Respiratory Alkalosis

Respiratory alkalosis is an acid base imbalance marked by decreased levels of blood carbon dioxide with subsequent pH elevation. The direct cause is an increase in respiratory rate, which results in the excessive loss of CO2 on exhalation. The cause of increased respiratory rate is quite variable including high altitude, aspirin toxicity, restrictive lung disease, pulmonary embolism, pregnancy or anxiety. Carbon dioxide is an acidic molecule which helps maintain the blood's pH close to 7.4. When it is excessively exhaled, this balance is disrupted leading to an increase in the blood pH. This is referred to as respiratory alkalosis.



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Hyperventilation
Hiker-vent
When patients undergo hyperventilation, they blow off increased CO2. In acute cases, this may present as lightheadedness, anxiety, perioral numbness, and paresthesia. Tetany occurs from a low ionized calcium, since severe alkalosis increases calcium-binding to albumin.
It's important to note that ionized calcium is the most effective form of calcium which is readily available for cells.

High Altitude
Mountain-tops
Due to the decreased partial pressure of oxygen at high altitudes, a normal breath yields less oxygen when breathing at higher altitudes as compared to lower altitudes. This results in an increased respiratory rate to increase oxygen delivery. However, an increased respiratory rate can lead to respiratory alkalosis.

Aspirin
Aspirin
Salicylates directly stimulate respiration and aspirin toxicity should be suspected when both respiratory alkalosis and anion gap metabolic acidosis are present, particularly with alkalemia. This then can present as a mixed acid base disorder.

Restrictive Lung Disease
Restrictive-rope on Lungs
Restrictive lung disease is marked by the inability of the lungs to adequately expand. This results in the inability to efficiently acquire oxygen which causes a subsequent increase in ventilation to compensate, leading to a respiratory alkalosis.

Pulmonary Embolism
Lungs Elmo
A pulmonary embolism (airway obstruction) occludes the lung vasculature and subsequently creates extra dead space within the lung. With increased dead space, the lung is unable to adequately supply oxygen to the rest of the body. The body compensates by increasing ventilation to maximize oxygen delivery, resulting in hyperventilation.

Pregnancy
Pregnant-woman
Increased progesterone in pregnancy stimulates the respiratory center (brain stem), producing an average PCO2 of 30 mm Hg, resulting in sustained hyperventilation leading to respiratory alkalosis.

Progesterone
Jester
This hormone stimulates the respiratory center and can cause respiratory alkalosis if levels are persistently elevated. Elevated progesterone can be seen in pregnancy, those taking infertility medications, and liver failure.

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Rib Fracture

Ribs Shattered

Rib fractures can result in decreased lung expansion due to pain on inspiration and pressure on the involved rib. This results in the inability to efficiently acquire oxygen which causes a subsequent increase in ventilation to compensate, leading to a respiratory alkalosis.

Anxiety

Anxiety-bag

An acute anxiety attack can result in a rapid and severe hyperventilation respiratory response which can result in significant loss of CO2 and quick onset of alkalosis. The traditional treatment of breathing into a paper bag should be discouraged because it does not correct PCO2 and may decrease PO2. Reassurance may be sufficient for the anxious patient but sedation may be necessary. Hyperventilation is usually self-limited since muscle weakness caused by the respiratory alkalemia will suppress ventilation.

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