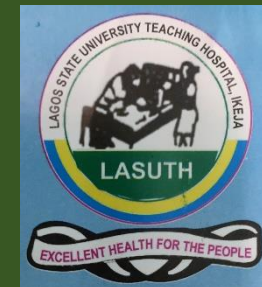


CLINICAL VIGNETTE
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Arterial Blood Gas Analysis



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Arterial Blood Gas Analysis

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INTRODUCTION

- Arterial blood gas (ABG) measures Acidity, Oxygen tension (PaO_2), Carbon dioxide tension (PaCO_2), Oxyhaemoglobin saturation and Bicarbonate concentration
- *Some blood analyzers also measures- Methaemoglobin, Carboxyhaemoglobin and Haemoglobin levels
- Essential for diagnosing, monitoring a patient oxygenation status/gas exchange & acid base balance (whether patient is on mechanical ventilator or not)
- *Change in H^+ concentration is responded to by BICARBONATE BUFFER SYSTEM in few seconds, RESPIRATORY REGULATION in few minutes & RENAL REGULATION in hours to days
- *Normal ABG result does not rule out acid base imbalance

ABG COMPONENTS & NORMAL VALUES

- **pH**- hydrogen ion concentration (7.35-7.45)
 - **PaCO₂**- pressure of CO₂ in the blood (35-45mmHg)
 - **PaO₂**- pressure of O₂ dissolved in the blood (72-104mmHg)
 - **Oxygen saturation**- amount of oxygen in the blood (95-100%)
 - **HCO₃⁻** kidney ability to retain and excrete bicarbonate (22-26mEq/L)
 - **Electrolytes**- Na, K
 - **Base Excess**- assessment of metabolic acidosis/alkalosis (± 2 mEq/L)
 - **Anion Gap**- Difference in measured cations and anions (12 ± 4)
- *O₂ Saturation measured by pulse oximeter- SpO₂
- *O₂ Saturation measured by CO-oximeter- SaO₂

CLINICAL CORRELATE

- **pH**- Determines presence of acidaemia or alkalaemia
- **PaO₂**-
 - Reflect gas exchange in the lung
 - From ventilation perfusion mismatch or hypoventilation
 - Decreases with age
- *PaO₂ :FiO₂< 300mmHg- Acute lung injury
- *PaO₂:FiO₂<200mmHg- Acute respiratory distress
- **PaCO₂**-
 - Reflect the state of alveolar ventilation
 - Elevated PaCO₂ reflects alveolar hypoventilation
 - Decrease PaCO₂ reflects hyperventilation

OBTAINING A BLOOD SAMPLE

- Explain procedure to the patient and obtain Consent
- Check vital sign
- Materials- Heparinized 1ml syringe, heparinized needle (23-26G)
- Perform Allen's test when using radial artery
- Other Arterial sites: brachial, femoral, dorsalis pedis

ABG ANALYZERS

- i-STAT and I-STAT I Portable Clinical Analyzer
- i- STAT Cartridges(i-stat G3 Cartridges)
- Stored at 2- 8°C
- Cartridge are used at room temperature
- About 30 minutes to reach room temperarure
- I-STAT Calibration verification material

ACID BASE DISORDERS...

RESPIRATORY ACIDOSIS

pH<7.35; PaCO₂> 45mmHg

- CNS DEPRESSION- Head injury, Narcotic, Sedatives
- Neuromuscular disease
- Pulmonary disorder
- Hypoventilation- Pain, chest trauma, deformity

RESPIRATORY ALKALOSIS

pH>7.45; PaCO₂<35mmHg

- Metabolic demand: fever, sepsis
- Drugs: respiratory stimulant

ACID BASE DISORDERS

METABOLIC ACIDOSIS

pH<7.35; HCO_3^- <22mEq/L; Negative base excess

- Renal failure
- Diabetic ketoacidosis (DKA)
- Salicylate poisoning
- Starvation

METABOLIC ALKALOSIS

pH>7.45; HCO_3^- >26mEq/L; Positive base excess

- Ingestion of antacid
- Excess use of bicarbonate
- Loss of acid – protracted vomiting, excess diuretics

High anion gap

Indicative of acidosis

- lactic acidosis
- ketoacidosis: DKA, Alcohol abuse
- Toxin- methanol, ethylene glycol, uremia, aspirin, cyanide
- Renal failure

Low anion gap

Caused by hypoalbuminemia

- Nephrotic syndrome
- Liver cirrhosis

INTERPRETATION...

	pH	PaCO ₂	PaO ₂	Base excess	HCO ₃
Respiratory acidosis	Low	Increased	Normal	Normal/Increased	Normal
Respiratory alkalosis	High	Low	Normal	Normal/Decreased	Normal
Metabolic acidosis	Low	Normal	Normal	Reduced	Reduce
Metabolic alkalosis	High	Normal	Normal	Increased	Elevated

INTERPRETATION

	pH	PaCO ₂ (mmHg)	HCO ₃ ⁻ (mEq/L)
Respiratory Acidosis			
Acute	<7.35	>45	Normal
Partly compensated	<7.35	>45	>26
Compensated	Normal	>45	>26
Respiratory Alkalosis			
Acute	>7.45	<35	Normal
Partly compensated	>7.45	<35	<22
Compensated	Normal	<35	<22
Metabolic Acidosis			
Acute	<7.35	Normal	<22
Partly compensated	<7.35	<35	<22
Compensated	Normal	<35	<22
Metabolic Alkalosis			
Acute	>7.45	Normal	>26
Partly compensated	>7.45	>45	>26
Compensated	Normal	>45	>26

CASE SCENARIO: 50-year-old man with multisystem trauma, deteriorating 5 days after admission.

pH	7.25
PO ₂	90mmHg
PCO ₂	22mmHg
SO ₂	95%
Actual HCO ₃ ⁻	10.3mEq/L
Na ⁺	139mEq/L
Cl ⁻	100mEq/L

Interpretation

- ACIDAEMIA- pH of 7.25
- METABOLIC- PCO₂
- ANION GAP= Na – (HCO₃ +Cl)
= 139-(10.3+100)
= 28.7 =HIGH

FACTORS INFLUENCING ABG RESULTS

- * Delayed processing may yield falsely low PaO₂
- * Air bubbles introduced during arterial puncture can lead to falsely high PaO₂ and low PaCO₂.
- * Body temperature can affect blood gas tension

LIMITATIONS OF ABG ANALYSIS

- It cannot yield specific diagnosis
- The analysis does not reflect the degree to which an abnormality actually affect a patient
- Cannot be used as a screening test for early pulmonary disease

CONCLUSION

- ABG results shows if the patient is acidaemic or alkalaemic and whether the cause is likely to have a respiratory or metabolic component
- Useful adjunct to the assessment of patient with acute/chronic disease and in mechanically ventilated patients in ICU or intra-operatively
- When combined with patient clinical features its analysis can facilitate diagnosis

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