



มหาวิทยาลัยราชภัฏนครปฐม



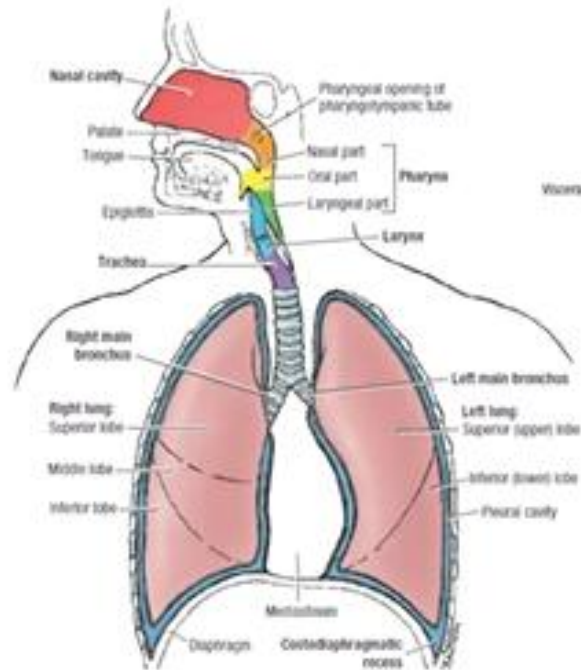
Mechanism and Illness of Human Body 2

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Disorders of the Respiratory System

Anatomy and Physiology of Respiratory System



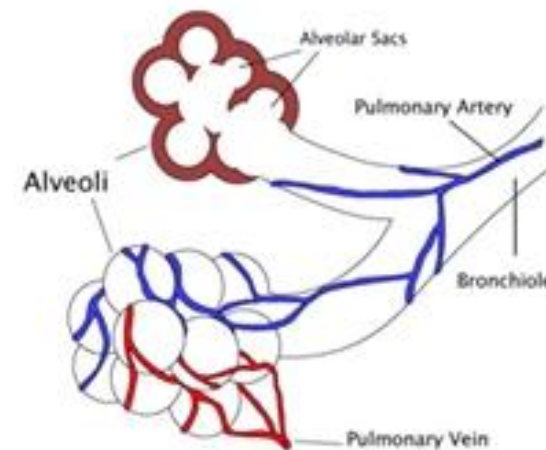
Conducting part

Function:

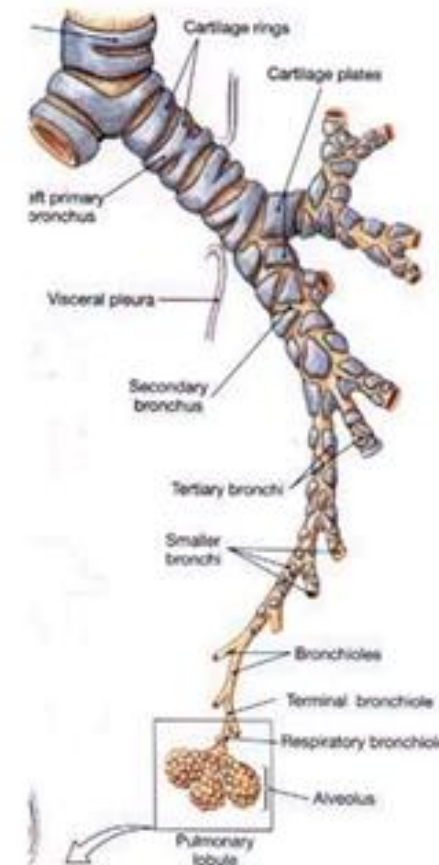
Remove particle, warming and moisture

Respiratory part

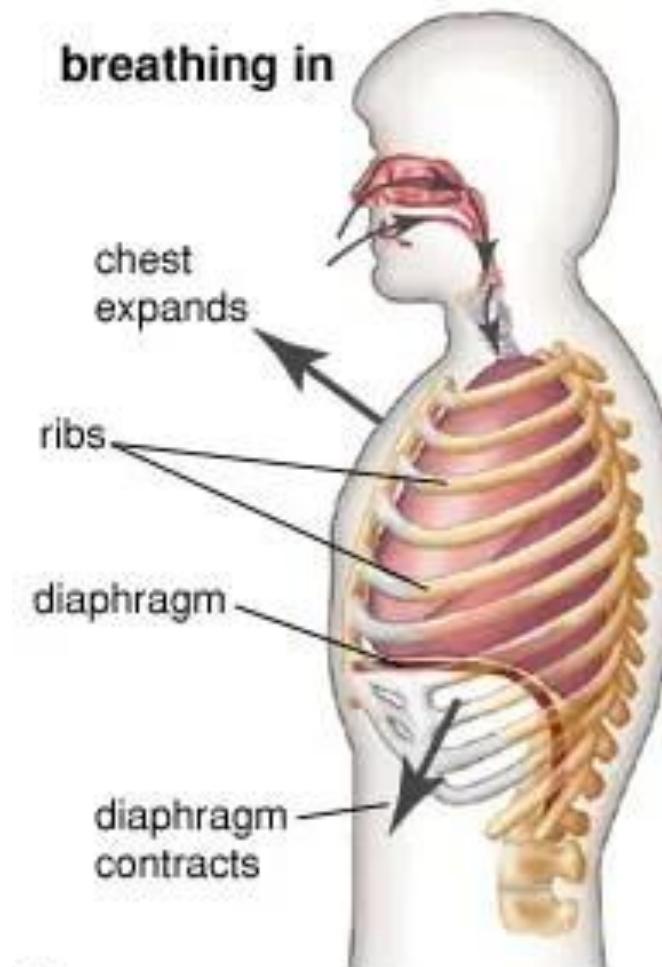
- **Respiratory bronchiole**
- **Alveolar duct**
- **Alveolar sac**
- **Alveoli (300-500 alveoli)**



