MEDICAL EDUCATION RESOURCE

Facts to Remember & Clinicoanatomical Problems

Facts to Remember — Lungs

- Each lung is a **conical, spongy, elastic organ** situated in its own pleural cavity.
- The **right lung** is **larger, shorter, and wider** than the left because of the **liver below** and has **three lobes** (upper, middle, lower).
- The **left lung** is **smaller and narrower** due to the presence of the **heart**, has **two lobes** (upper and lower), and a **cardiac notch** with a **lingula**.

- **Apex of lung**: projects into the root of the neck, about **2.5 cm above the medial 1/3 of the clavicle**.
- **Base of lung**: rests on the **diaphragm**.
- **Costal surface**: convex, related to ribs and intercostal muscles.
- **Medial surface**: concave, related to mediastinum, heart, and great vessels.

- **Borders of lung:**
  - **Anterior border:** thin and sharp; left lung has the **cardiac notch** here.
  - **Posterior border:** thick and rounded, corresponding to **vertebral column**.
  - **Inferior border:** separates the base from the costal and medial surfaces.

- **Right lung lobes:**
  - **Superior lobe** — above horizontal fissure.
  - **Middle lobe** — between horizontal and oblique fissures.
  - **Inferior lobe** — below oblique fissure.
- **Left lung lobes:**
  - **Superior lobe** — includes the **lingula**.
  - **Inferior lobe** — below oblique fissure.

- **Fissures of lungs:**
  - **Right lung:** oblique and horizontal.
  - **Left lung:** only oblique fissure.
- **Cardiac notch:** indentation on the anterior border of the **left lung** below the **4th costal cartilage**.
- **Lingula:** tongue-like projection of the **upper lobe of left lung**, homologous to the **middle lobe of the right lung**.

- **Root of lung** contains:
  - 1 bronchus (right has 2 — eparterial and hyparterial).

    - 1 pulmonary artery.
    - 2 pulmonary veins.
    - Bronchial vessels, lymph nodes, and nerves.

- **Arrangement (Right Lung):** Bronchus – Artery – Bronchus – Veins (**B-A-B-V**).
- **Arrangement (Left Lung):** Artery – Bronchus – Veins (**A-B-V**).

- **Bronchial tree hierarchy:**
  Trachea ? Principal bronchus ? Lobar bronchus ? Segmental bronchus ? Terminal bronchiole ? Respiratory bronchiole ? Alveolar duct ? Alveolus.
- Each lung has **10 bronchopulmonary segments**, each aerated by an individual **segmental bronchus** and supplied by a **segmental artery**.
  These segments are **functionally and surgically independent**.

- **Histology:**
    - **Bronchi:** pseudostratified ciliated columnar epithelium with cartilage and glands.
    - **Bronchioles:** simple columnar to cuboidal, no cartilage or glands.
    - **Alveoli:** lined by **Type I and Type II pneumocytes**.
    - **Type II cells** secrete **surfactant**, which **reduces surface tension** and **prevents alveolar collapse**.

- **Developmental origin:**

- **Endoderm:** epithelium of airways and alveoli.
- **Splanchnic mesoderm:** cartilage, muscle, and connective tissue.
- Development begins in **week 3** as **respiratory diverticulum** from foregut.

- **Molecular control:**
  - **TBX4** ? induces lung bud formation.
  - **FGF10** ? promotes bud outgrowth.
  - **SHH (Sonic Hedgehog)** ? controls branching and patterning.

- **Stages of lung development:**
  - **Pseudoglandular (5–17 weeks):** formation of bronchioles.
  - **Canalicular (16–25 weeks):** vascularization begins.
  - **Terminal sac (24 weeks–birth):** alveoli begin forming.
  - **Alveolar (birth–8 years):** maturation of alveoli.

- **Clinical correlations:**
  - **Aspiration** ? more common in right bronchus.
  - **Carina** ? sensitive ridge triggering cough reflex.

- **Bronchiectasis** ? dilation of bronchi due to infection.
- **Bronchogenic carcinoma** ? arises from bronchial epithelium.
- **Pulmonary embolism** ? blockage of pulmonary artery by a clot.
- **Tuberculosis** ? commonly affects lung apices.
- **Neonatal respiratory distress** ? due to surfactant deficiency.

