Aterial Blood Gases
Adult Health Nursing (2)
Clinical

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OUTLINE:

- Introduction
- Definition
- Indication
- ABG component
- Normal value
- Procedure:

  preparatory – performance – follow up phase
- Complication
- acid-base disorders
- Result interpretation
- compansation
- Tutorial

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INTRODUCTION

- The major function of the pulmonary system (lungs and pulmonary circulation) is to deliver oxygen to cells and remove carbon dioxide from the cells.
- If the patient's history and physical examination reveal evidence of respiratory dysfunction, diagnostic test will help identify and evaluate the dysfunction.
- ABG analysis is one of the first tests ordered to assess respiratory status because it helps evaluate gas exchange in the lungs.
- An ABG test can measure how well the person's lungs and kidneys are working and how well the body is using energy.

DEFINITION

It is a diagnostic procedure in which a blood is obtained from an artery directly by an arterial puncture or accessed by a way of indwelling arterial catheter

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INDICATION

- To obtain information about patient ventilation (PCO2) , oxygenation (PO2) and acid base balance
- Monitor gas exchange and acid base abnormalities for patient on mechanical ventilator or not
- To evaluate response to clinical intervention and diagnostic evaluation (oxygen therapy)
- An ABG test may be most useful when a person's breathing rate is increased or decreased or when the person has very high blood sugar levels, a severe infection, or heart failure

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ABG COMPONENT

- **PH:**

  measures hydrogen ion concentration in the blood, it shows blood' acidity or alkalinity

- **PCO2 :**

  It is the partial pressure of CO2 that is carried by the blood for excretion by the lungs, known as respiratory parameter

- **PO2:**

  It is the partial pressure of O2 that is dissolved in the blood , it reflects the body ability to pick up oxygen from the lungs

- **HCO3 :**

  known as the metabolic parameter, it reflects the kidney's ability to retain and excrete bicarbonate

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NORMAL VALUES:

- PH = 7.35 – 7.45
- PCO2 = 35 – 45 mmHg
- PO2 = 80 – 100 mmHg
- HCO3 = 22 – 26 meq/L

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EQUIPMENT

Blood gas kit OR

- 1ml syringe
- 23-26 gauge needle
- Stopper or cap
- Alcohol swab
- Disposable gloves
- Plastic bag & crushed ice
- Lidocaine (optional)
- Vial of heparin (1:1000)
- Par code or label

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PREPARATORY PHASE:

- Record patient inspired oxygen concentration
- Check patient temperature
- Explain the procedure to the patient
- Provide privacy for client
- If not using hepranized syringe , hepranize the needle
- Perform Allen's test
- Wait at least 20 minutes before drawing blood for ABG after initiating, changing, or discontinuing oxygen therapy, or settings of mechanical ventilation, after suctioning the patient or after extubation.