From: <https://commons.wikimedia.org/wiki/File:Gcsebiolalveol2.gif>

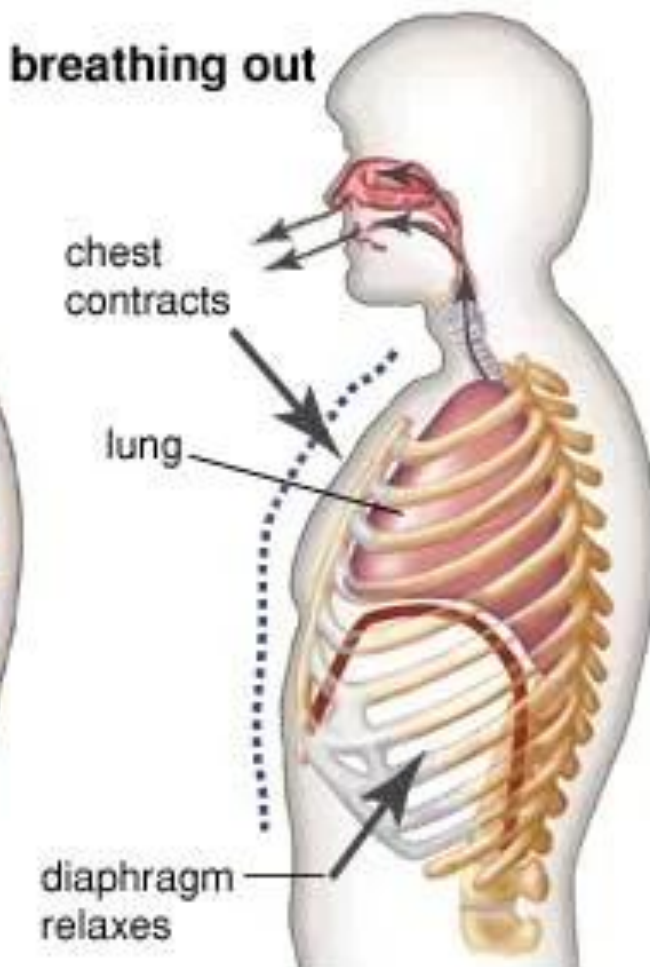


breathing in



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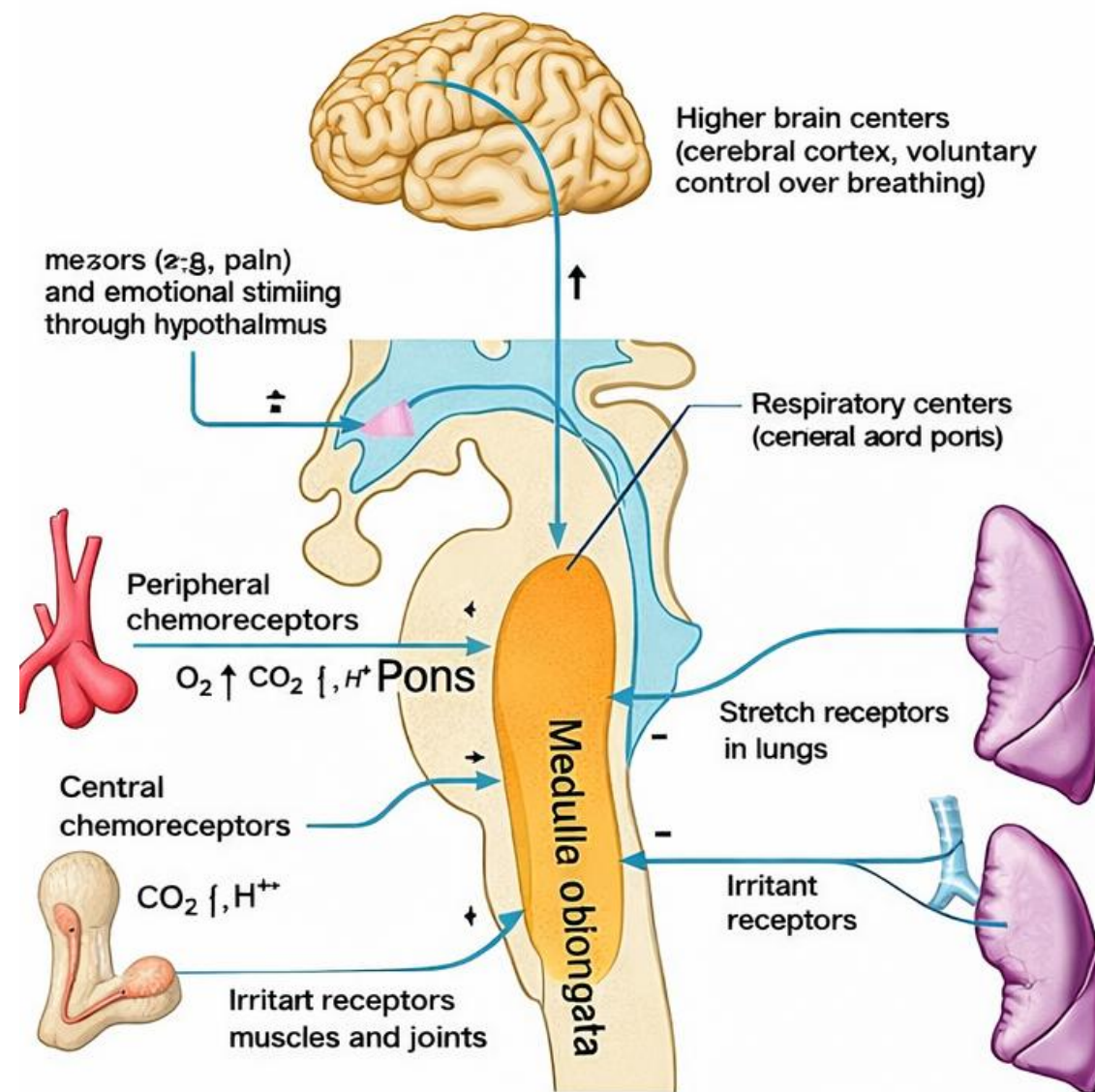
breathing out



Disorders of the Respiratory System

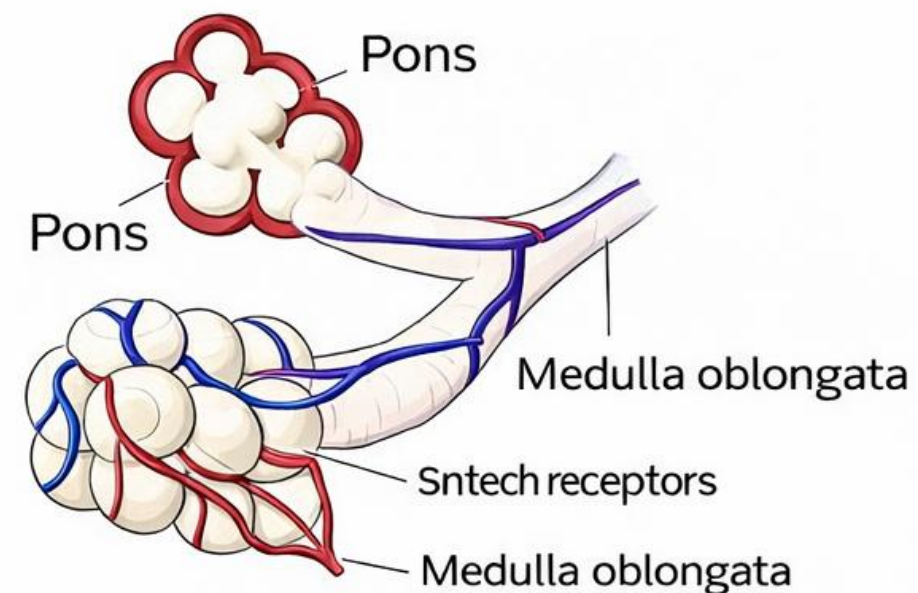


Respiratory Center



Pons controls rate of breathing, depth, and **Inspiration**

Medulla oblongata controls **rhythm** of inspiration and expiration





Disorders of the Respiratory System

Physiology of Respiration



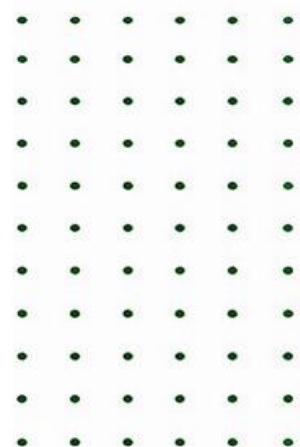
Ventilation(V) refers to the passage of air in and out of the respiratory system

- **Pulmonary ventilation** is the volume of air that enters and exits the lungs in 1 minute

$$\text{Pulmonary ventilation} = \text{Tidal volume} \times \text{RR}$$

- **Alveolar ventilation** is the volume of air that enters respiratory part in 1 minute

$$\text{Alveolar ventilation} = (\text{TV} - \text{Dead space volume}) \times \text{RR}$$

