Methemoglobinemia Characteristics

Methemoglobinemia is characterized by the conversion of ferrous iron (Fe²⁺) in hemoglobin to the oxidized ferric form (Fe³⁺), which has a decreased affinity for oxygen and an increased affinity for cyanide. Some notable etiologies of methemoglobinemia include excessive dietary nitrates, some drugs like nitroglycerin and lidocaine, and G6PD deficiency.

PLAY PICMONIC

Characteristics

Oxidized Iron in Hemoglobin

Oxidized-ox creates Iron suit for He-man-globe

Methemoglobinemia is characterized by the oxidation of ferrous iron (Fe²⁺) in hemoglobin to ferric iron (Fe³⁺), which has a decreased ability to bind oxygen. It can be life-threatening due to tissue hypoxia.

Decreased Affinity for Oxygen

Down-arrow O2-tank

The ferric (Fe³⁺) state of iron is an oxidized form of hemoglobin that occurs in methemoglobinemia. It doesn't have as strong a binding ability for oxygen as ferrous iron (Fe²⁺), resulting in a decreased ability to bind and transport oxygen to tissue. As a result, functional anemia can also be seen.

Increased Affinity for Cyanide

Up-arrow Sai

Ferric (Fe3+) state, formed in methemoglobinemia, doesn't have a strong binding ability for oxygen, but it can effectively bind to cyanide. Therefore, it is helpful in treating cyanide toxicity.

Etiologies

Dietary Nitrates

Dietary-plate Nitro-tank

Dietary nitrites/nitrates are found in foods or high-altitude water sources. Excessive ingestion can cause methemoglobinemia because the nitrate group can accept electrons from iron, thereby oxidizing it.

Drugs

Med-bottle

Methemoglobinemia can be acquired after exposure to substances that cause oxidized iron in hemoglobin. These may include indirect oxidation (e.g., nitrates), direct oxidizing agents (e.g., benzocaine), or metabolic activation (e.g., dapsone and aniline).

Nitroglycerin

Nitro-glacier

Methemoglobinemia should be a part of the differential diagnosis in patients with cyanosis with respiratory distress, especially if the patients are exposed to oxidizing agents, such as nitroglycerin. It can be suspected in critically ill settings.

Lidocaine

Lion-cane

Lidocaine can induce methemoglobinemia by its direct oxidizing effect. It is most commonly reported from upper gastrointestinal or upper airway procedures. Patients with G6PD deficiency or hepatic insufficiency may have a higher risk of developing this condition.

G6PD Deficiency

Glue (6) Sax-P-Dehydrator Broken

G6PD deficiency can manifest with severe hemolysis, resulting in more ferric state formation than the ferrous state. As a result, methemoglobin occurs.