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**DEPARTMENT OF PHYSICIAN ASSISTANT**

**COURSE NAME: PULMONOLOGY**

**TOPIC :- HYPERCAPNIA**

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# INTRODUCTION



- Hypercapnia is a medical condition characterized by an abnormally high level of carbon dioxide (CO<sub>2</sub>) in the bloodstream.
- This can occur due to respiratory or metabolic reasons.
- Respiratory causes include conditions such as chronic obstructive pulmonary disease (COPD), asthma, sleep apnea, neuromuscular diseases, chest injuries, and infections that impair the ability to breathe out enough CO<sub>2</sub>.
- Metabolic causes include diabetes, kidney failure, liver failure, and dehydration that lead to an increase in CO<sub>2</sub> production.





# RESPIRATORY CAUSES



Respiratory causes of hypercapnia occur when there is an issue with the respiratory system that prevents the body from effectively removing carbon dioxide from the lungs. This can lead to an accumulation of carbon dioxide in the bloodstream, resulting in hypercapnia.

Some common respiratory causes of hypercapnia include:

**1. Chronic Obstructive Pulmonary Disease (COPD):** COPD is a group of lung diseases that make it difficult to breathe. Conditions such as chronic bronchitis and emphysema can cause hypercapnia by making it harder for the lungs to expel carbon dioxide.

**2. Asthma:** Asthma is a chronic respiratory condition that causes inflammation and narrowing of the airways. This can lead to hypercapnia during asthma attacks, as the airways become even more constricted, making it harder to breathe out carbon dioxide.



# RESPIRATORY CAUSES



**3. Sleep Apnea:** Sleep apnea is a sleep disorder that causes breathing to stop and start during sleep. This can lead to hypercapnia, as the body is not able to effectively remove carbon dioxide during these periods of apnea.

**4. Neuromuscular Diseases:** Neuromuscular diseases such as amyotrophic lateral sclerosis (ALS) and myasthenia gravis can weaken the muscles involved in breathing, making it harder to expel carbon dioxide and leading to hypercapnia.

**5. Chest Injuries and Infections:** Chest injuries or infections such as pneumonia or pleurisy can cause inflammation and damage to the lungs, making it harder to breathe out carbon dioxide and leading to hypercapnia.



# METABOLIC CAUSES



Metabolic causes of hypercapnia occur when there is an issue with the body's ability to metabolize carbon dioxide properly. This can lead to an accumulation of carbon dioxide in the bloodstream, resulting in hypercapnia. Some common metabolic causes of hypercapnia include:

- 1. Diabetes:** Diabetes can lead to hypercapnia through a process called diabetic ketoacidosis (DKA). DKA occurs when there is a buildup of ketones in the bloodstream due to a lack of insulin, which can lead to an increase in carbon dioxide levels.
- 2. Kidney Failure:** Kidney failure can lead to hypercapnia through a process called metabolic acidosis. Metabolic acidosis occurs when the kidneys are unable to remove enough acid from the body, which can lead to an increase in carbon dioxide levels.



# METABOLIC CAUSES



**3. Liver Failure:** Liver failure can lead to hypercapnia through a process called hepatic encephalopathy. Hepatic encephalopathy occurs when there is a buildup of toxic substances in the brain due to liver failure, which can lead to an increase in carbon dioxide levels.

**4. Dehydration:** Dehydration can lead to hypercapnia through a process called dehydration alkalosis. Dehydration alkalosis occurs when there is a loss of electrolytes and water from the body, which can lead to an increase in carbon dioxide levels due to changes in pH balance.



# SYMPTOMS OF HYPERCAPNIA



**Headaches.**



**Shortness of breath.**



**Seizures.**



**Persistent tiredness  
or sluggishness  
during the day.**



**Neurological symptoms  
(disorientation, confusion, altered  
mental state, depression).**



# SYMPTOMS



Symptoms of hypercapnia can vary depending on the severity of the condition. Some common symptoms include:

- 1. Confusion:** As the level of CO<sub>2</sub> in the bloodstream increases, it can lead to confusion and disorientation. This is because high CO<sub>2</sub> levels can affect the brain's ability to function properly.
- 2. Dizziness:** Dizziness is a common symptom of hypercapnia, especially when standing up suddenly. This is because high CO<sub>2</sub> levels can cause a drop in blood pressure, leading to dizziness or lightheadedness.
- 3. Headache:** High CO<sub>2</sub> levels can cause headaches, which may be dull or throbbing in nature. These headaches are often accompanied by other symptoms of hypercapnia.