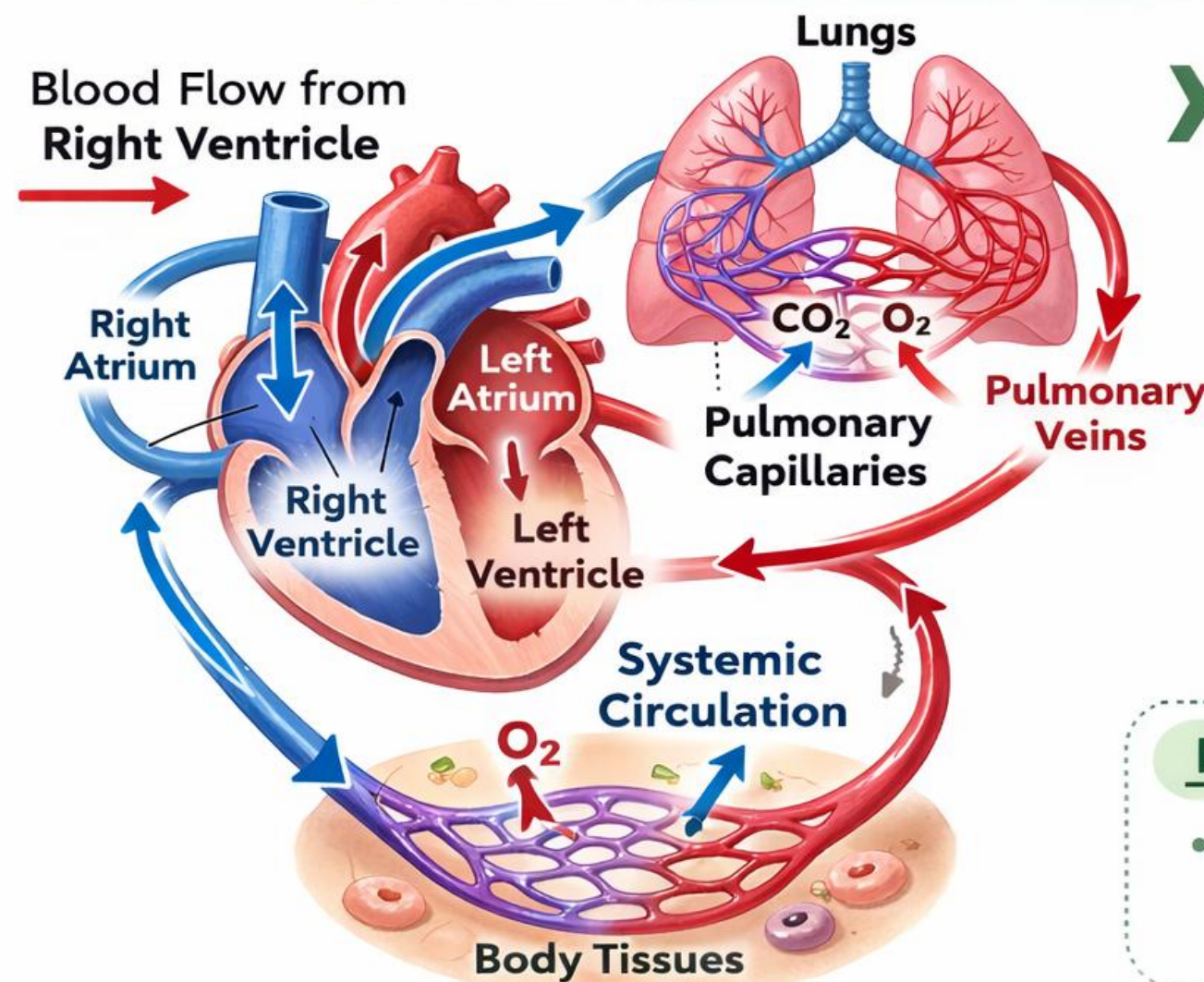


If normal RR is 12 times per minute, Tidal volume = 500 ml,
Anatomical dead space = 150 ml
then pulmonary and alveolar ventilation will be mL/min.....

Disorders of the Respiratory System



Physiology of Respiration (Perfusion (Q))



➤ **Perfusion (Q)** is the blood flow from the **Right Ventricle**

- **Pulmonary Artery** → Carries blood to the **lungs**
- **Pulmonary Capillaries** (Gas Exchange)
 - **O₂** enters the blood
 - **CO₂** leaves the blood
- **Pulmonary Veins** → Return **oxygenated blood** to the heart

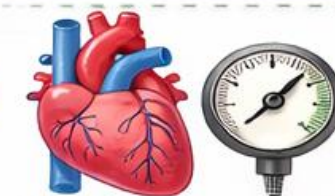
Pulmonary Circulation (Low Pressure)

- Resistance of pulmonary circulation is **lower than** **Systemic Circulation**

Example: If normal **Cardiac Output** = **5 L/min**

→ **Pulmonary Perfusion** = **5,000 mL/min**

→ **Alveolar Perfusion** = **5,000 mL/min**



(Low Pressure)

Disorders of the Respiratory System

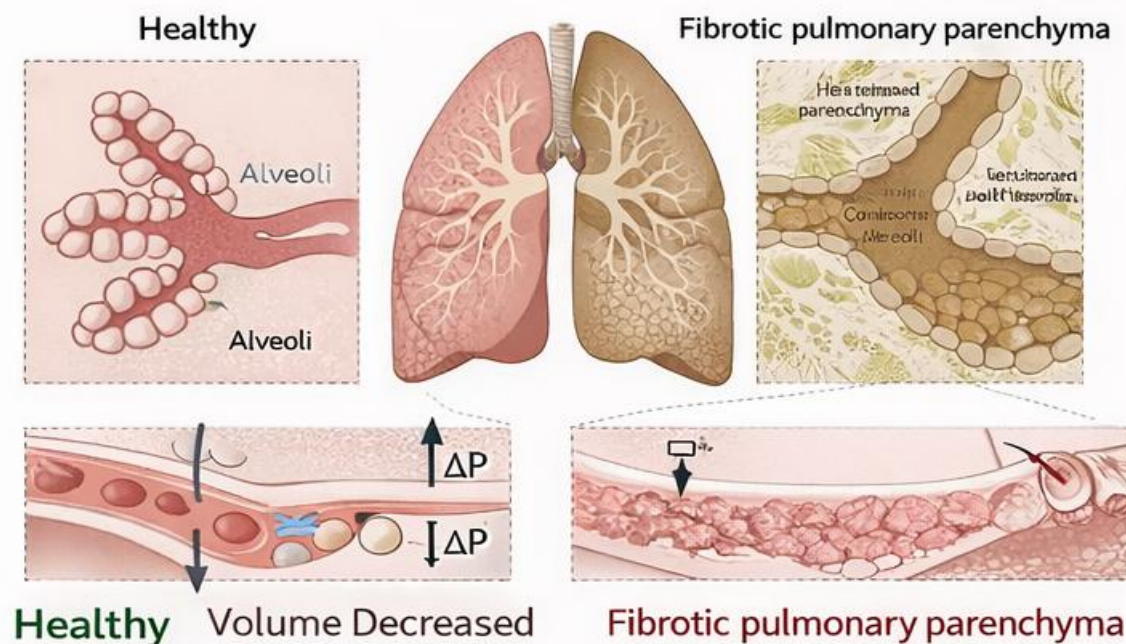


Physiology of Respiration

Lung compliance (c)

High c = lungs expand easily; **Low** c = lungs require more force to expand

- Relationship between: Volume, pressure difference, + in alveoli and bronchioles

