RESPIRATORY FAILURE

Definition

- It is a condition in which the respiratory system cannot fulfill the primary function of maintaining adequate gas exchange: oxygenation (inability to maintain either the normal level or delivery of oxygen to tissues) and carbon dioxide elimination (inability to remove carbon dioxide from the tissues). leading to PaO_2 less than 60mmHg and/or $PaCO_2$ more than 49mmHg in ABG.
- It is a syndrome rather than a disease.
- It includes the causative disease and manifestations of respiratory failure.

Types of respiratory failure

1. **Type 1 hypoxic RF**
Respiratory pump (ventilator failure)
PaO2
PaCO2

2. **Type 2 Hypercapnic RF**
Lungs (Pulmonary failure)
PaO2
PaCO2

3. **Acute RF**
a short-term condition develops in minutes to hours. It occurs suddenly and is typically treated as a medical emergency.

4. **Chronic respiratory failure**
It gradually develops over time develops over several days or longerand requires long-term treatment.

Causes of respiratory failure

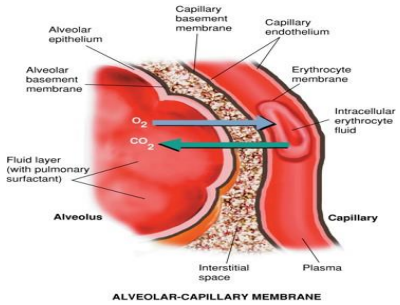
A) Ventilation disorders:

1. **Low FiO_2 (fraction of inspired O_2** normally = 21%)
- In high altitude the level of FiO_2 decrease than that at sea level and Fire places.
2. **Spinal cord lesion**
   - high cervical trauma above level of C_3.
3. **Diseases affect chest bellow or "ventilatory pump":**
   - Neuromuscular disease:
   - Myopathy.
   - Tetanus.
   - Myasthenia gravis.
   - Gullian Barre' syndrome.
   - Poliomyelitis.
   - Chest wall deformity: kyphoscoliosis.
   - Pleural diseases: massive pleural effusion or pneumothorax.
4. **CNS causes** (leads to respiratory center depression).
   - cerebral strokes.
   - Cerebral tumor.
   - Drugs that depress the respiratory center such as barbiturate and opiate poising.
   - Head injury.
   - Central sleep apnea syndromes.
5. **Airflow limitation:**

- Airway obstruction leads to conduction defect.
- Upper airway obstruction (e.g., laryngeal edema, tracheal obstruction).
- Lower airway obstruction:
  i. Generalized bronchospasm:
     - Acute severe attack of asthma.
     - COPD.
     - Bronchiactasis.
  ii. Localized obstruction of a main bronchus.
     - Foreign body aspiration.
     - Bronchial tumors.

B) Diffusion disorders:

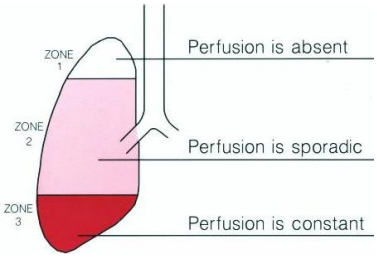
- Alveolo-capillary membrane thickening as in: interstitial lung diseases (ILD).
- Alveolar and interstitial diseases:
- Severe pneumonia.
- Pulmonary edema.
- Acute respiratory distress syndrome.



ALVEOLAR-CAPILLARY MEMBRANE

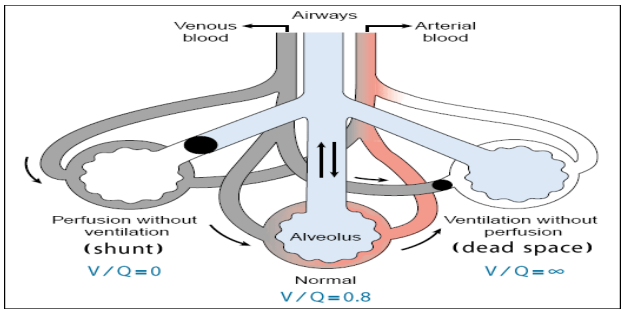
C) Perfusion disorders:

- Pulmonary artery obstruction: pulmonary embolism.
- Shock states.



D) Ventilation/perfusion mismatching

Area of low ventilation relative to perfusion.



