ARTERIAL BLOOD GASES

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OUTLINE:

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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

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

NORMAL VALUES:

- PH = 7.35 – 7.45
- PCO2 = 35 – 45 mmhg
- PO2 = 80 – 100 mmhg
- HCO3 = 22 – 28 meq/L

EQUIPMENT

Blood gas kit OR

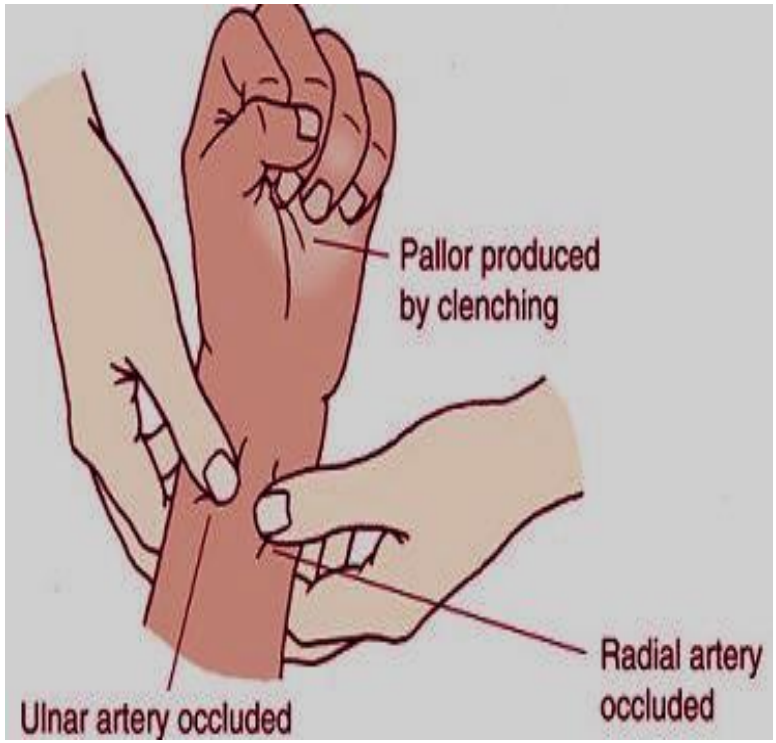
- 1ml syringe
- 23-26 gauge needle
- Stopper or cap
- Alcohol swab
- Disposable gloves
- Plastic bag & crushed ice
- Lidocaine (optional)
- Vial of heparin (1:1000)
- Par code or label

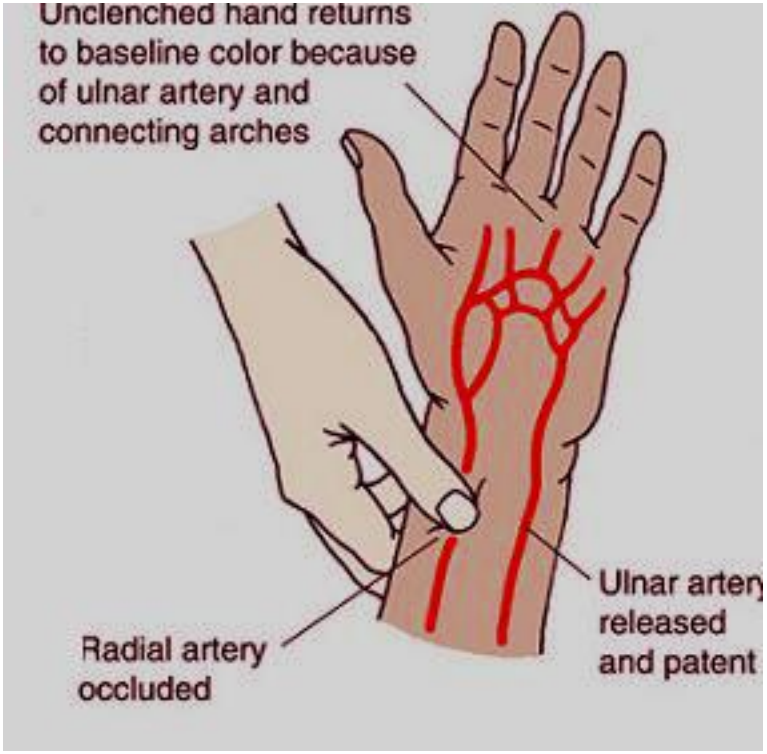
PREPARATORY PHASE:

- 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.

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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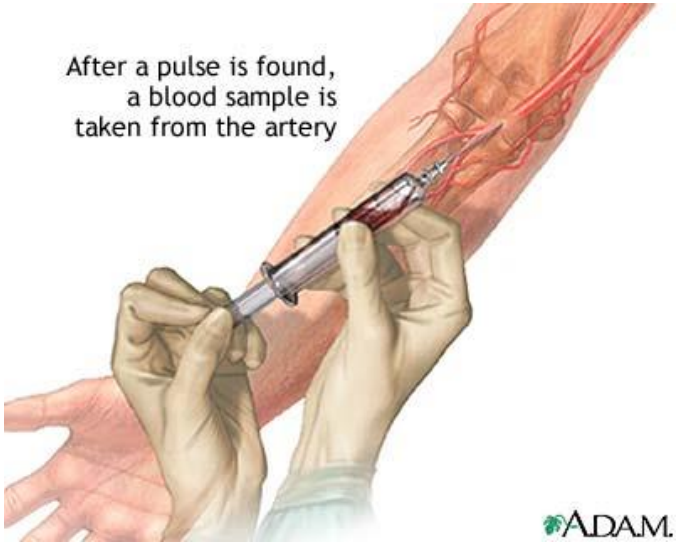
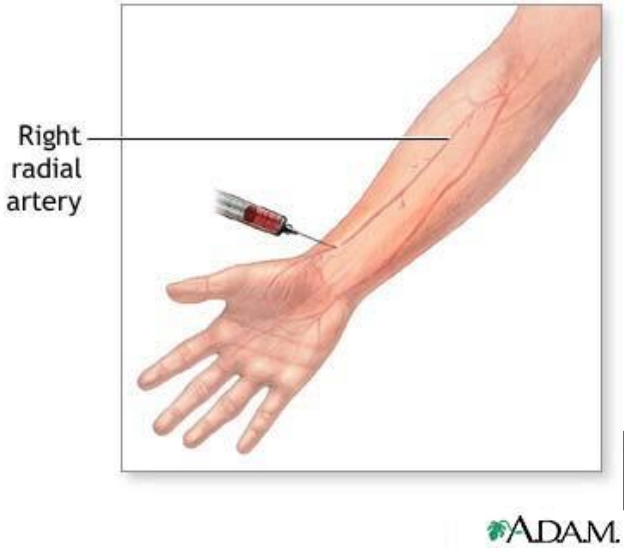
SITES FOR OBTAINING ABG

- 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 O2 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

COMPLICATION

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

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

Interpretation of ABG results

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

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
↓	↑	------

Respiratory alkalosis

PH	PCO2	HCO3
↑	↓	------

Metabolic acidosis		
PH	PCO2	HCO3
↓	------	↓

Metabolic alkalosis

PH	PCO2	HCO3
↑	------	↑

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

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

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

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

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

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

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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