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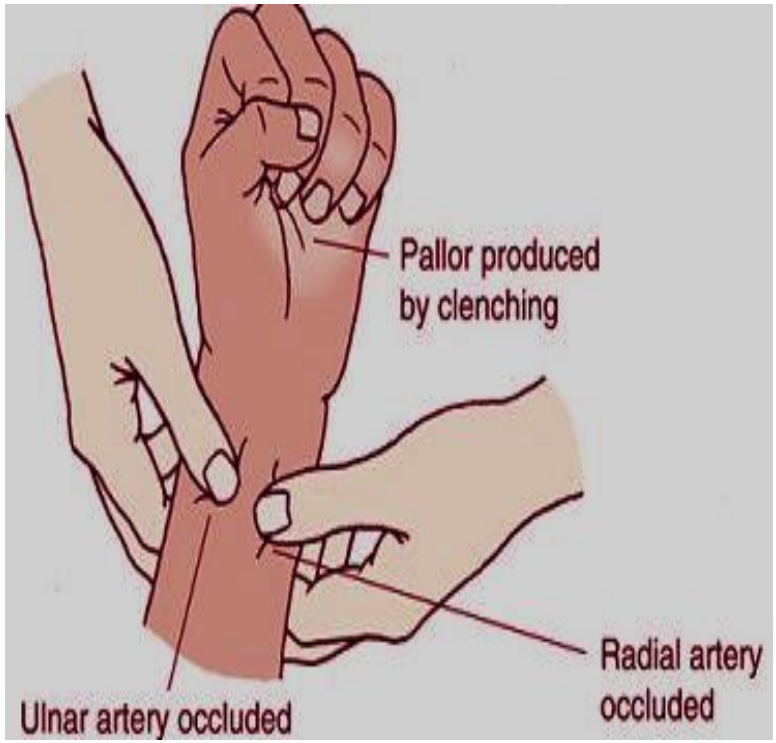
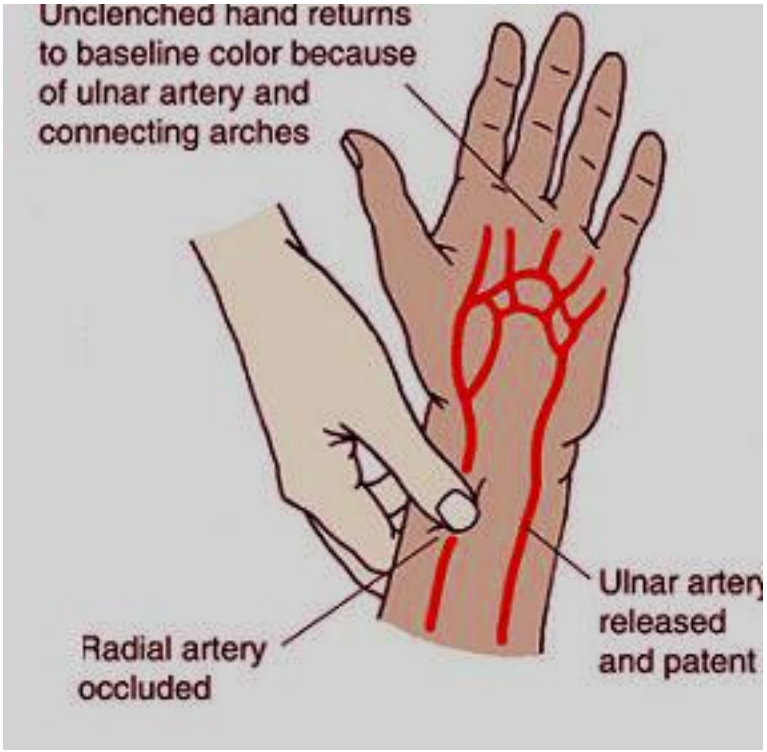
ALLEN'S TEST

It is a test done to determine that collateral circulation is present from the ulnar artery in case thrombosis occur in the radial





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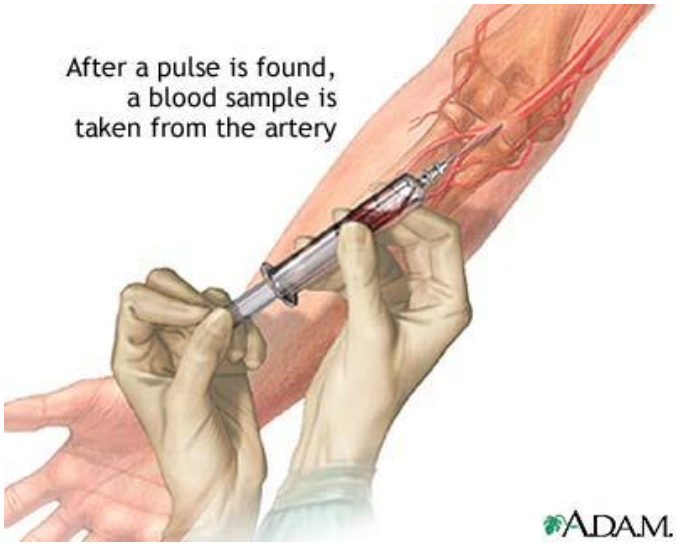
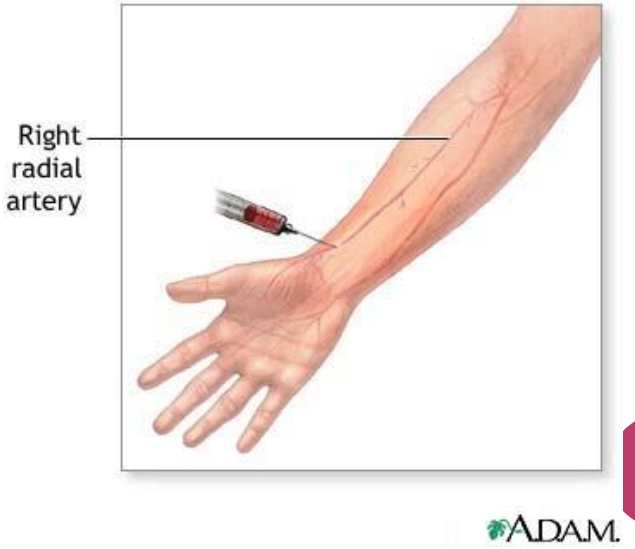
SITES FOR OBTAINING ABG

