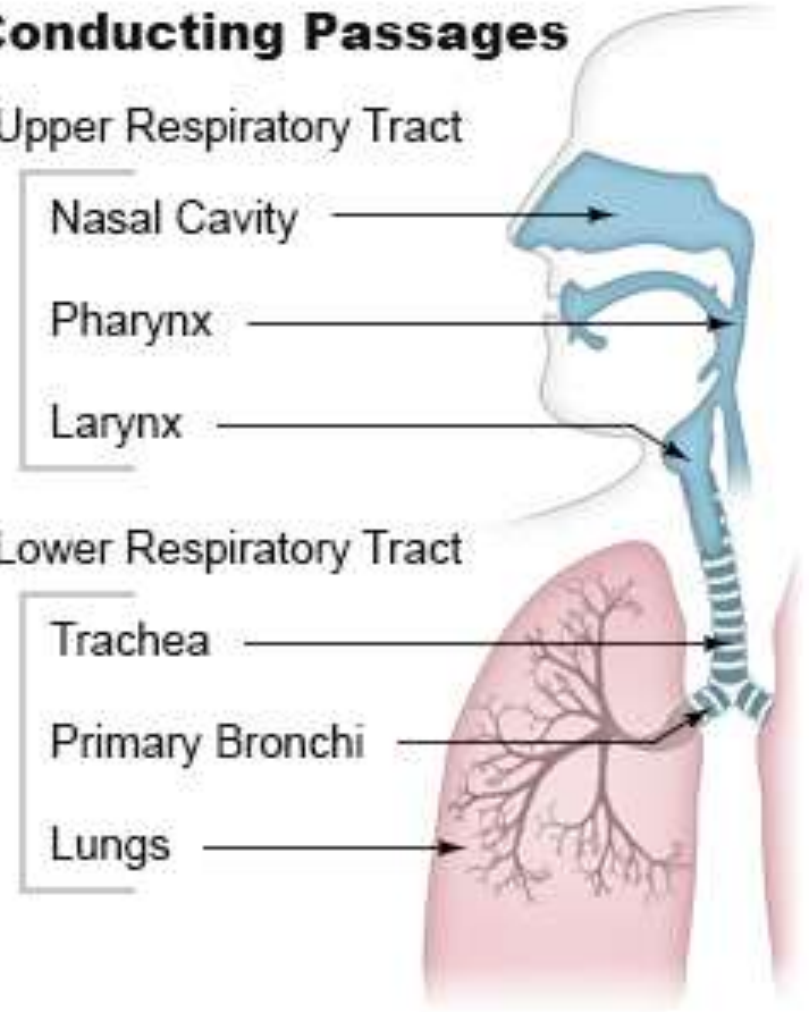
Larynx

Lower Respiratory Tract

Trachea

Primary Bronchi

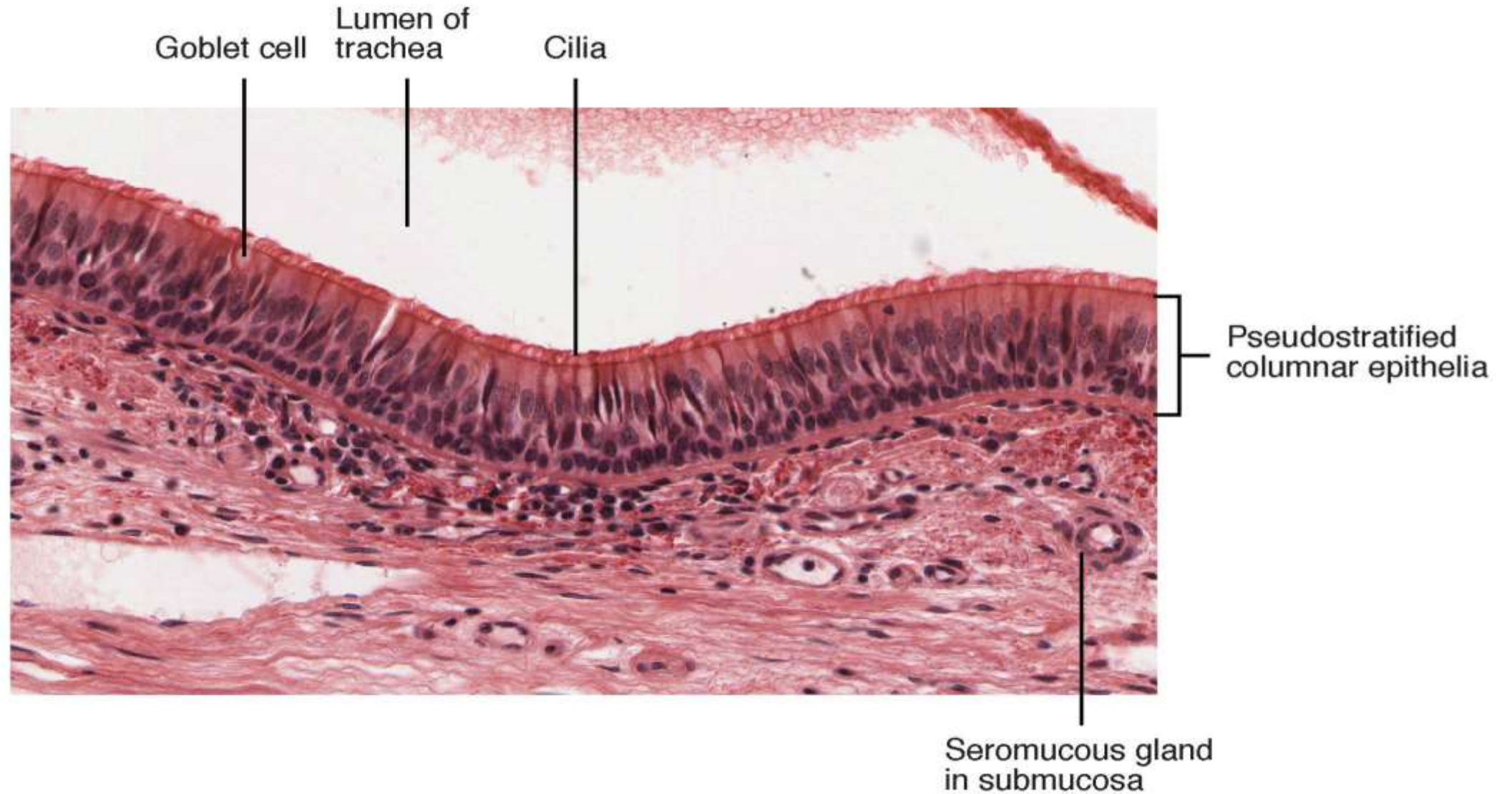
Lungs



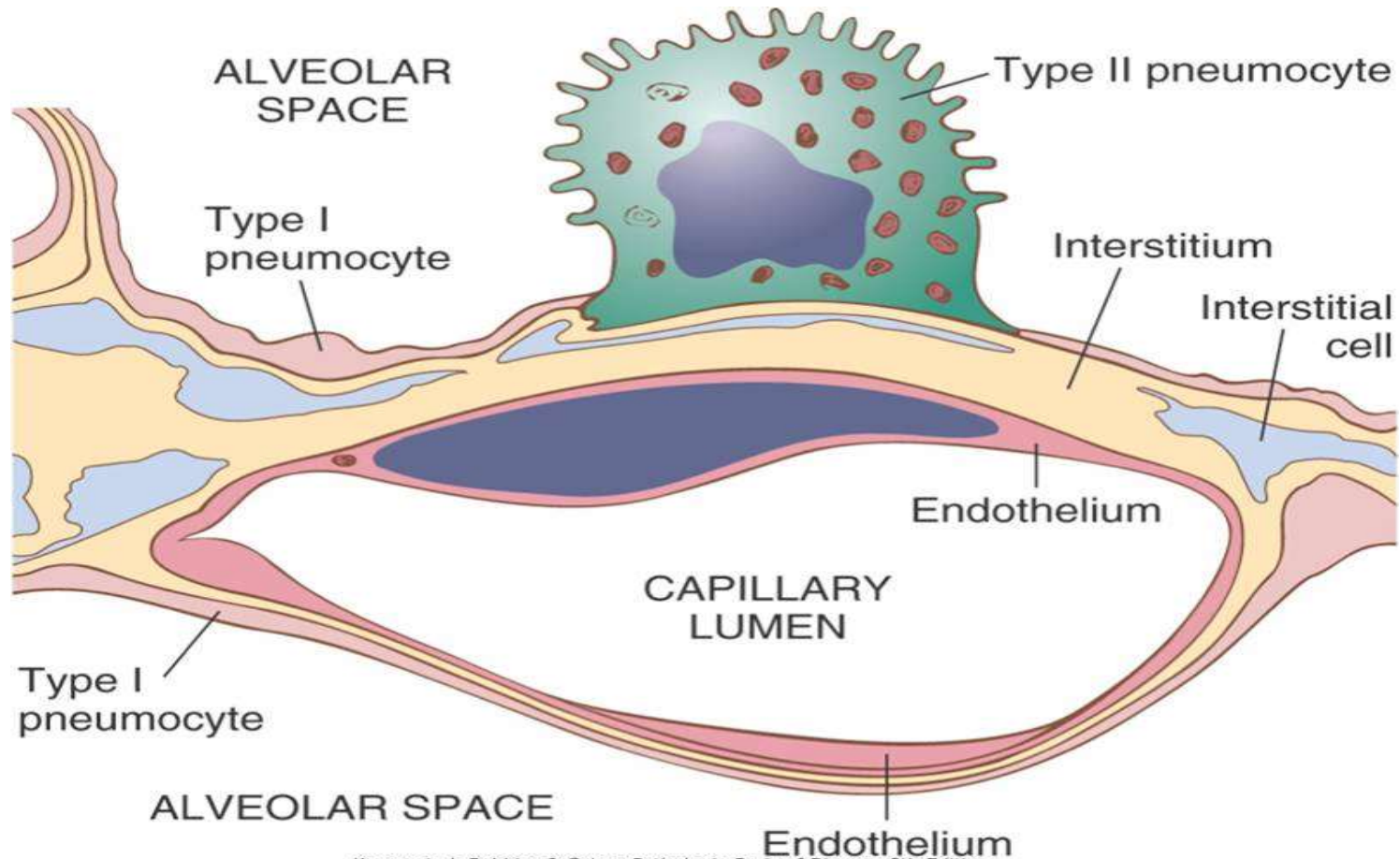
Histology

- **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

RESPIRATORY EPITHELIUM



The wall of Alveolus

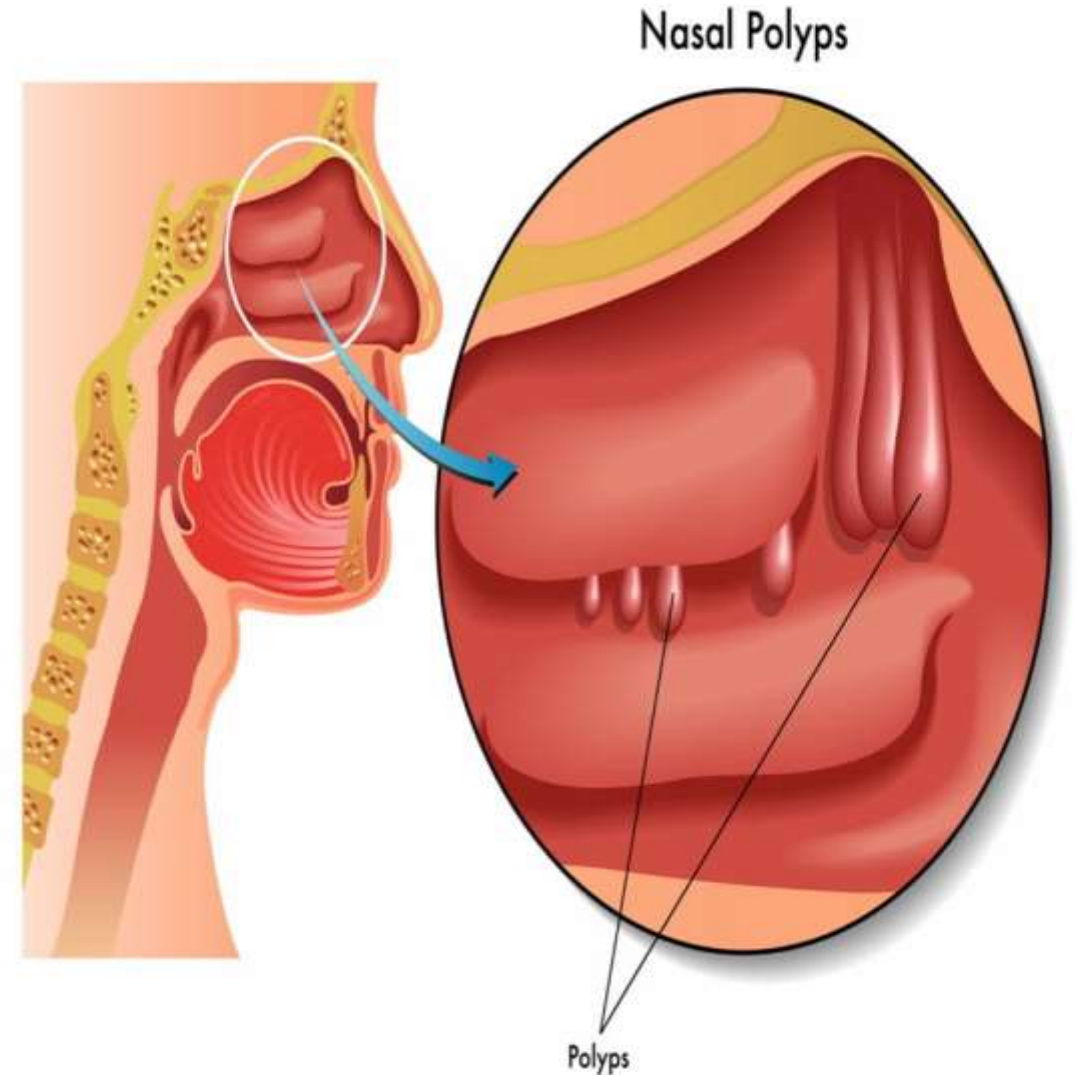


Infections of upper respiratory tract:

