ARTERIAL BLOOD GASES INTERPRETATION

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Purpose of ABG

- **Assess degree to which lungs are able to provide adequate oxygen & remove CO2 & degree to which the kidneys are able to reabsorb or excrete HCO3**

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1. **Establish the diagnosis and severity of respiratory failure**
2. **Manage patients in intensive therapy units admitted for:**
    - **Respiratory failure or dysfunction**
    - **Cardiac failure**
    - **Renal or hepatic failure**
    - **Poly trauma and multiorgan failure**
    - **Diabetic ketoacidosis**
    - **Sepsis and burns**
    - **Poisoning**

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1. **Guide therapy in patients in the ICU, e.g.**
   - **Oxygen administration**
   - **Mechanical ventilation**
2. **Monitor patients during**
   - **Cardiopulmonary surgery**
   - **Cardiopulmonary exercise testing**
   - **Sleep studies**
3. **Determine prognosis in critically ill patients**

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ACID BASE BALANCE
ABG ANALYSIS

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Metabolic

- **Metabolic:** **referring to metabolism.**
  - **Metabolism: the sum of all chemical processes that take place in the body as they relate to the movement of nutrients in the blood after digestion, resulting in growth, energy, release of wastes, and other body functions.**

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Respiratory:

- **Respiratory:** referring to breathing (respiration).
  - Respiration: breathing, the give and take of oxygen and carbon dioxide in the body's tissues, from the lungs to the level of the cells. The rate changes with the age and condition of the person.

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Acidosis

- **Acidosis: is the process that cause acidemia.**
  - **Acidemia: is a condition in which the hydrogen ion concentration of the blood is elevated, the blood has an acid excess or base deficit (pH < 7.35).**

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Alkalosis

- **Alkalosis:** **is the process that cause alkalemia.**
  - **Alkalemia: is a condition in which the hydrogen ion concentration of the blood is reduced, the blood has an acid deficit or base excess (pH > 7.45).**

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ABG ANALYSIS

- **PH:** is a measure of its hydrogen-ion concentration.

- **CO2:** Carbonic dioxide, is a potential acid, when dissolve in water, its comes Carbonic acid H2CO3

- **HCO3:** bicarbonate, is a base and accepting or combine with H^+ ions to remove these ions from a solution.

- **PAO2:** Partial Pressure of Alveolar oxygen

- **O2 Saturation:** Percentage of haemoglobin which oxygenated (oxyhaemoglobin). At low partial pressures of oxygen, most hemoglobin is deoxygenated.

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- **O2 Saturation** > 88% = Arterial
  < 88% = Mixed, Venous

- **BE: Base Excess,** Base that must be added to Restore a normal pH . The value is usually reported in units of (mEq/L).
- **Normal Range:** -2 to +2 meq/L
- **Positive (Base Excess):** Metabolic Alkalosis
- **Negative (Base Deficit):** Metabolic Acidosis

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Normal Blood Gases Values
Acidemia and Alkalemia

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What You Must Look at to Interpret ABGs

- Look at Your pH
- Is it normal?
- Is it high ?
- Is it low?

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Examples

- pH = 7.36
- pH = 7.23
- pH = 7.47
- A high pH indicates alkalosis
- A low pH indicates acidosis

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Look at Your PaCO2

- Is it normal ?
- Is it high ?
- Is it low ?

- This is the respiratory component
- An abnormality in the PaCO2 will indicate a respiratory problem
- Hyperventilating? (Decreased PaCO2)
- Hypoventilating? (Increased PaCO2)
- Normal ventilation

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Examples

- PaCO2 = 40 mm Hg
- PaCO2 = 23 mm Hg
- PaCO2 = 48 mm Hg
- A high PaCO2 indicates acidity
- A low PaCO2 indicates alkalosis

- Lungs will increase or decrease ventilation to remove the appropriate amount of CO2
- Lung compensation begins quickly

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Now Look at Your HCO3

- Is it normal ?
- Is it high ?
- Is it low ?
- This is the metabolic component
- An abnormality in the HCO3 indicates a metabolic problem

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Examples

- HCO3 = 25 mEq/l
- HCO3 = 19 mEq/l
- HCO3 = 32 mEq/l
- A low HCO3 indicates acidity
- A high HCO3 indicates alkalosis

- The kidneys excrete Hydrogen (acid) & retain bicarbonate (base) to help maintain pH
- Renal compensation is slow