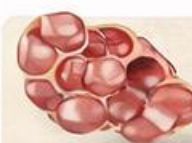
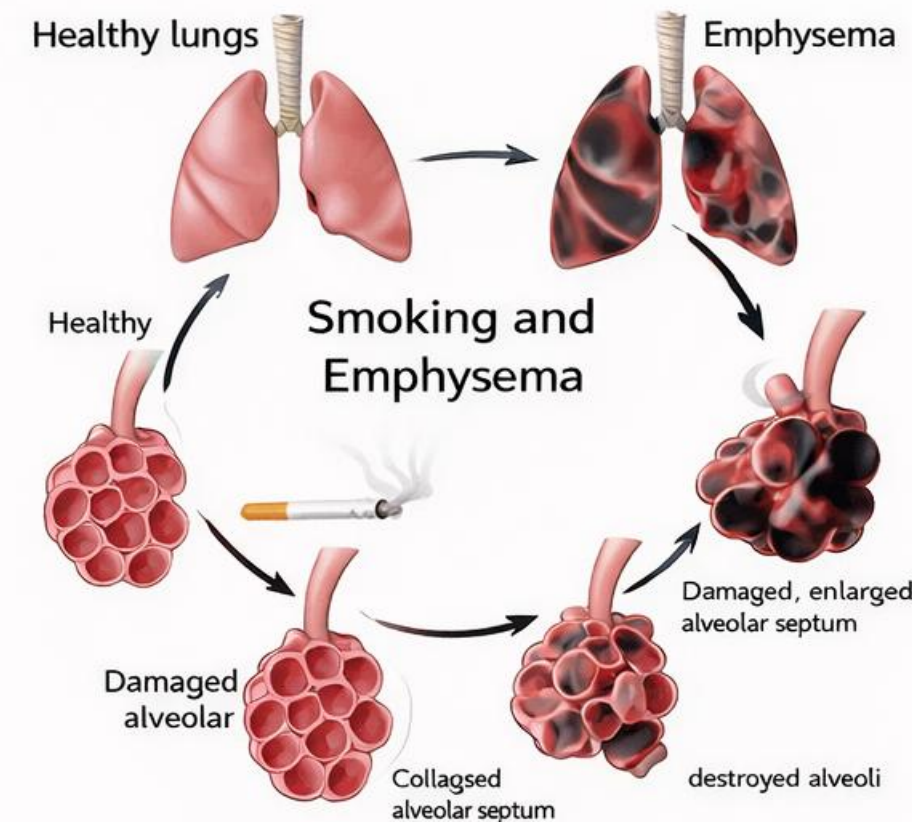


- Fibrotic tissue (Lung fibrosis) leads to stiff lung tissue
- Damaged alveoli (Emphysema) such as COPD

Source: <https://www.nature.com/articles/nrdp201774>



Fibrotic tissue (Lung fibrosis)
leads to stiff lung tissue



Damaged alveoli (**Emphysema**) such as COPD

Disorders of the Respiratory System

(physiology of respiration)

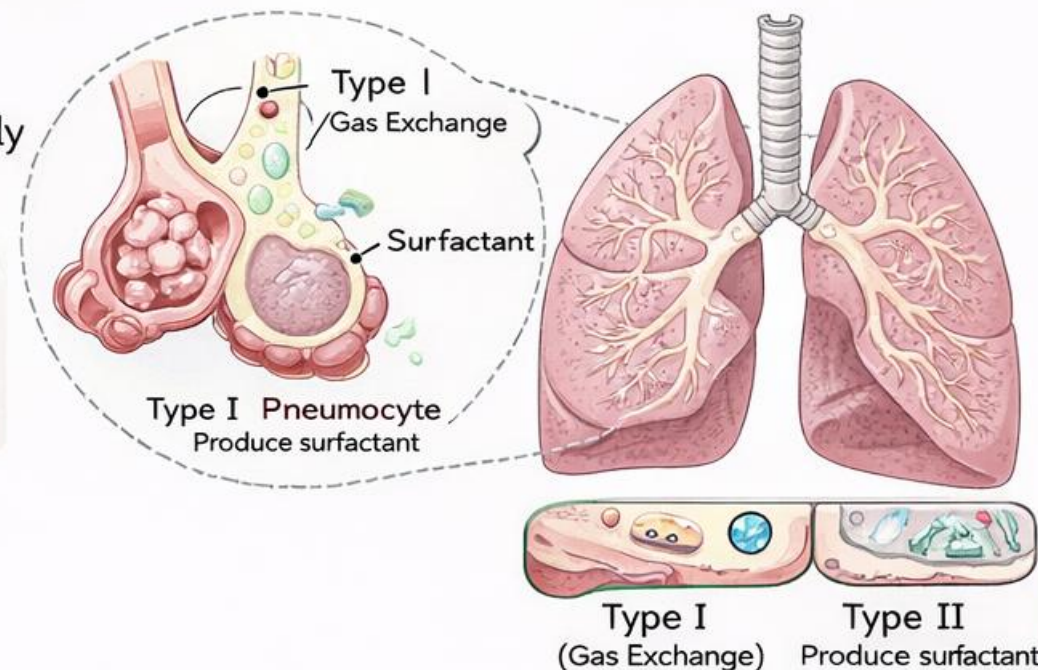
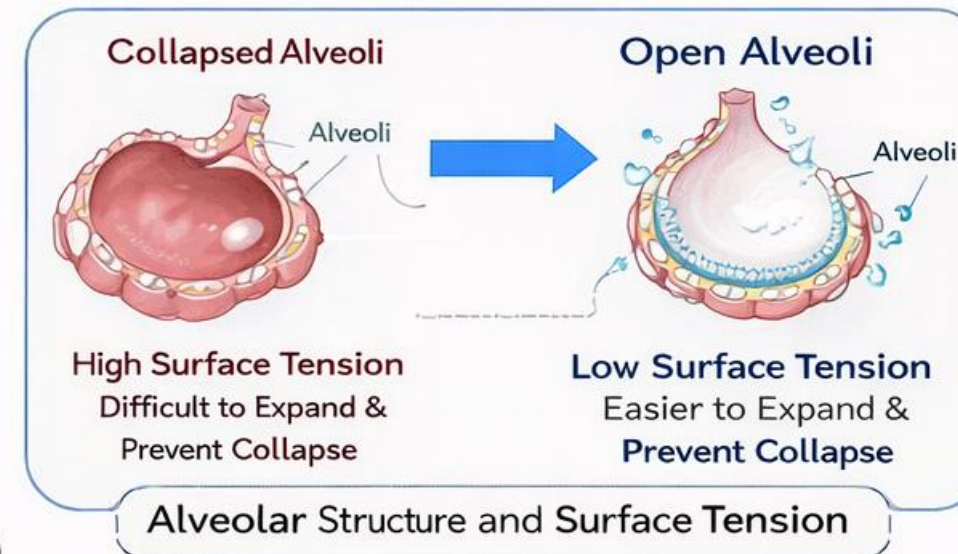
Surface tension (s)

- Inside alveoli, a substance called **surfactant** reduces **surface tension** & prevents collapse (anti surface tension)
- Pneumocyte type I (**gas exchange**)
- Pneumocyte type II (**surfactant**)
- If surfactant decreases (collapsed alveoli difficult to open)
 - **Inhalation:** Requires greater force to expand alveoli
 - **Exhalation:** 2 sides of the alveoli stick together more easily

If surfactant decreases (collapsed alveoli difficult to open)

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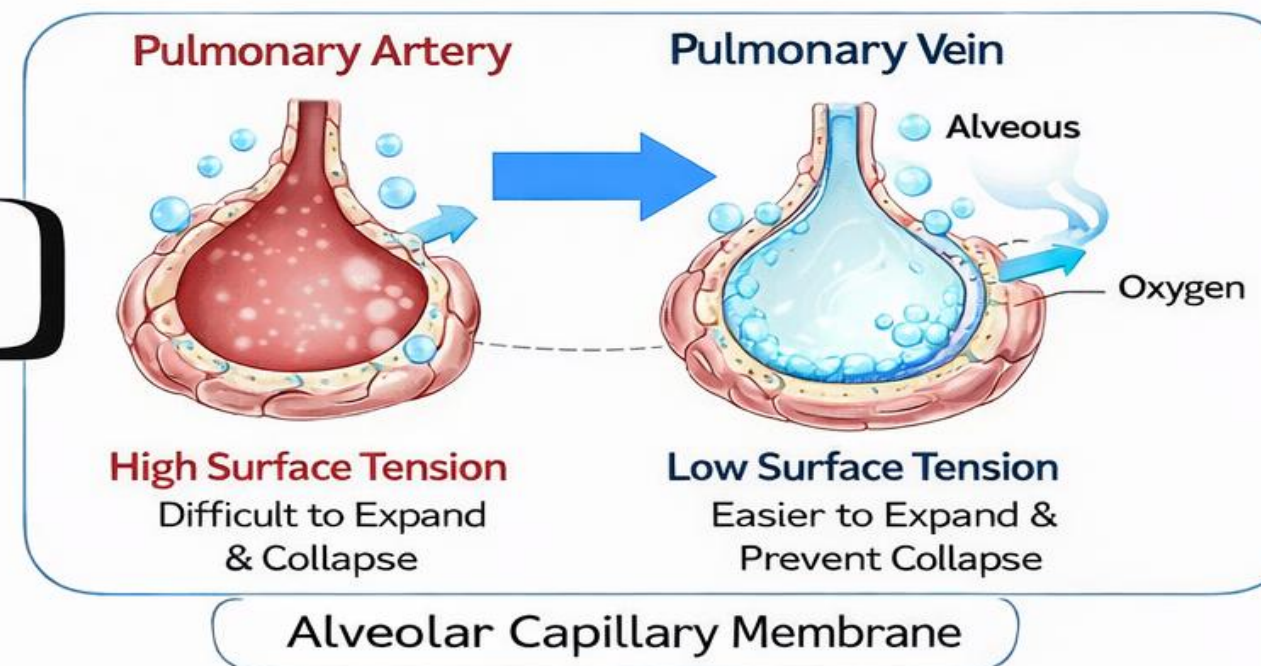
Disorders of the Respiratory System