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

Nasal polyps:

- It is focal protrusion of the mucosa, secondary to recurrent attacks of rhinitis.
- Not true neoplasms, they are associated with inflammation and allergy.
- Generally, they are multiple, and nearly always bilateral.



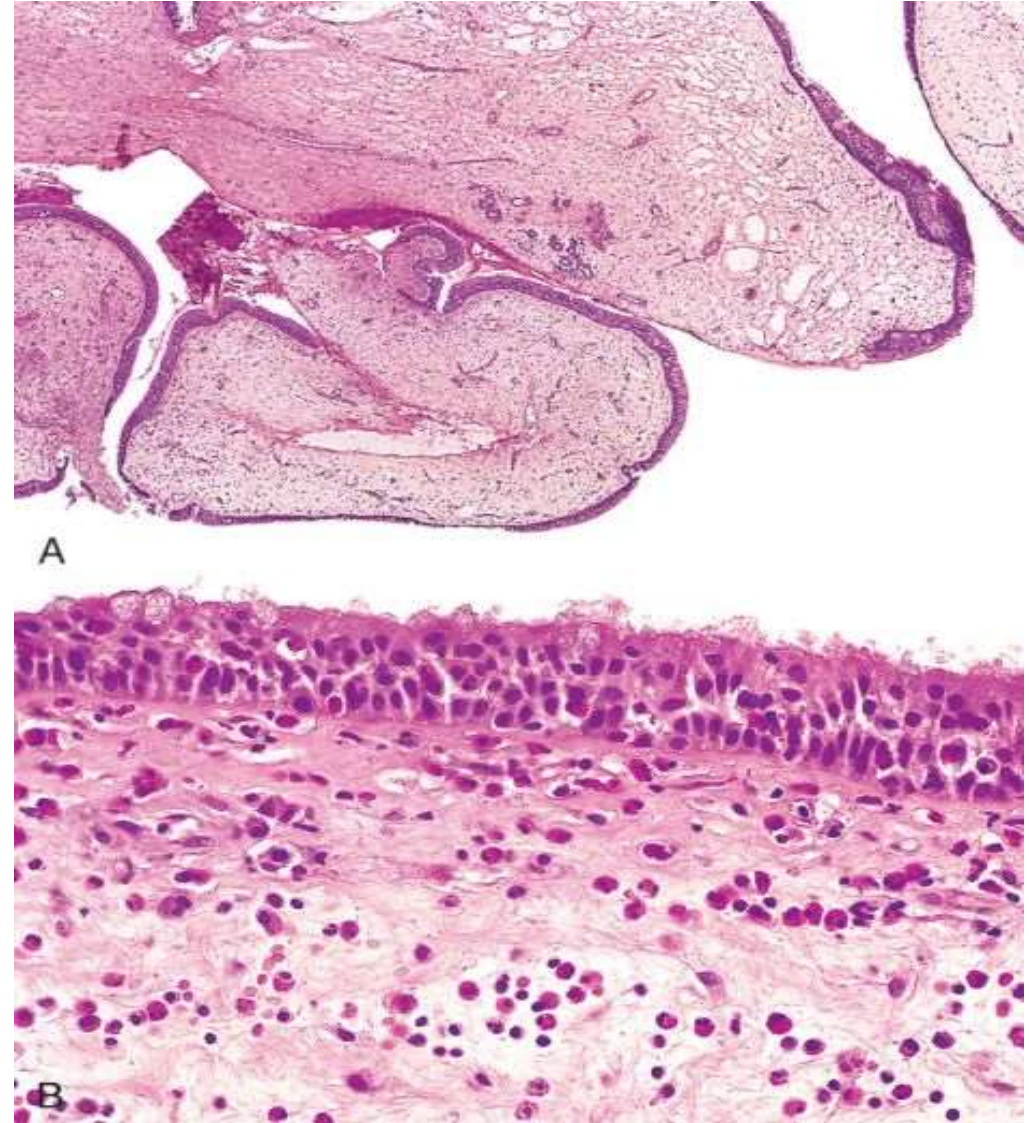
- **Microscopically:**

- Consists of **edematous stroma**, **hyperplastic or cystic mucous glands**, and infiltrated by variety of **inflammatory cells** including neutrophils, eosinophils, and plasma cells with occasional clusters of lymphocytes **lined by respiratory epithelium**

- **Complications:**

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

2-It may become ulcerated or infected.