- **Lymph drainage:**
  - **Superficial plexus:** under pleura ? bronchopulmonary (hilar) nodes.
  - **Deep plexus:** along bronchi ? pulmonary ? tracheobronchial ? paratracheal nodes.
  - Final drainage ? **thoracic duct (left)** or **right lymphatic duct**.

- **Nerve supply:**
  - **Parasympathetic (vagus):** bronchoconstriction, vasodilation, secretion.
  - **Sympathetic (T1–T5):** bronchodilation, vasoconstriction, reduced secretion.

- **Blood supply:**
  - **Pulmonary arteries** ? deoxygenated blood to lungs.
  - **Pulmonary veins** ? oxygenated blood to left atrium.

- **Bronchial arteries** ? nutrient supply to bronchial tree.

- **Radiological importance:**
  - **Horizontal fissure** visible in PA chest X-ray at 4th costal cartilage.
  - **Oblique fissure** seen in lateral view, running from T4 to 6th costal cartilage.
  - Knowledge of **segmental anatomy** aids in interpreting **collapse, consolidation, and effusion**.

Clinicoanatomical Problems — Lungs

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1. Foreign Body Aspiration

Case:
A child accidentally inhales a peanut while playing. The child begins to cough and shows signs of respiratory distress.

Anatomical Basis:

- The **right principal bronchus** is **shorter, wider, and more vertical**, so inhaled foreign bodies commonly enter it.
- Within the right lung, they most often lodge in the **posterior basal segment of the lower lobe**.
- May lead to **obstructive pneumonia** or **segmental collapse (atelectasis)**.

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2. Bronchiectasis

Case:
A patient presents with chronic productive cough, foul sputum, and recurrent chest infections.

Anatomical Basis:

- **Permanent dilation** of bronchi due to **destruction of their muscular and elastic tissue** following infection or obstruction.
- Commonly affects **lower lobes** (especially the posterior basal segments).
- Segmental drainage and postural physiotherapy help prevent recurrence.

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3. Pulmonary Collapse (Atelectasis)

Case:
A postoperative patient develops sudden breathlessness and absent breath sounds on one side.

Anatomical Basis:

- **Blockage of a bronchus** (by mucus, tumor, or foreign body) prevents air entry to alveoli, leading to **alveolar collapse**.
- The **mediastinum shifts toward** the collapsed lung, and affected area appears opaque on X-ray.

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4. Pneumothorax

Case:
A tall, thin young man suddenly develops chest pain and difficulty breathing.

Anatomical Basis:

- **Rupture of subpleural blebs** or trauma allows air to enter the **pleural cavity**, collapsing the lung.
- **Tension pneumothorax** occurs when air enters but cannot escape, pushing the **mediastinum to the opposite side**.
- Requires emergency **needle decompression**.

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5. Bronchogenic Carcinoma

Case:
A chronic smoker develops persistent cough, hemoptysis, and weight loss.

Anatomical Basis:

- Cancer arises from **bronchial epithelium**, commonly near the **hilum** of the lung.
- Metastasis occurs via **lymph nodes** (bronchopulmonary ? tracheobronchial ? paratracheal) and **blood** (to brain, bone, liver).
- May compress **recurrent laryngeal nerve**, causing **hoarseness of voice**.

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6. Carina Distortion

Case:
Bronchoscopy in a patient with lung cancer reveals a widened carina.

Anatomical Basis:

- The **carina** (ridge at the tracheal bifurcation) is displaced or widened due to **enlarged subcarinal lymph nodes** in bronchogenic carcinoma.
- Carina is highly sensitive; irritation produces a **cough reflex** via **vagus nerve**.

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7. Pulmonary Embolism

Case:
A bedridden patient suddenly develops dyspnea, chest pain, and cyanosis.

Anatomical Basis:

- **Thrombus** from deep leg veins may travel through the **inferior vena cava and right heart** to block a **pulmonary artery**.
- Leads to **pulmonary infarction** and **sudden circulatory collapse**.
- Common site: **lower lobar arteries**.

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8. Lung Abscess

Case:
A patient with aspiration pneumonia develops fever, cough, and expectoration of foul-smelling sputum.

Anatomical Basis:

- **Suppurative necrosis** of lung tissue due to infection.
- Common in **posterior segment of upper lobe** or **superior segment of lower lobe** (dependent areas in supine position).
- Requires **antibiotics and postural drainage**.