Perfusion : Q

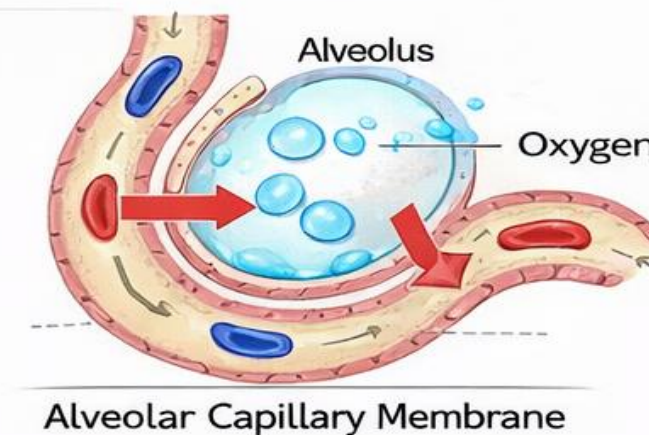
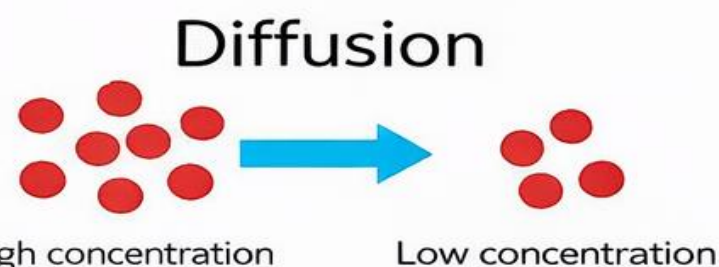
Perfusion is the flow of blood starting from the Pulmonary artery delivering from the right ventricle (deoxygenated blood) to the pulmonary capillary.

- Ensures adequate blood flow
- Adequate volume

Diffusion : D

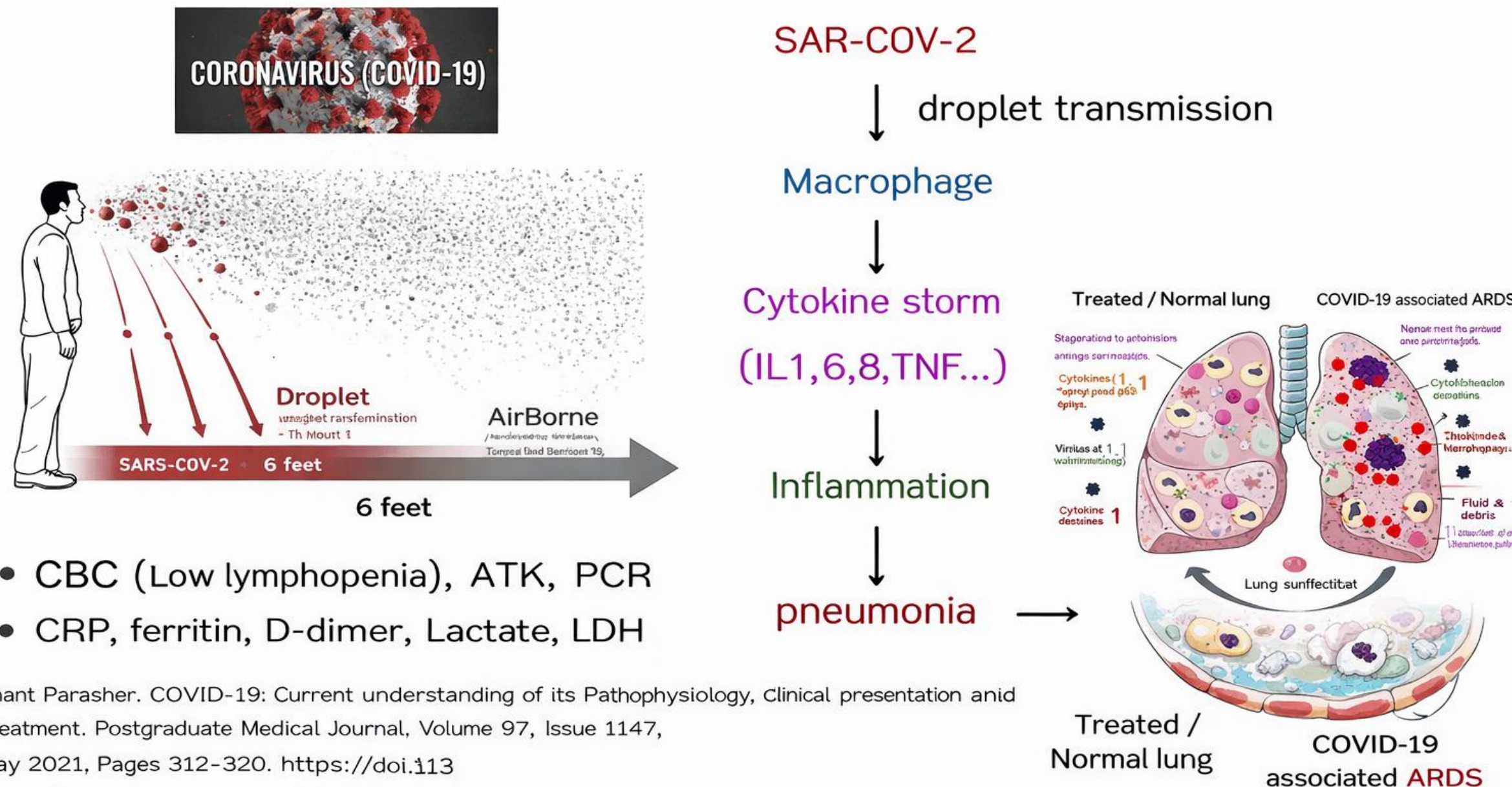


Diffusion is the exchange of gases CO_2 and O_2 between alveoli and pulmonary capillary across Alveolar Capillary Membrane