# SYMPTOMS



**4. Fatigue:** Fatigue is a common symptom of hypercapnia, as the body works harder to breathe due to the increased CO<sub>2</sub> levels. This can lead to feelings of tiredness and weakness.

**5. Shortness of breath:** As CO<sub>2</sub> levels increase, it can become more difficult to breathe, leading to shortness of breath or dyspnea. This is because the body's respiratory system is working harder to remove excess CO<sub>2</sub> from the bloodstream.

In severe cases of hypercapnia, symptoms such as seizures and coma may occur due to the effects of high CO<sub>2</sub> levels on the brain. It's important to seek medical attention if you experience any symptoms of hypercapnia or if you have concerns about underlying respiratory conditions that may lead to hypercapnia.



# DAIGNOSIS



## **Blood Gas Analysis:**

- Blood gas analysis is a laboratory test that measures the levels of oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), and pH in a blood sample. This test is performed using a specialized machine called a blood gas analyzer. The process involves drawing a small amount of blood from a vein or an artery and placing it into the machine. The machine then measures the levels of O<sub>2</sub>, CO<sub>2</sub>, and pH in the blood sample and provides a report with the results.
- In the context of hypercapnia diagnosis, blood gas analysis is used to measure the arterial partial pressure of carbon dioxide (PaCO<sub>2</sub>) in the bloodstream. PaCO<sub>2</sub> is a key indicator of hypercapnia as it reflects the concentration of CO<sub>2</sub> in the arterial blood. A PaCO<sub>2</sub> level above 45 mmHg in adults or above 50 mmHg in children is considered as hypercapnia.



# DAIGNOSIS



## Pulse CO2 Monitoring:

- Pulse CO2 monitoring is a non-invasive method for measuring CO2 levels in the body. This method involves attaching a sensor to the earlobe, finger, or forehead to measure the amount of CO2 being exhaled with each breath. The sensor detects changes in skin color caused by CO2 levels and converts them into numerical values that can be displayed on a monitor.
- Pulse CO2 monitoring is particularly useful for diagnosing hypercapnia in patients who are unable to undergo invasive procedures such as blood gas analysis due to medical conditions or age restrictions. This method can also provide real-time data on CO2 levels, allowing healthcare providers to monitor changes over time and adjust treatment plans accordingly.





# TREATMENT FOR RESPIRATORY CAUSES



**1. Oxygen therapy:** In respiratory causes of hypercapnia, oxygen therapy is the primary treatment. Oxygen is administered to increase the oxygen content in the blood, which helps to reduce the workload of the respiratory muscles and improve gas exchange.





# TREATMENT FOR RESPIRATORY CAUSES



**2. Bronchodilators:** Bronchodilators are medications that help to relax the airway muscles and improve airflow. They are useful in treating respiratory causes of hypercapnia, such as chronic obstructive pulmonary disease (COPD) and asthma, where bronchoconstriction contributes to hypercapnia.





# TREATMENT FOR RESPIRATORY CAUSES



**3. Chest physiotherapy:** Chest physiotherapy involves techniques such as postural drainage, percussion, and vibration to help clear mucus from the airways. It is useful in treating respiratory causes of hypercapnia, such as bronchiectasis and cystic fibrosis, where mucus accumulation leads to hypercapnia.