A -Low-power magnification showing **edematous masses lined by epithelium**.
B, High-power view showing edema and **eosinophil-rich** inflammatory infiltrate.

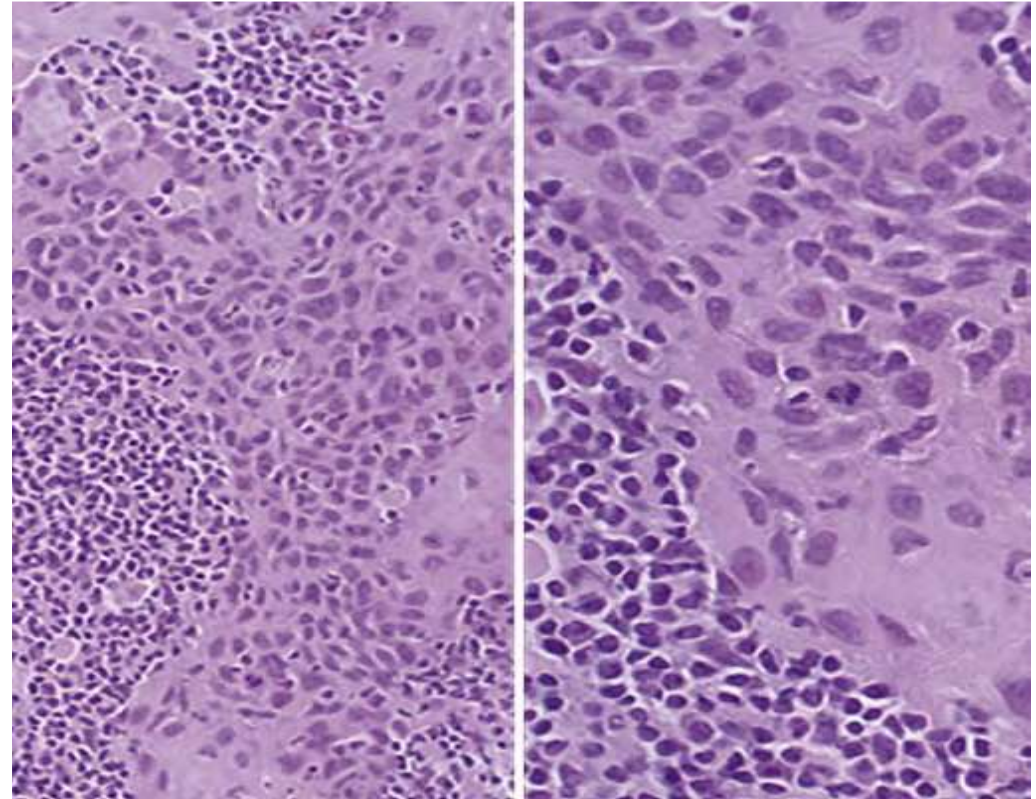
Tumors of nasal cavity

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 one most closely linked with EBV, characterized by **syncytial growth 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