Disorders of the Respiratory System

Covid-19

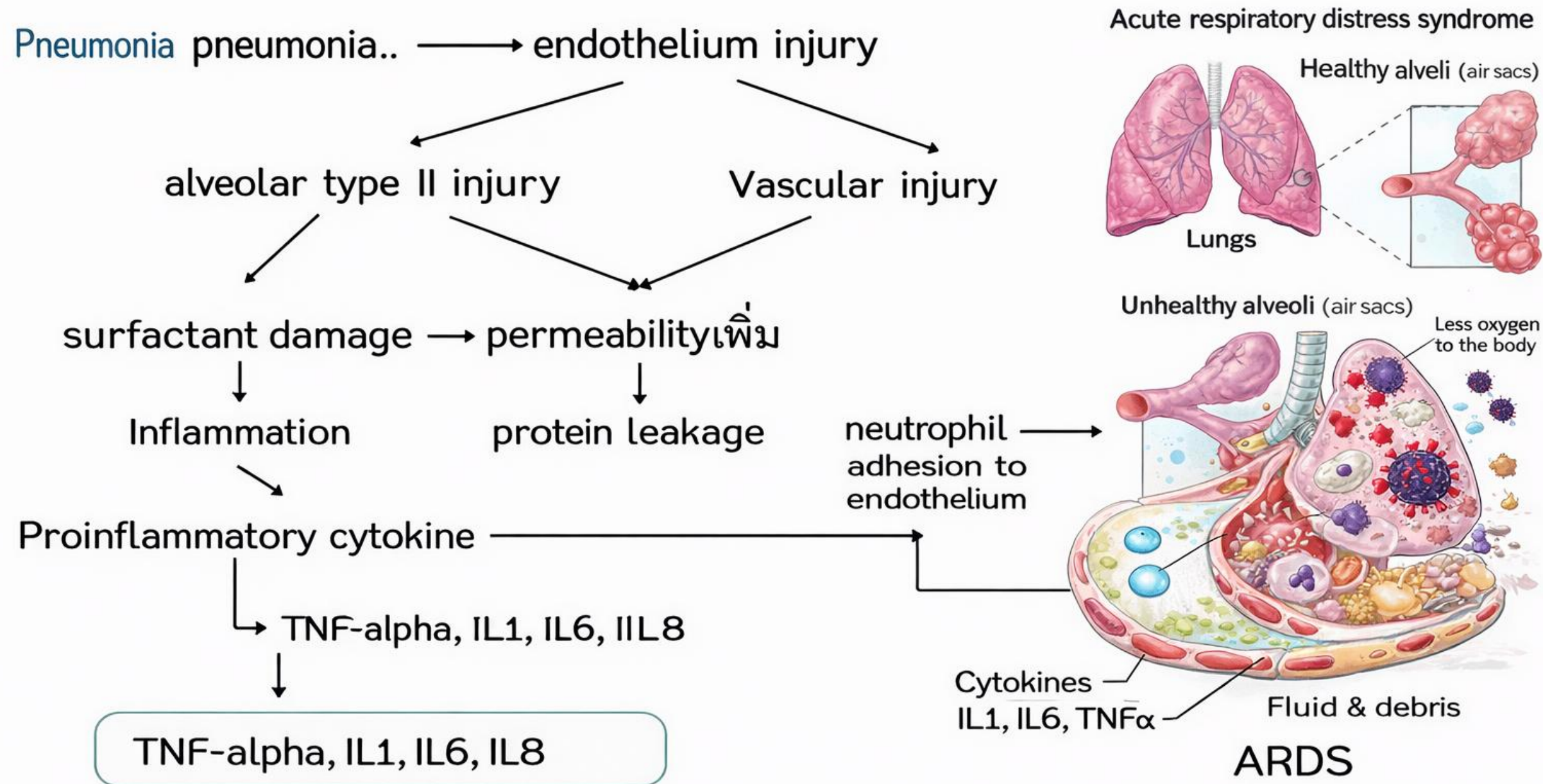


- CBC (Low lymphopenia), ATK, PCR
- CRP, ferritin, D-dimer, Lactate, LDH

Anant Parasher. COVID-19: Current understanding of its Pathophysiology, Clinical presentation and Treatment. Postgraduate Medical Journal, Volume 97, Issue 1147, May 2021, Pages 312-320. <https://doi.113>
<https://doi.1136/postgradmedj-2020-136577>

Disorders of the Respiratory System

Acute respiratory distress syndrome





Disorders of the Respiratory System

Hypoxia

= Tissue hypoxemia

($\text{PaO}_2 < 50 \text{ mmHg}$, $\text{PaCO}_2 > 50 \text{ mmHg}$)

4 Causes

1. Hypoventilation
2. V/Q matching
3. Diffusion impairment
4. Shunting



Disorders of the Respiratory System

Hypoventilation

– CO₂ is retained in the alveoli while O₂ intake is reduced

- Delivered to the frontal lobe:

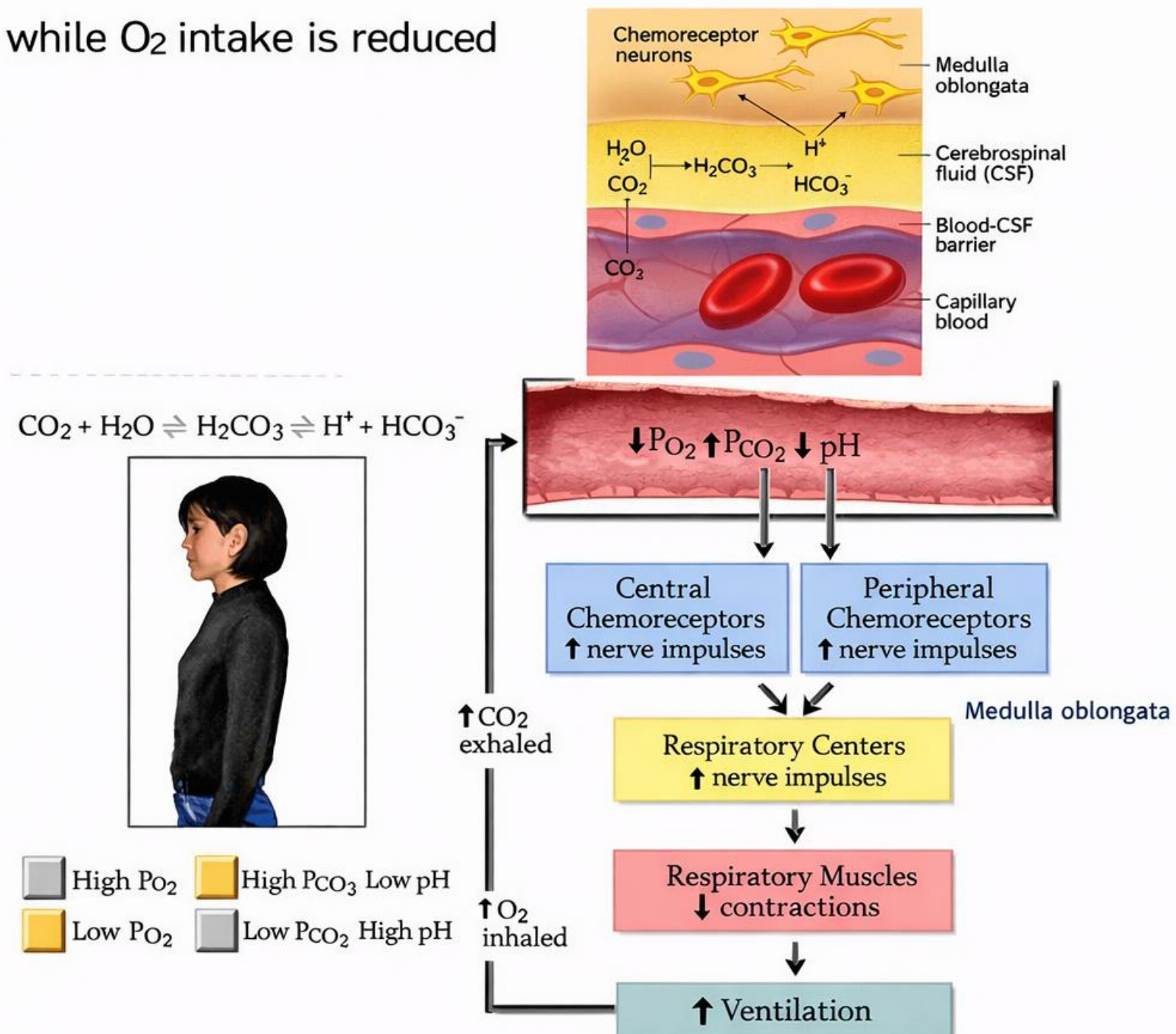
TLC

FVC

FEV₁/FVC ratio
(normal > 0.7) (0.8–)