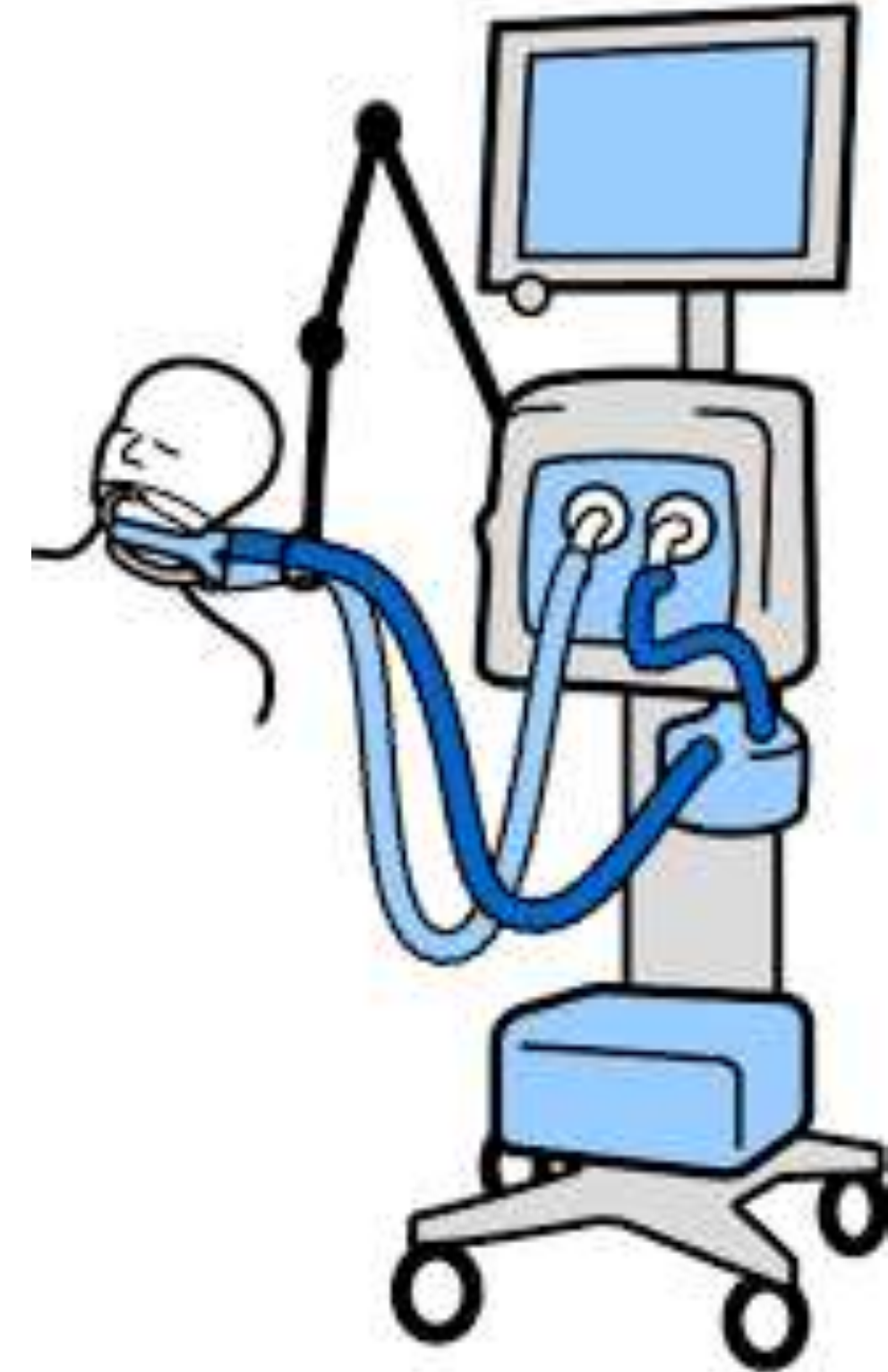




# TREATMENT FOR RESPIRATORY CAUSES



**4. Mechanical ventilation:** Mechanical ventilation is a life-saving intervention for severe respiratory causes of hypercapnia, such as acute respiratory distress syndrome (ARDS) and severe COPD exacerbations. It involves the use of a mechanical ventilator to assist with breathing and improve gas exchange.





# TREATMENT FOR METABOLIC CAUSES



**1. Insulin therapy:** In metabolic causes of hypercapnia, such as diabetic ketoacidosis (DKA) and hyperglycemic hyperosmolar state (HHS), insulin therapy is the primary treatment. Insulin helps to lower blood sugar levels and correct metabolic acidosis, which reduces CO<sub>2</sub> production and improves gas exchange.