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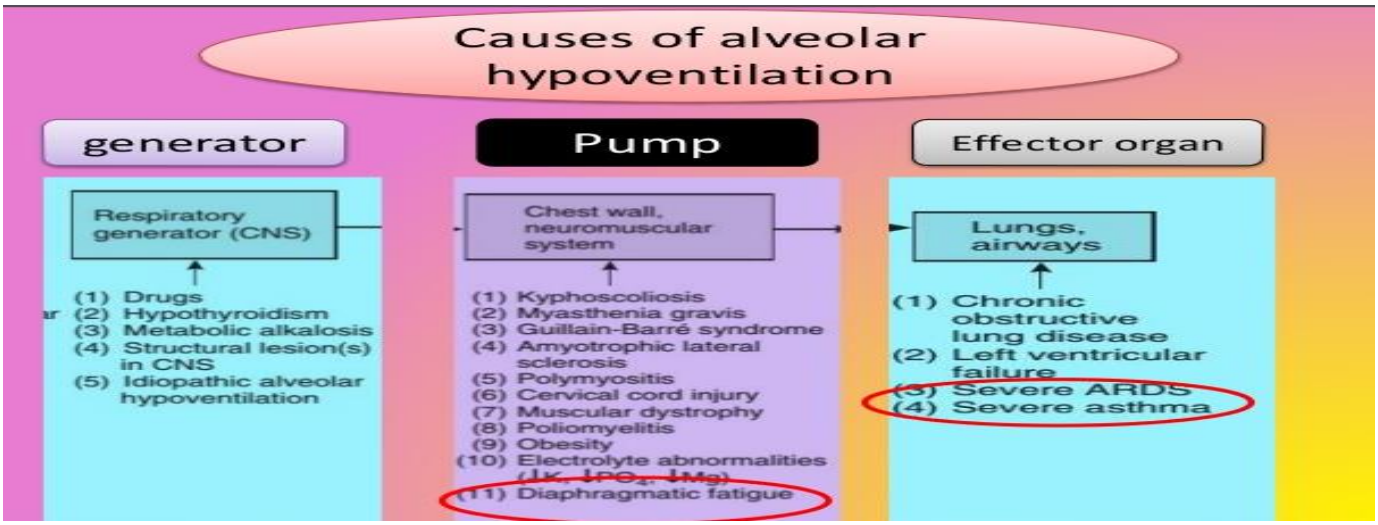
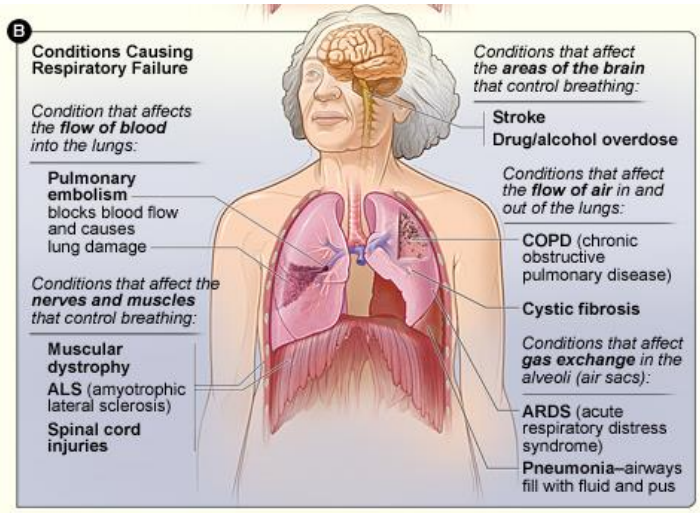


Causes

Hypoxaemic (Type I)	Hypercapnic (Type II)
• Pneumonia	• COPD / Severe Asthma
• ARDS	• Drug Overdose (Opiates benzodiazepines,)
• Pulmonary fibrosis	• CNS Injury (SCI, CVA)
• Asthma	• Primary muscle disorders *(Duchenne muscular dystrophy)*
• COPD	• Neuromuscular junction disorders *(eg. Myasthenia gravis)*
• Pnemothorax	• Anatomical chest deformities *(eg. Kyphoscoliosis, Flail chest)*
• PE	• Obesity Hypo-ventilatory *(Pickwickian)* syndrome
• Obesity	
• Pulmonary Hypertension	