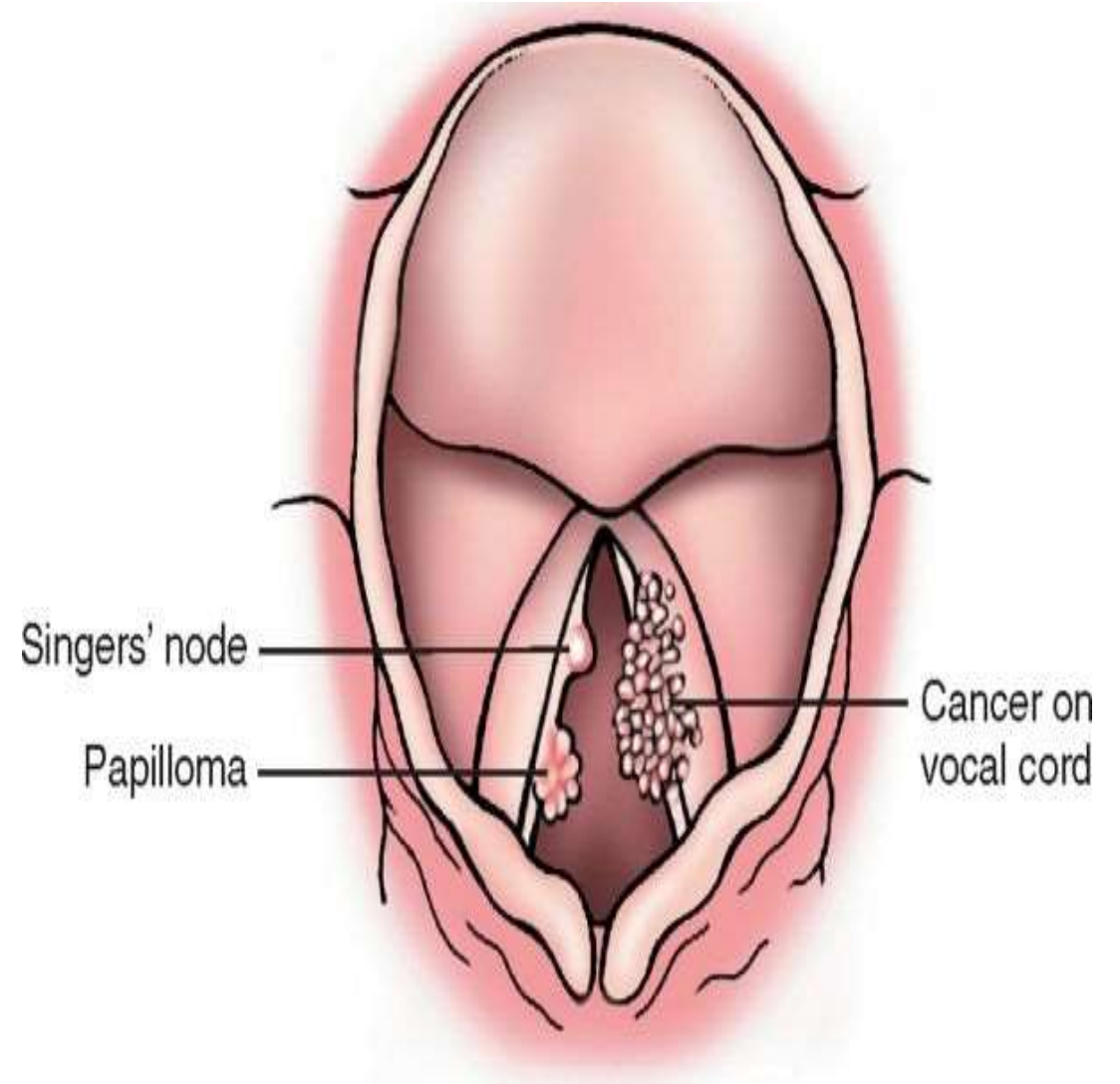
LARYNGEAL TUMORS

❖ Benign Lesions :

- *Vocal cord nodules*
- *Laryngeal papilloma (squamous papilloma) of the larynx*

❖ Malignant Lesions :

- *Carcinoma of the Larynx*



❖ Benign Lesions :

1- Vocal cord nodules (Reactive, Laryngeal nodules)

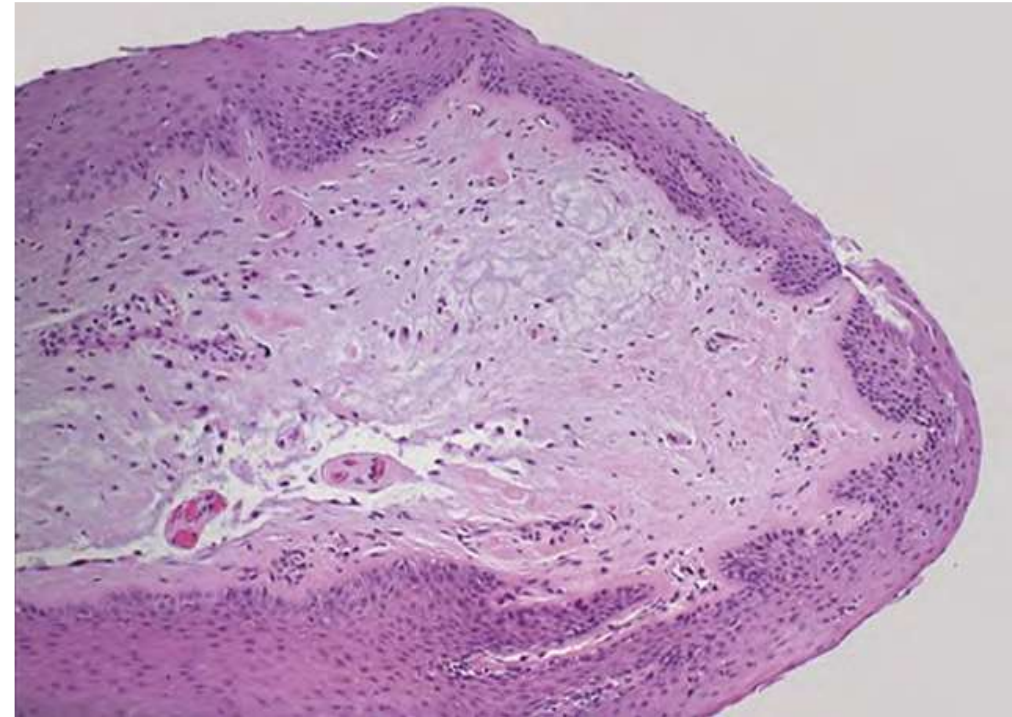
- Are **NOT** a neoplasm but smooth rounded protrusions
- Usually **less than 0.5 cm** in diameter
- Located on the **true vocal cords**.
- Composed of **fibrous tissue** and covered by stratified squamous **mucosa**.
- Occur chiefly in **heavy smokers** or in individuals who impose great strain on their 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**.

Vocal cord nodules (Reactive, Laryngeal nodules)



Grossly:

It is a small nodule at the vocal cord (localized swellings) are pale and translucent or bluish in colour.



Microscopically:

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

2- Laryngeal papilloma (squamous papilloma) of the larynx:

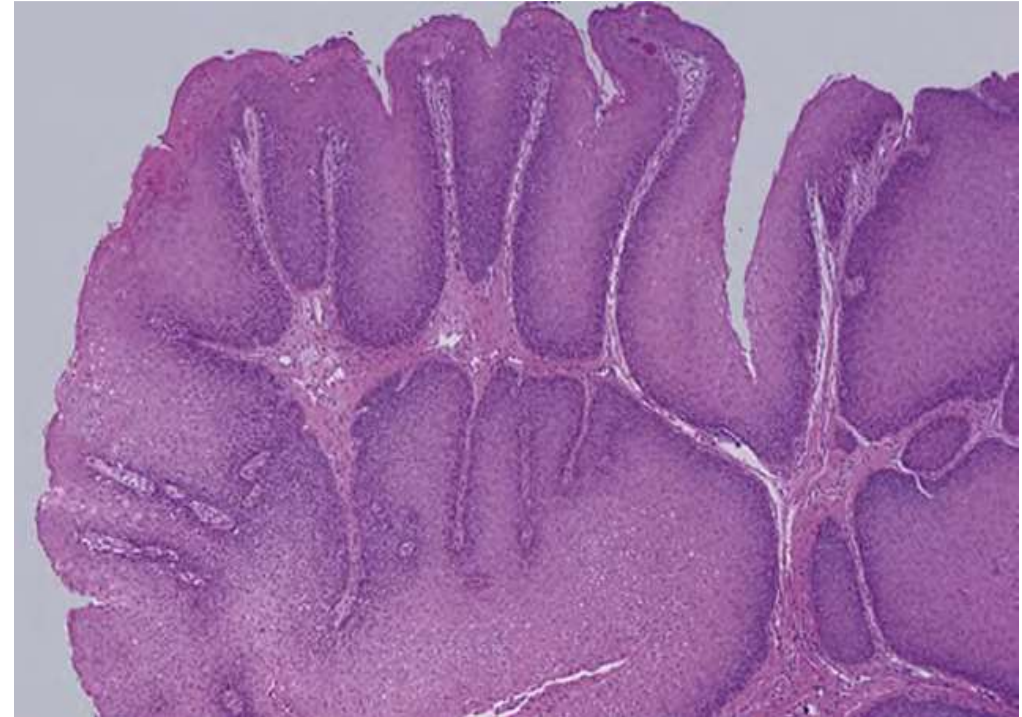
- Are **benign neoplasms**
- Usually located on **the true vocal cords**
- Papillomas are **usually solitary in adults** but are often **multiple in children**, a condition referred to as **juvenile laryngeal papillomatosis**.
- The lesions are caused *by HPV types 6 and 11*.
- They **DO NOT** become malignant, but **frequently recur**.
- They often spontaneously **regress at puberty**.
- The regularity of recurrence requires some children to undergo numerous surgeries.

Laryngeal papilloma (squamous papilloma) of the larynx:



Grossly:

soft, **raspberry-like mass** rarely more than 1 cm in diameter.



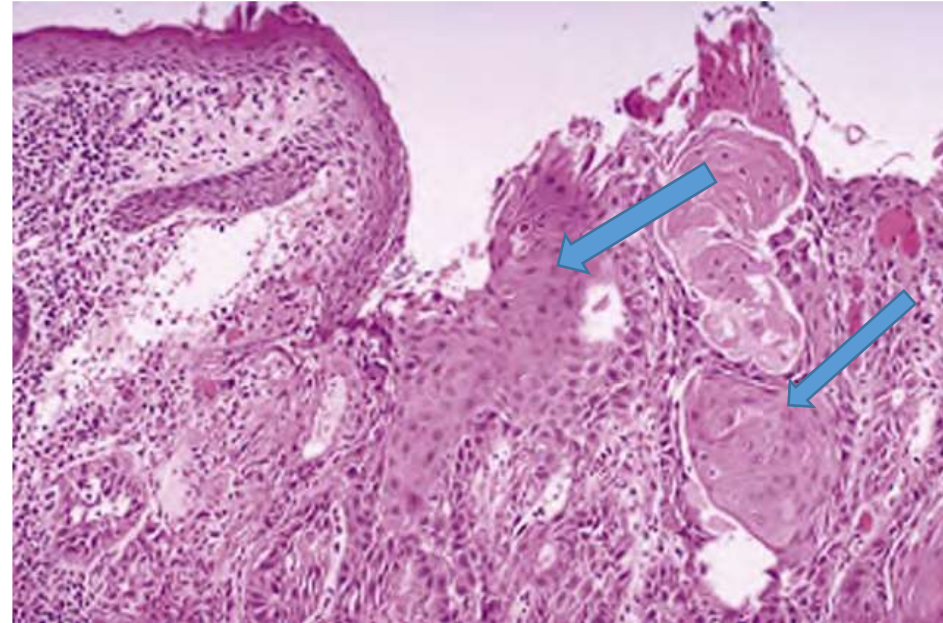
Microscopically:

Multiple slender, finger-like projections supported by central fibrovascular cores and covered by an orderly stratified squamous epithelium.

❖ 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.
- **Clinically** The initial manifestation is often **persistent hoarseness of voice , dysphagia, and dysphonia.**
- Types according to the sites:
 1. **Glottic carcinoma:** (on the vocal cord), 60-70% of cases.
 2. **Supraglottic carcinoma:** above the vocal cord 25%
 3. **Subglottic:** below the vocal cord less than 5% of cases.

Morphology malignant carcinoma of larynx



➤ **Grossly:** Fungating mass but may cause focal thickenings, or ulcerated lesions.

Note the large fungating lesion involving the vocal cord.

➤ **Microscopically:** The vast majority (95%) are **squamous cell carcinomas**, which started as mucosal hyperplasia, dysplasia & carcinoma in situ. **Note the atypical lining epithelium and invasive keratinizing cancer cells in the submucosa.**

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.

Lung Pathology Outline

- **Congenital anomalies**
- **Atelectasis**
- **Acute respiratory distress syndrome**
- **Diffuse lung diseases**
- **Pulmonary disease of vascular origin**
- **Infections**
- **Lung tumors**

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.
- End-stage lung disease is the principal cause of death.

- **Pathogenesis:**

- Gene defect → defect in cystic fibrosis transmembrane conductance regulator (**CFTR**) → 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 .

- **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)