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Let's Look at the 4 Situations that Can Occur

ACIDOSIS

- **Develops when:**
- **Excess accumulation of acid**
- **Decreased amount of alkali**
- **Can be respiratory or metabolic**

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Metabolic Acidosis

ABG:

- Low pH (below 7.35)
- Decreased HCO3 (below 22)
- PaCo2 will be normal
- Remember both the pH & HCO3 will be low
- Caused by too much acid in the body or loss of bicarbonate
- Diarrhea (loss of HCO3)
- Diabetic ketoacidosis
- Renal failure

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Respiratory Acidosis

ABG:

- Low pH (below 7.35)
- Increased PaCO2 (above 45)
- HCO3 will be normal
- Remember the pH will be low & PaCO2 will be elevated.
- Caused by acid buildup due to lungs not eliminating CO2
- Anything that decreased respirations can cause respiratory acidosis
- Chronic respiratory disease
- CNS depression

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ALKALOSIS

Develops when:

- **Excess accumulation of bicarbonate**
- **Loss of acid**

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Metabolic Alkalosis

ABG:

- Increase in pH (greater than 7.45)
- Increased HCO3 (greater than 26)
- PaCO2 will be normal
- Remember both the pH & the HCO3 will be elevated
- Loss of acid or increase in HCO3
- Vomiting or NG drainage (loss of Hydrogen)
- Excessive use of antacids

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Respiratory Alkalosis

ABG:

- Increase in pH (greater than 7.45)
- Decrease in PaCO2 (less than 35)
- HCO3 will be normal
- Remember the pH will be high & PaCO2 will be low.
- Caused by too much CO2 being excreted by the lungs
- Hyperventilation

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Problems

- pH of 7.33
- PaCO2 of 40 mmHg
- HCO3 of 20 mEq/L
- What does this indicate
- Break it down
- pH = acidosis
- PaCO2 = normal
- HCO3 = acidosis
- An abnormal HCO3 indicates a "Metabolic Acidosis"

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Problem

- pH of 7.59
- PaCO2 of 29 mm Hg
- HCO3 of 24mEq/L
- What does this indicate
- Break it down
- pH = alkalosis
- PaCO2 = alkalosis
- HCO3 = normal
- An abnormal PaCO2 indicates "Respiratory Alkalosis"

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Problem

- pH of 7.25
- PaCO2 of 61 mmHg
- HCO3 of 26 mEq/L
- What does this indicate
- Break it down
- pH = acidosis
- PaCO2 = acidosis
- HCO3 = normal
- An abnormal PaCO2 indicates "Respiratory Acidosis"

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Problem

- pH of 7.51
- PaCO2 of 44mmHg
- HCO3 of 56
- What does this indicate
- Break it down
- pH = alkalosis
- PaCO2 = normal
- HCO3 = alkalosis
- An abnormal HCO3 indicates "Metabolic Alkalosis"

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Compensation

- Occurs as the body begins to correct the acid base imbalance
- pH will be normal or near normal if total compensation
- pH will be abnormal if partial compensation
- Both the PaCo2 & HCO3 will be abnormal
- Respiratory imbalances are compensated for by the renal system
- Metabolic imbalances are compensated for by the respiratory system

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Example

- pH of 7.27
- PaCO2 of 27 mm Hg
- HCO3 of 10 mEq/l
- Note that both the PaCO2 & the HCO3 are low

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Let's Break it Down

- **Low pH** = acidosis
- **Low PaCO2** = alkalosis
- **Low HCO3** = acidosis
- **HCO3** corresponds with the **pH**
- This is a **metabolic problem**
- **Metabolic acidosis with partial compensation**

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Problems

- **pH of 7.52**
- **PaCO2 of 47 mmHg**
- **HCO3 of 36 mEq/L**
- **What does this indicate????**

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- Break it down
- pH = alkalosis
- PaCO2 = acidosis
- HCO3 = alkalosis
- Which 2 go together
- Metabolic Alkalosis with Partial Compensation

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Problems

- pH of 7.45
- PaCO2 of 50 mmHg
- HCO3 of 33 meq/L
- Break it down
- pH = normal
- PaCo2 = acidosis
- HCO3 = alkalosis
- Your pH leans toward the alkalosis side
- " Fully Compensated Metabolic Alkalosis"

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