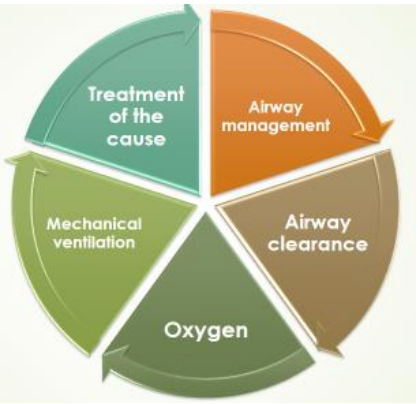


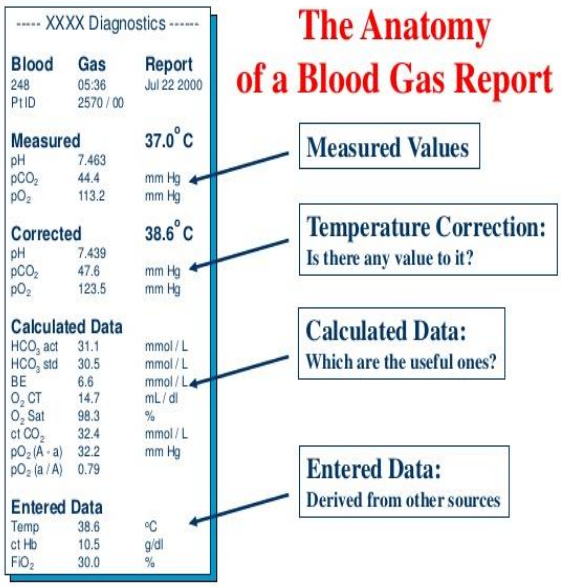
Clinical pictures

Hypoxemia	Hypercapnia
1. Central cyanosis. 2. Respiratory manifestations: Hypoxaemia will stimulate carotid chemoreceptors and leads to: ➨ Tachypnea. ➨ Dyspnea. 3. CNS manifestations: Hypoxia affects the CNS at an early stage and leads to: • Irritability. • Impaired intellectual function. • Clouding of consciousness If hypoxia progress it will lead to: - Convulsions. - Coma and death. 4. CVS manifestations: - Tachycardia or any cardiac dysarrhythmias. - Cor pulmonale: - Chronic hypoxia leads to vasoconstriction of pulmonary arteries which leads to pulmonary hypertension and cor-pulmonale. 5. Fine tremors. 6. Secondary polycythemia due to stimulation of the kidney to secrete erythropoietin hormone. ➨ Acute hypoxia is more serious than chronic hypoxia.	1. CNS manifestations: ❖ CO2 narcosis: Hypercapnia leads to somnolence, confusion, and coma. The rapidity of in $PaCO_2$ and the severity of the associated hypoxia contribute to the level of consciousness. ❖ Vasodilatation of cerebral vessels will lead to increase intracranial tension producing morning headache (due to CO_2 retention during sleep), blurring of vision (papilloedema can be visualized by ophthalmoscope). ❖ Sympathetic stimulation of the eye pupil lead to pupillary dilatation. 2. Flapping tremors, mycolonic jerks and even seizures. 3. CVS manifestations due to VD of peripheral circulation: • Warm sweaty hands. • Bounding pulse. • Hypotension (in sever hypercapnia). • Congested conjunctiva.

Investigations

1. Pulse oximetry
2. Capnography
3. Arterial blood gases





Treatment of Respiratory Failure

1. Airway Management
   - Endotracheal tube
   - Ambo bag
   - Tracheostomy
2. Oxygen therapy
   Short term (emergency)
   Long term (home)
3. Mechanical Ventilation
   Indication of Invasive MV:
   - Apnea / respiratory arrest.
   - Acute respiratory acidosis with pH < 7.25 that affect conscious level.
   - The partial pressure of oxygen in arterial blood (PaO2) cannot be maintained above 50mm Hg despite high levels of delivered oxygen
   - Ventilation becomes inefficient and/or exhausted (Severe bronchospasm, flail chest and impending respiratory failure).

Treatment of the Cause

- Antibiotics & inhaler

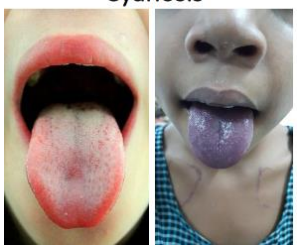
Prognosis

- The mortality associated with respiratory failure varies according to the etiology.
- For ARDS, mortality is approximately 40-45%;
- For patients with COPD and acute respiratory failure, the overall mortality has declined from approximately 26% to 10%.

The Examiner will ask you:

1. What is the types of RF?
2. What is your three most relevant causes for each type?
3. What is the clinical picture of hypoxemia and hypercapnia?
4. What is the different types of investigation used in diagnosis?
5. What is your plan of management?
6. Interpret this skill lab findings / ABG

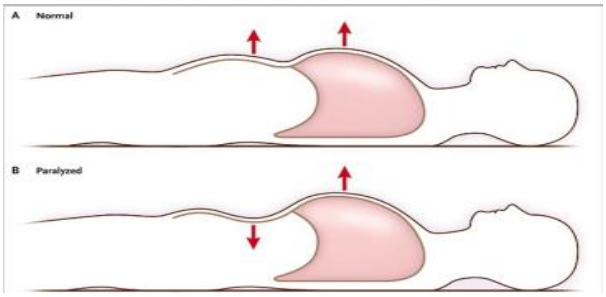
Cyanosis



Suprasternal retraction

Chest wall Retraction

Abdominal paradox



Tachypnea

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