- Radial artery (most common)
- Brachial artery
- Femoral artery



Radial is the <u>most preferable</u> site used because:

- It is easy to access
- It is not a deep artery which facilitate palpation, stabilization and puncturing
- The artery has a collateral blood circulation



PERFORMANCE PHASE:

- Wash hands
- Put on gloves
- Palpate the artery for maximum pulsation
- If radial, perform Allen's test
- Place a small towel roll under the patient wrist
- Instruct the patient to breath normally during the test and warn him that he may feel brief cramping or throbbing pain at the puncture site
- Clean with alcohol swab in circular motion
- Skin and subcutaneous tissue may be infiltrated with local anesthetic agent if needed

- Insert needle at 45 radial ,60 brachial and 90 femoral
- Withdraw the needle and apply digital pressure
- Check bubbles in syringe
- Place the capped syringe in the container of ice immediately
- Maintain firm pressure on the puncture site for 5 minutes, if patient has coagulation abnormalities apply pressure for 10 – 15 minutes

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FOLLOW UP PHASE:

- Send labeled, iced specimen to the lab immediately
- Palpate the pulse distal to the puncture site
- Assess for cold hands, numbness, tingling or discoloration
- Documentation include: results of Allen's test, time the sample was drawn, temperature, puncture site, time pressure was applied and if O_2 therapy is there
- Make sure it's noted on the slip whether the patient is breathing room air or oxygen. If oxygen, document the number of liters . If the patient is receiving mechanical ventilation, FIO_2 should be documented

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COMPLICATION

- Arteriospasm
- Hematoma
- Hemorrhage
- Distal ischemia
- Infection
- Numbness

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A LOOK AT ACIDS AND BASES

- The body constantly works to maintain a balance (homeostasis) between acids and bases. Without that balance, cells can't function properly. As cells use nutrient to produce the energy, two by-products are formed H+ & CO2. acid-base balance depends on the regulation of the free hydrogen ions

- Even slight imbalance can affect metabolism and essential body functions. Several conditions as infection or trauma and medications can affect acid-base balance

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Interpretation of ABG results

PH	7.30	acidemia
PaCO2	55 mmhg	increased (respiratory cause)
HCO3	25 meq/l	normal
PaO2	80 mmhg	normal

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Respiratory acidosis

PH	7.49	alkalemia
PaCO2	40 mmhg	normal
HCO3	29 meq/l	increased (metabolic cause)
PaO2	85 mmhg	normal

Metabolic alkalosis

ACID BASE DISORDERS

Respiratory acidosis		
PH	PCO2	HCO3
↓	↑	------

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Respiratory alkalosis

PH	PCO2	HCO3
↑	↓	------

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Metabolic acidosis

PH	PCO2	HCO3
↓	------	↓

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Metabolic alkalosis

PH	PCO2	HCO3
↑	------	↑

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COMPENSATION

- The respiratory and metabolic system works together to keep the body's acid-base balance within normal limits.
- The respiratory system responds to metabolic based PH imbalances in the following manner:

* metabolic acidosis: ↑ respiratory rate and depth (↓PaCO2)