TLC= Total lung compliance

FVC= Functional volume capacity

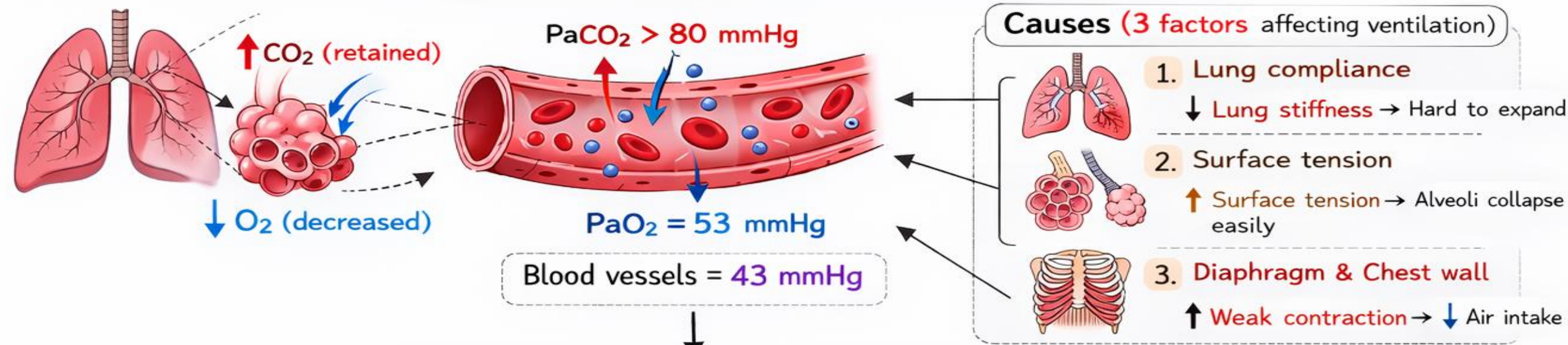


Disorders of the Respiratory System

Hypoventilation

Decreased alveolar ventilation → **CO₂ is retained**, **O₂ is decreased**

PaCO₂ > 80 mmHg, **PaO₂ ↓ to 53 mmHg** When blood vessels: ↓ to **43 mmHg**



Hypoventilation Disorders

1. Obstructive Lung Diseases

Upper Airway

- Throat obstruction
- Epiglottitis, Tumor

Lower Airway

- Bronchus, COPD, Asthma



2. Restrictive Lung Diseases

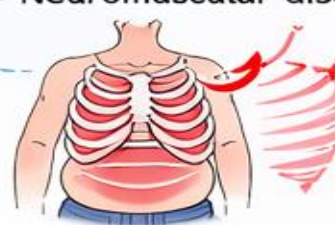
Parenchymal

- Fibrosis, Pneumonia
- Interstitial lung disease



Extra-Parenchymal

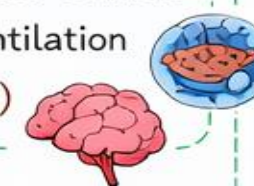
- Obesity, Chest wall injury
- Neuromuscular disease



3. Central and Sleep-Related Hypoventilation

Congenital

- Congenital central hypoventilation (CCHS)



Acquired

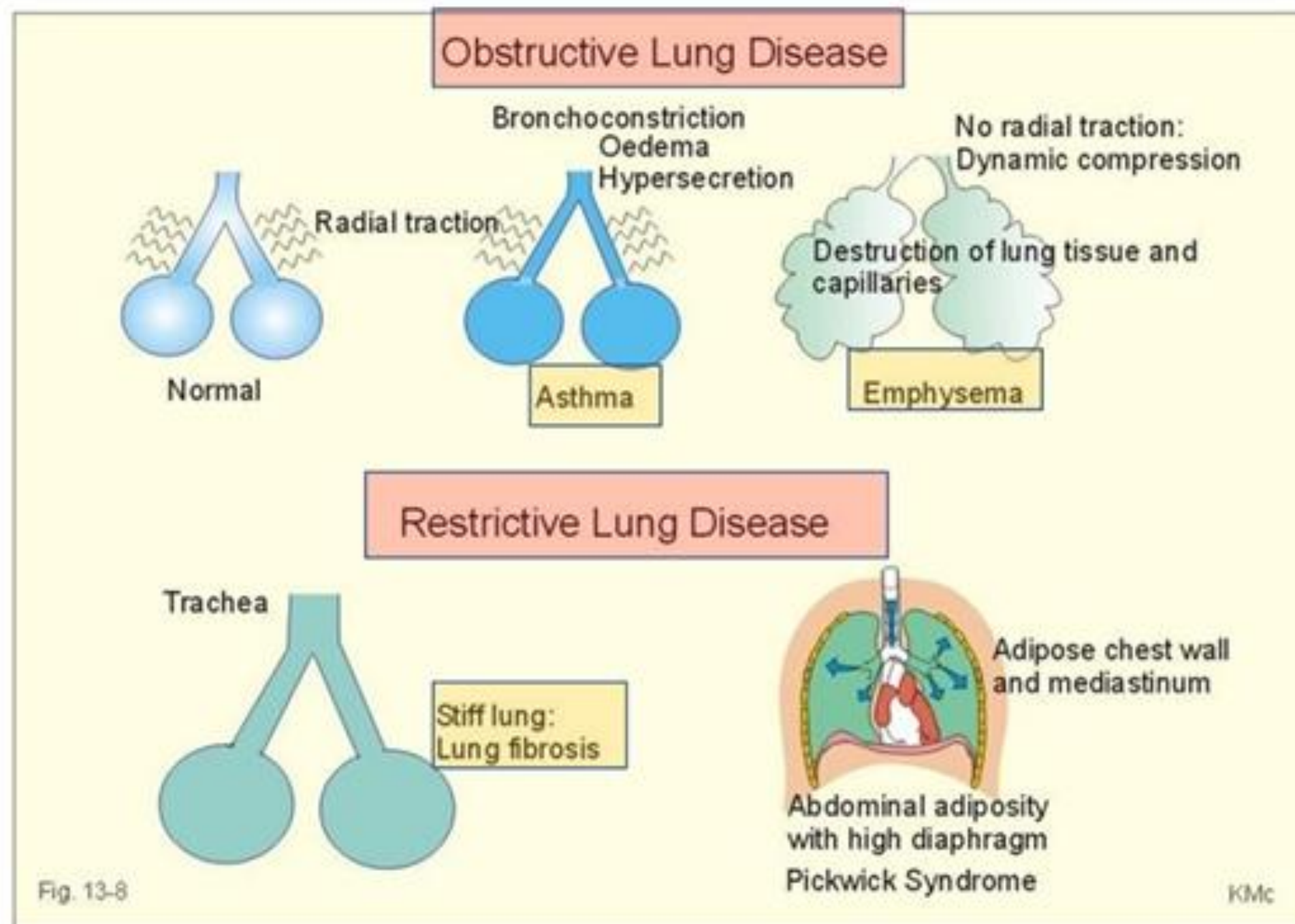
- Brain injury, Drugs, Sedatives
- Sleep apnea, Obesity hypoventilation



