Blood Gases

By

Dr. Walaa Bayoumie El Gazzar

Arterial Blood Gases
ABGs

- Blood gases are a group of tests that are performed together to measure blood-gas tension values of the arterial partial pressure of oxygen (PaO_2), and the arterial partial pressure of carbon dioxide ($PaCO_2$), and the blood's pH. In addition, the arterial oxygen saturation (SaO_2) can be determined.

- The partial pressure of a gas is a measure of thermodynamic activity of the gas's molecules.

- In medicine, oxygen saturation (SO2), commonly referred to as "sats," measures the percentage of hemoglobin binding sites in the bloodstream occupied by oxygen. At low partial pressures of oxygen, most hemoglobin is deoxygenated.

- oxygen saturation approaches 100% at partial oxygen pressures of >10 kPa.

- Such information is vital when caring for patients with critical illness or respiratory disease. Therefore, the ABG test is one of the most common tests performed on patients in intensive care units (ICUs).

- Blood gas measurements are used to evaluate a person's lung function and acid/base balance.

- They are typically ordered if someone is having worsening symptoms of a respiratory problem, such as difficulty breathing or shortness of breath, and a condition such as asthma or chronic obstructive pulmonary disease (COPD) is suspected. Blood gases may also be used to monitor treatment for lung diseases and to evaluate the effectiveness of supplemental oxygen therapy.

- The following components can be determined by blood gas analysis:

-pH: The pH or H^+ indicates if a patient is acidemic (pH < 7.35; H^+ >45) or alkalemic (pH > 7.45; H^+ < 35).

-Arterial oxygen partial pressure (P_aO_2) [range: 75–100 mmHg or 11–13 kPa kilopascal] : A low PaO_2 indicates that the patient is not oxygenating properly, and is hypoxemic. At a P_aO_2 of less than 60 mm Hg, supplemental oxygen should be administered. At a P_aO_2 of less than 26 mmHg, the patient is at risk of death and must be oxygenated immediately

- Arterial carbon dioxide partial pressure (P_aCO_2) [range: 35–45 mmHg OR 4.7–6.0 kPa]: A high $PaCO_2$ (respiratory acidosis, alternatively hypercapnia) indicates underventilation (or, more rarely, a hypermetabolic disorder), a low $PaCO_2$ (respiratory alkalosis, alternatively hypocapnia) hyper- or overventilation.
- HCO_3^- (22–26 mEq/L) : The HCO_3^- ion indicates whether a metabolic problem is present (such as ketoacidosis). A low HCO_3^- indicates metabolic acidosis, a high HCO_3^- indicates metabolic alkalosis.
- O_2 saturation (O_2Sat or S_aO_2): The percentage of hemoglobin that is carrying oxygen.
- O_2 content (O_2CT or C_aO_2). The amount of oxygen per 100 mL of blood. This is the sum of oxygen dissolved in plasma and chemically bound to hemoglobin

- **uncompensated respiratory acidosis**.

(HCO3 normal---H2CO3 increased---pH **<**7.35)

compensated respiratory acidosis.

(HCO3 increased--H2CO3 increased---pH **near** 7.35)

- **uncompensated respiratory alkalosis**.

(HCO_3^- normal---H2CO3 decreased---pH>7.45)

- **compensated respiratory alkalosis.**

(HCO_3^- decreased---H2CO3 decreased---pH near 7.45)

- A 1 mmHg change in $PaCO_2$ above or below 40 mmHg results in 0.008 unit change in pH in the opposite direction.
- The $PaCO_2$ will decrease by about 1 mmHg for every 1 mEq/L reduction in $[HCO_3^-]$ below 24 mEq/L
- A change in $[HCO_3^-]$ of 10 mEq/L will result in a change in pH of approximately 0.15 pH units in the same direction.