* metabolic alkalosis: ↓ respiratory rate and depth (↑PaCO2)

- The metabolic system responds to respiratory based PH imbalances in the following manner:

*respiratory acidosis: ↑ HCO3 reabsorption

*respiratory alkalosis: ↓HCO3 reabsorption

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A. Respiratory acidosis

Phase	PH	PaCO2	HCO3
UNCOMPENSATED	↓	↑	------

Because there is no response from the kidneys yet to acidosis the HCO3 will remain normal

Phase	PH	PaCO2	HCO3
PARTIAL COMPENSATED	↓	↑	↑

The kidneys start to respond to the acidosis by increasing the amount of circulating HCO3

Phase	PH	PaCO2	HCO3
FULL COMPENSATED	N	↑	↑

PH return to normal PaCO2 & HCO3 levels are still high to correct acidosis

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B. Respiratory alkalosis

Phase	PH	PaCO2	HCO3
UNCOMPENSATED	↑	↓	------

Because there is no response from the kidneys yet to acidosis the HCO3 will remain normal

Phase	PH	PaCO2	HCO3
PARTIAL COMPENSATED	↑	↓	↓

The kidneys start to respond to the alkalosis by decreasing the amount of circulating HCO3

Phase	PH	PaCO2	HCO3
FULL COMPENSATED	N	↓	↓

PH return to normal PaCO2 & HCO3 levels are still low to correct alkalosis

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C. METABOLIC ACIDOSIS

Phase	PH	PaCO2	HCO3
UNCOMPENSATED	↓	-------	↓

Because there is no response from the lungs yet to acidosis the PaCO2 will remain normal

Phase	PH	PaCO2	HCO3
PARTIAL COMPENSATED	↓	↓	↓

The lungs start to respond to the acidosis by decreasing the amount of circulating PaCO2

Phase	PH	PaCO2	HCO3
FULL COMPENSATED	N	↓	↓

PH return to normal PaCO2 & HCO3 levels are still low to correct acidosis

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D. METABOLIC ALKALOSIS

Phase	PH	PaCO2	HCO3
UNCOMPENSATED	↑	-------	↑

Because there is no response from the lungs yet to alkalosis the PaCO2 will remain normal

Phase	PH	PaCO2	HCO3
PARTIAL COMPENSATED	↑	↑	↑

The lungs start to respond to the alkalosis by increasing the amount of circulating PaCO2

Phase	PH	PaCO2	HCO3
FULL COMPENSATED	N	↑	↑

PH return to normal PaCO2 & HCO3 levels are still high to correct alkalosis

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TUTORIAL

Example 1

Jane Doe is a 45-year-old female admitted to the nursing unit with a severe asthma attack. She has been experiencing increasing shortness of breath since admission three hours ago.
Her arterial blood gas result is as follows

Clinical Laboratory:

pH 7.22

PaCO2 55

HCO3 25

Follow the steps:

- **1. Assess the pH. It is low therefore, we have acidosis.**
- **2. Assess the PaCO2. It is high and in the opposite direction of the pH.**
- **3. Assess the HCO3. It has remained within the normal range (22-26).**

Acidosis is present (decreased pH) with the PaCO2being increased, reflecting a primary respiratory problem. For this patient, we need to improve the ventilation status by providing oxygen therapy, mechanical ventilation or by administering bronchodilators.

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Example 2

John Doe is a 55-year-old male admitted with a recurring bowel obstruction. He has been experiencing intractable vomiting for the last several hours, Here is his arterial blood gas result:

Clinical Laboratory:

pH 7.50

PaCO2 42

HCO3 33

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Follow the steps again:

- **1. Assess the pH. It is high (normal 7.35-7.45), therefore, indicating alkalosis.**
2. **Assess the PaCO2. It is within the normal range (normal 35-45).**
3. **Assess the HCO3. It is high (normal 22-26) and moving in the same direction as the pH.**

Alkalosis is present (increased pH) with the HCO3 increased, reflecting a primary metabolic problem. Treatment of this patient might include administration of I.V. fluids and measures to reduce the excess base.

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