Disorders of the Respiratory System



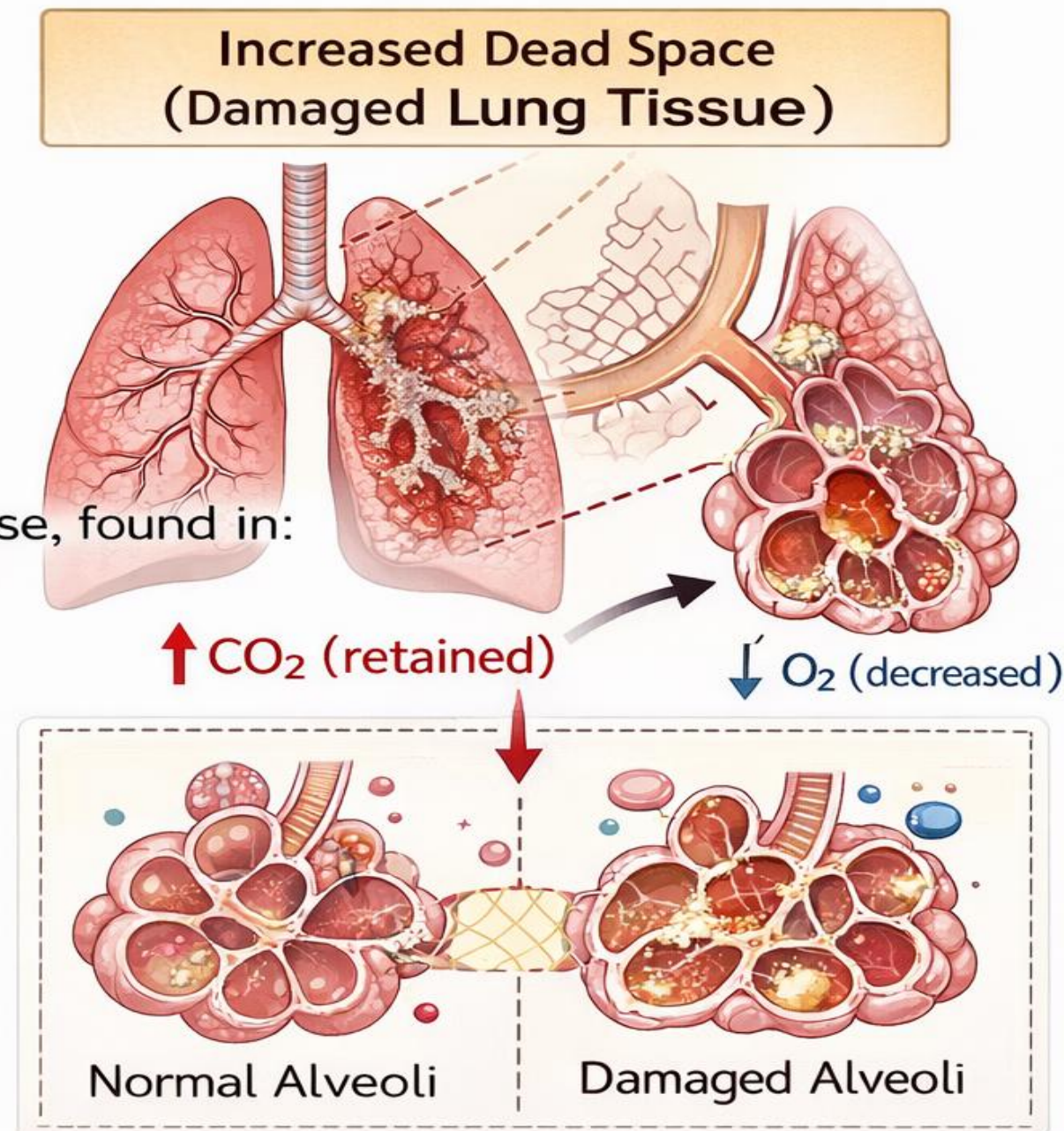
Hypoventilation disorder



Disorders of the Respiratory System

Alveolar Hypoventilation

- Damaged lung tissue (physiologic dead space) increases
- **↑ dead space ventilation**
- Decreased air volume and ventilation
- ↓ CO₂ removal and O₂ levels in blood decrease, found in:
 - Respiratory Infection
 - Acute respiratory infection
 - Chronic respiratory infection
 - Exacerbations of airway disease (e.g, Asthma, COPD)



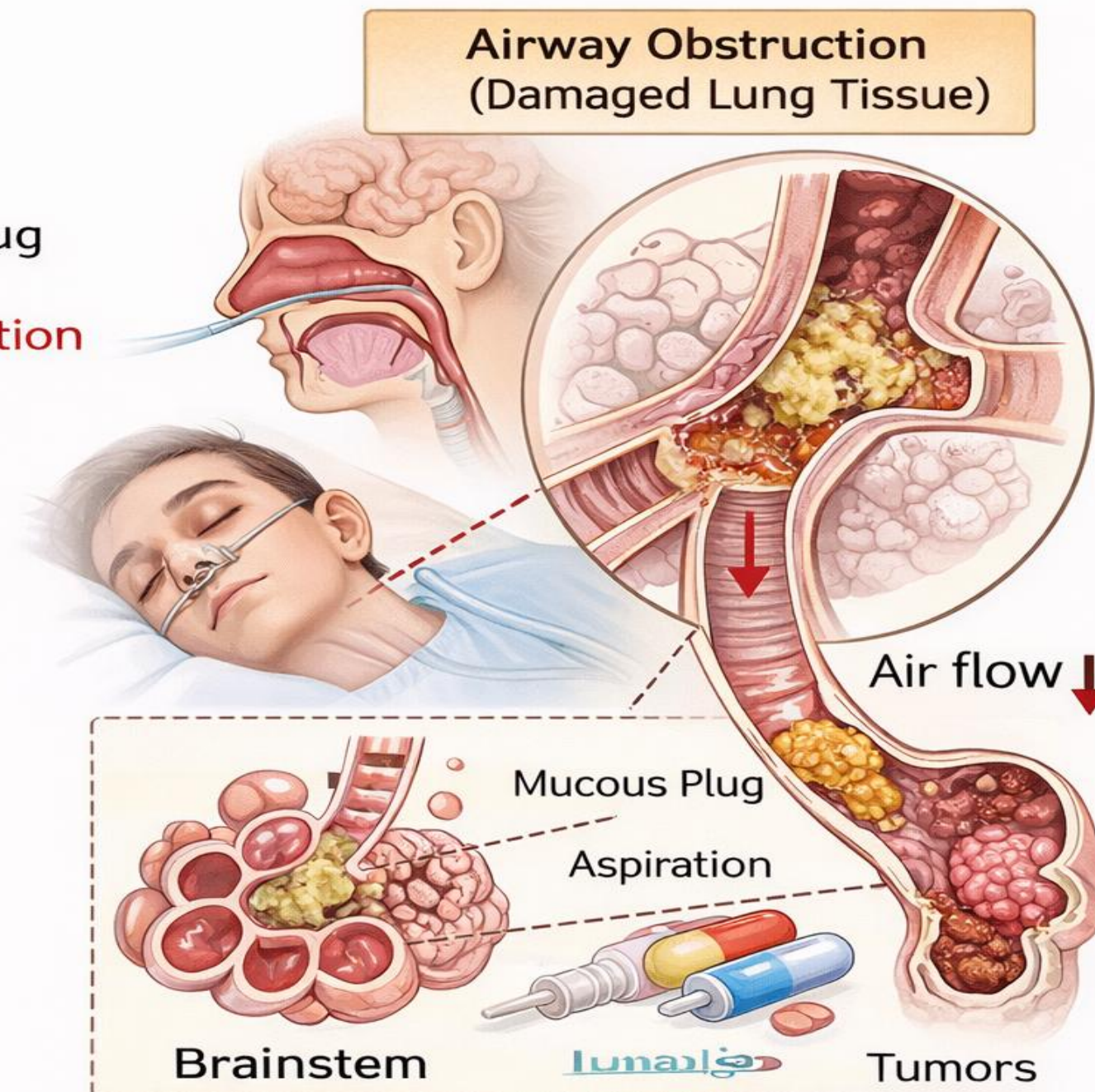
Disorders of the Respiratory System

Alveolar Hypoventilation

- Airway Obstruction:

- ↓ Air passage flow or blocked
- ↓ Air clearance: aspiration, mucous plug

1. Central hypoventilation: **brainstem infarction**
2. Chemical hypoventilation: sedative drugs, respiratory depressants (e.g., Morphine)
3. Bronchospasm with ↑ airway resistance: Bronchial asthma
4. Tumors





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