6. Obstruction of **seminal vesicles**..... Male infertility

7. **pancreatic duct obstruction** ...steatorrhea and malabsorption

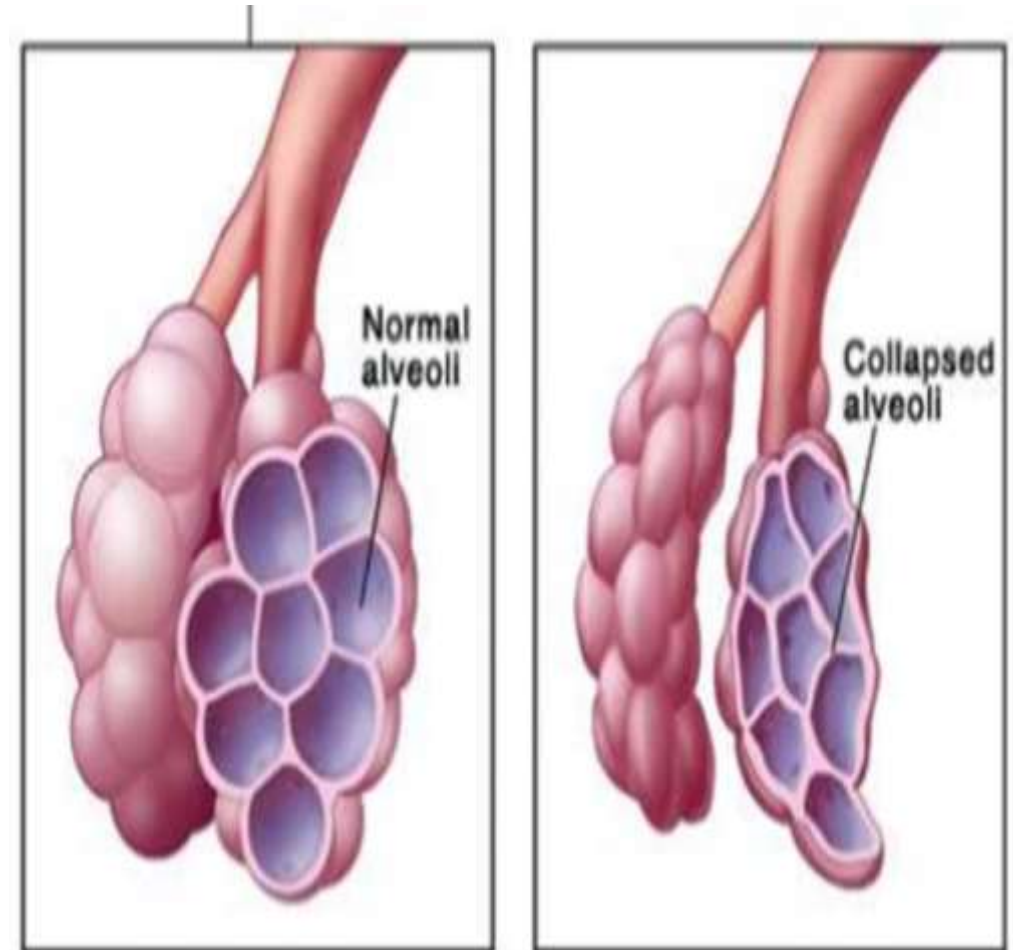
Lung Pathology Outline

- Congenital anomalies
- **Atelectasis**
- Acute respiratory distress syndrome
- Diffuse lung diseases
- Pulmonary disease of vascular origin
- Infections
- Lung tumors

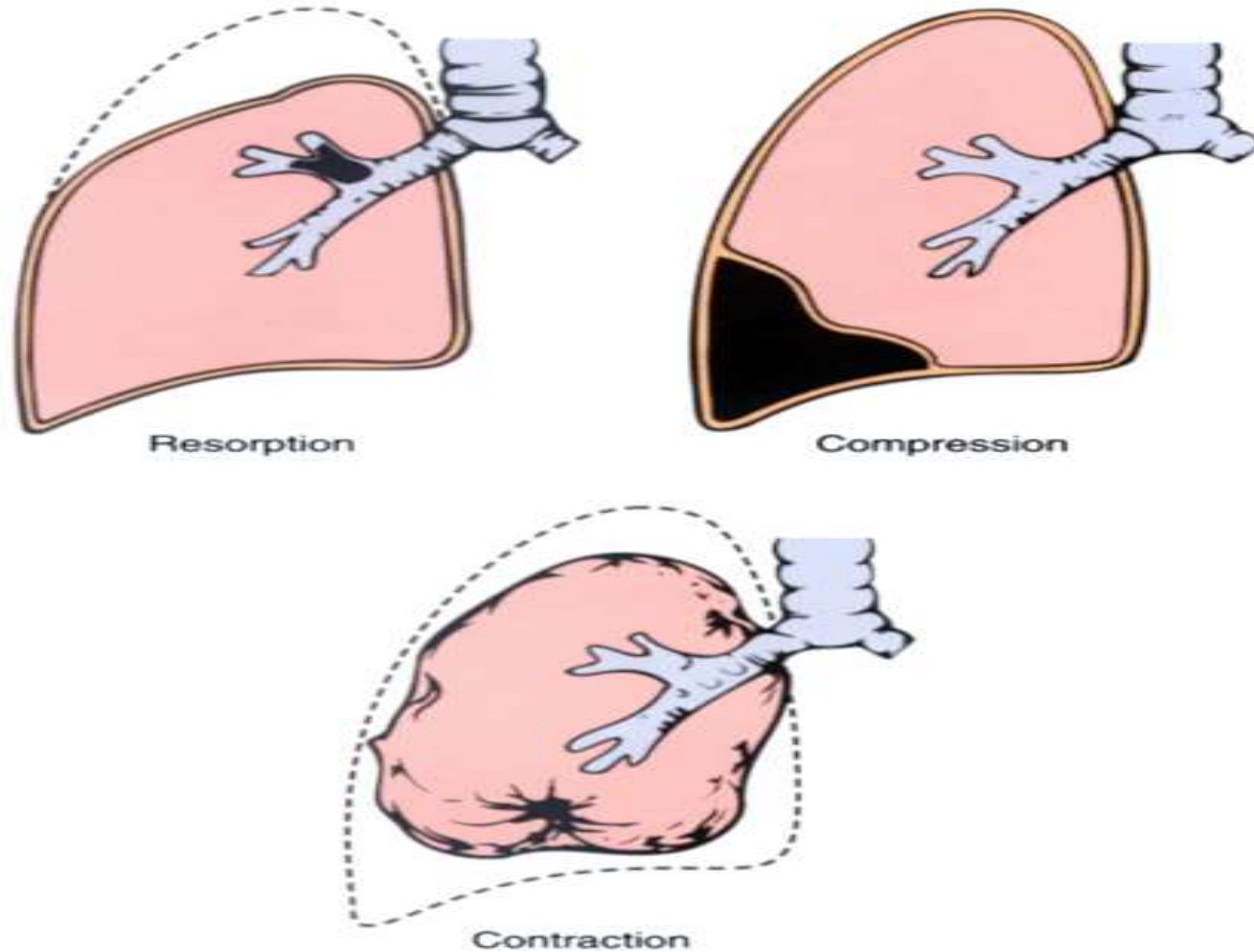
❖ **Ateletasis (Collapse):**

- 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.