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9. Tuberculosis

Case:
A young adult presents with chronic cough, low-grade fever, and apical opacity on chest X-ray.

Anatomical Basis:

- **Primary focus (Ghon focus)** usually develops in the **upper part of the lower lobe** or **lower part of the upper lobe**, often near the **apex** due to high oxygen tension.
- May progress to **fibrosis and cavitation**.
- Spread via lymphatics and bloodstream leads to **miliary TB**.

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10. Lung Fibrosis

Case:
A worker exposed to silica dust develops progressive breathlessness and restrictive lung changes.

Anatomical Basis:

- **Fibrotic thickening** of lung tissue leads to **reduced compliance and gas exchange**.
- Common in **silicosis, asbestosis, and coal worker's pneumoconiosis**.
- Affects **upper lobes** in silicosis, **lower lobes** in asbestosis.

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11. Pleural Effusion Secondary to Lung Disease

Case:
A patient with pneumonia develops dullness on percussion and reduced breath sounds at lung base.

Anatomical Basis:

- Inflammation of the **pleura** leads to **fluid accumulation** in the **costodiaphragmatic recess**, compressing lung tissue.
- Fluid is drained by **thoracocentesis**.

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12. Emphysema

Case:
A long-term smoker presents with breathlessness, barrel-shaped chest, and decreased breath sounds.

Anatomical Basis:

- **Destruction of alveolar walls** and **loss of elastic tissue** cause **air trapping** and overdistension of alveoli.
- Results in poor gas exchange and **chronic obstructive pulmonary disease (COPD)**.

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13. Neonatal Respiratory Distress Syndrome (Hyaline Membrane Disease)

Case:
A premature newborn shows labored breathing and cyanosis soon after birth.

Anatomical Basis:

- **Type II pneumocytes** fail to produce enough **surfactant**, causing **alveolar collapse**.
- Histology shows **hyaline membranes** lining alveoli.
- Treatment involves **surfactant therapy and assisted ventilation**.

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14. Lung Resection Surgery

Case:
A patient with localized bronchiectasis undergoes removal of one bronchopulmonary segment.

Anatomical Basis:

- Each **bronchopulmonary segment** is an independent unit with its own **segmental bronchus and artery**, separated by connective tissue septa.

- Allows **segmental resection** without affecting other segments.

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15. Azygos Lobe (Anatomical Variant)

Case:
An X-ray shows an extra fissure in the right upper lobe, mistaken for pathology.

Anatomical Basis:

- Caused by **aberrant course of the azygos vein**, which arches over the lung apex and forms an **accessory fissure** enclosing a **small azygos lobe**.
- Clinically insignificant but important radiologically.

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16. Sentinel Node (Virchow's Node) Enlargement

Case:
A patient with left lung carcinoma develops an enlarged left supraclavicular lymph node.

Anatomical Basis:

- Metastatic spread from **bronchogenic carcinoma** via **thoracic duct** to the **left supraclavicular node**, known as **Virchow's node**.
- Sign of **advanced malignancy**.

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17. Pulmonary Infarction

Case:
A patient with deep vein thrombosis develops sudden pleuritic chest pain and hemoptysis.

Anatomical Basis:

- **Embolic occlusion** of a branch of **pulmonary artery** causes **wedge-shaped infarct**, often in the **lower lobes**.

- The apex of the infarct points toward the **hilum**, and the base toward the **pleura**.

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18. Segmental Pneumonia

Case:
A patient with fever and cough shows segmental opacity on X-ray.

Anatomical Basis:

- Infection localized to one **bronchopulmonary segment**, often following obstruction or poor drainage.

- Segmental structure helps in identifying and targeting the lesion.

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19. Postural Drainage Application

Case:
A physiotherapist positions a patient with head-down tilt to drain secretions from the lower lobes.

Anatomical Basis:

- Knowledge of **segmental bronchial orientation** helps in using gravity to assist mucus clearance — vital in **bronchiectasis and cystic fibrosis**.

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20. Referred Pain in Lung Cancer

Case:
A patient with left apical tumor complains of shoulder and inner arm pain.

Anatomical Basis:

- **Pancoast tumor** at lung apex invades **brachial plexus (T1)** and **sympathetic chain**, producing **shoulder pain** and **Horner's syndrome** (ptosis, miosis, anhidrosis).