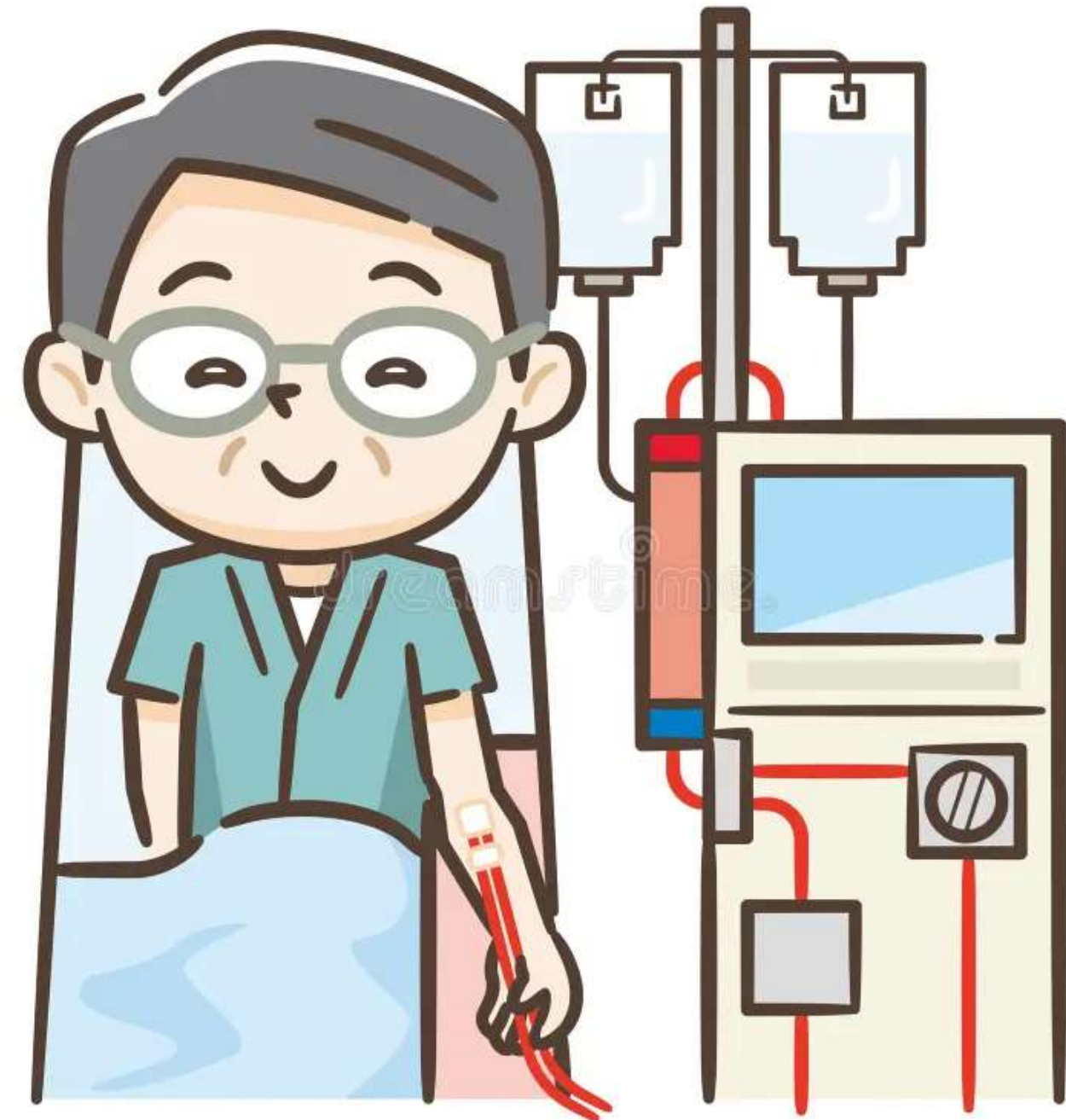




# TREATMENT FOR METABOLIC CAUSES



**2. Dialysis:** In metabolic causes of hypercapnia, such as renal failure and metabolic alkalosis, dialysis is a useful intervention to remove excess CO<sub>2</sub> from the bloodstream. Dialysis also helps to correct electrolyte imbalances that contribute to hypercapnia.





# TREATMENT FOR METABOLIC CAUSES



**3. Fluid replacement therapy:** In metabolic causes of hypercapnia, such as dehydration and hypovolemia, fluid replacement therapy is necessary to correct fluid imbalances that contribute to hypercapnia. Fluid replacement therapy helps to improve blood flow to the lungs and improve gas exchange.





# PREVENTION OF HYPERCAPNIA



**1. Quitting smoking:** Smoking is a major risk factor for respiratory causes of hypercapnia, such as COPD and lung cancer. Quitting smoking can help prevent respiratory causes of hypercapnia by reducing airway inflammation and improving lung function.





# PREVENTION OF HYPERCAPNIA



**2. Avoiding exposure to air pollution and secondhand smoke:** Exposure to air pollution and secondhand smoke can contribute to respiratory causes of hypercapnia, such as bronchitis and asthma. Avoiding exposure to these environmental factors can help prevent respiratory causes of hypercapnia.





# PREVENTION OF HYPERCAPNIA



**3. Maintaining a healthy weight:** Obesity is a risk factor for respiratory causes of hypercapnia, such as sleep apnea and OHS. Maintaining a healthy weight through diet and exercise can help prevent respiratory causes of hypercapnia by reducing airway obstruction and improving lung function.





# PREVENTION OF HYPERCAPNIA



**4. Regular checkups with healthcare providers:** Regular checkups with healthcare providers can help monitor lung function and address any underlying respiratory conditions early on. Early intervention can help prevent the progression of respiratory conditions that lead to hypercapnia.





**THANK YOU**