Ateletasis



The main types of acquired atelectasis



- **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 (particularly in children).

6- Intrabronchial tumor.

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)

- **Basal atelectasis** resulting from a failure to breathe deeply commonly occurs in :

1- Bedridden patients,

2- In patients with ascites,

3- During and after surgery.

3- 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.

Lung Pathology Outline

- Congenital anomalies
- Atelectasis
- **Acute respiratory distress syndrome**
- Diffuse lung diseases
- Pulmonary disease of vascular origin
- Infections
- Lung tumors

Acute Respiratory Distress Syndrome (ARDS)

- A clinical syndrome of progressive respiratory insufficiency caused by diffuse alveolar damage
- **Clinically:** It is characterized by
 1. Acute onset of **dyspnea**.
 2. **Hypoxemia** (refractory to O₂ therapy).
 3. Development of **bilateral pulmonary infiltrates on radiographs**.
 4. **Absence of clinical evidence of primary left-sided heart failure**.
- The condition may progress to multisystem organ failure.
- Represent the most common cause of noncardiogenic pulmonary edema.

The clinical setting associated with ARDS include::

A. Respiratory

1. Diffuse infections (viral, bacterial)
2. Aspiration
3. Inhalation (toxic gases, near drowning)
4. O₂ therapy

B. Non-respiratory

1. Sepsis (septic shock)
2. Trauma (with hypotension)
3. Burns
4. Pancreatitis
5. Ingested toxins

Pathogenesis

- The alveolar capillary membrane is formed by two separate barriers -the microvascular endothelium and the alveolar epithelium.
- **In ARDS** there is **damage to alveolar capillary membrane** by either endothelial or epithelial injury, or, more commonly, both. this leads to; **Increased vascular permeability, loss of diffusion capacity of the gasses and widespread surfactant abnormalities caused by damage to type II pneumocytes.**
- Most work suggests that ARDS stems from an inflammatory reaction initiated by a variety of pro-inflammatory mediators, which causes the endothelial damage.
- **Following the insult**, there is **increased synthesis of a potent neutrophil chemotactic and activating agents IL-8 & TNF by pulmonary macrophages.** The recruited activated neutrophils **release oxidants, proteases**, ect. That cause damage to the alveolar epithelium leading to loss of surfactant that interferes with alveolar expansion.

Morphology of ARDS:

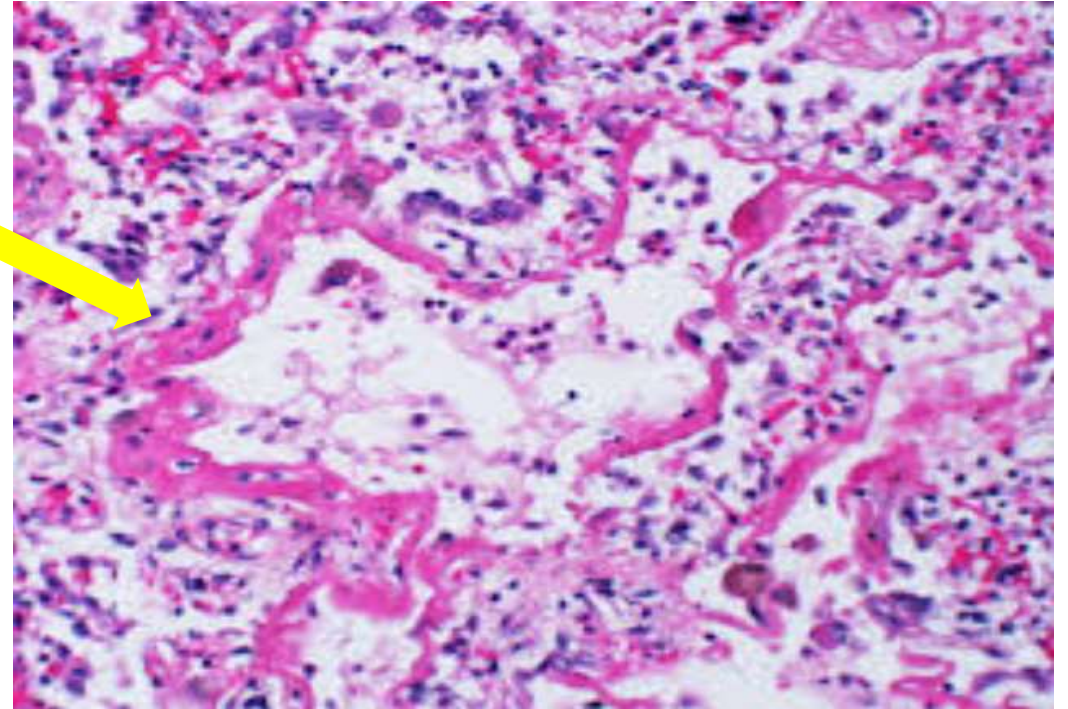


Gross appearance of lungs resemble the liver; they are dark red, firm, airless.

Microscopically:

➤ In acute exudative phase:

- Capillary **congestion**,
- **Necrosis** of alveolar epithelial cells,
- Interstitial and intraalveolar **edema** and hemorrhage, and (particularly with sepsis) collections of neutrophils in capillaries.
- The most characteristic finding is **hyaline membranes formation, particularly lining the distended alveolar ducts** such membranes consist of protein-rich edema fluid admixed with remnants of necrotic epithelial cells.



➤ In the organizing stage:

- Marked regenerative **proliferation of type II pneumocytes**, organization of the fibrin exudates (this eventuates in **intra- alveolar fibrosis**) and **marked fibrotic thickening of the alveolar septa**.

THANK YOU