



**Department of Anesthesia
Techniques**



**Arterial
BLOOD GASES**

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ACID-BASE BALANCE

- An **acid** is a proton donor and a **base** is a proton acceptor.
- Physiologically, there are two groups of important acids:
- Carbonic acid (H_2CO_2)
- Non carbonic acid

CARBONIC ACID (H₂CO₂)

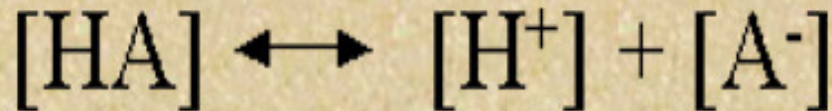
- **Carbonic acid** comes from CHO and fat metabolism and results in 15,000 mmol of CO₂/day. Carbonic acid metabolism is **mostly handled by respiration**. Recall:
- **CO₂ + H₂O \rightleftharpoons H₂CO₃**

Acid-Base Regulation

- Three mechanisms to maintain pH
 - Respiratory (CO₂)
 - Buffer (in the blood: carbonic acid/bicarbonate, phosphate buffers, Hb)
 - Renal (HCO₃⁻)

BUFFERS

- A **buffer** is a substance that **can give or accept protons**
- i.e. **H⁺**, in a manner that tends to *minimise changes* in the **pH** of the solution.
- Usually buffers are composed of a **weak acid** (proton donor) and a **weak base** (proton acceptor) as shown in the following equation.



REGULATION

- The process of acid-base regulation involves:
 1. Chemical buffering by intracellular and extracellular buffers
 2. Control of $p\text{CO}_2$ by normal respiratory function
 3. Control of HCO_3^- concentration and acid excretion by the kidney

THE RENAL FUNCTION

- Reabsorb filtered HCO_3^- (therefore, **avoid HCO_3^- loss**)
- **Regenerate HCO_3^-** in an amount equal to that used as buffer

RESPIRATORY FUNCTION

- the respiratory system is able to compensate for changes in the acid/base balance by **increasing or decreasing ventilatory rate.**
- This would result in an increase or decrease of PCO_2 in the blood. Thus changes are compensated at cost, i.e. changes in the bicarbonate pool.

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 arterial catheter



INDICATION

1. Assess patient **ventilation** (PCO_2) , **oxygenation** (PO_2) and **acid base balance**
2. Monitor gas exchange and acid base abnormalities for patient on **mechanical ventilator**
3. To evaluate response to clinical intervention and diagnostic evaluation (**oxygen therapy**)
4. In patient with respiratory 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:

It is metabolic indicator 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

Acidosis – presence of a process which tends to lower pH by gain of H^+ or loss of HCO_3

Alkalosis – presence of a process which tends to raise pH by loss of H^+ or addition of HCO_3^-

- **Acidemia** results when the blood pH is less than 7.35
- **Alkalemia** results when the blood pH is greater than 7.45

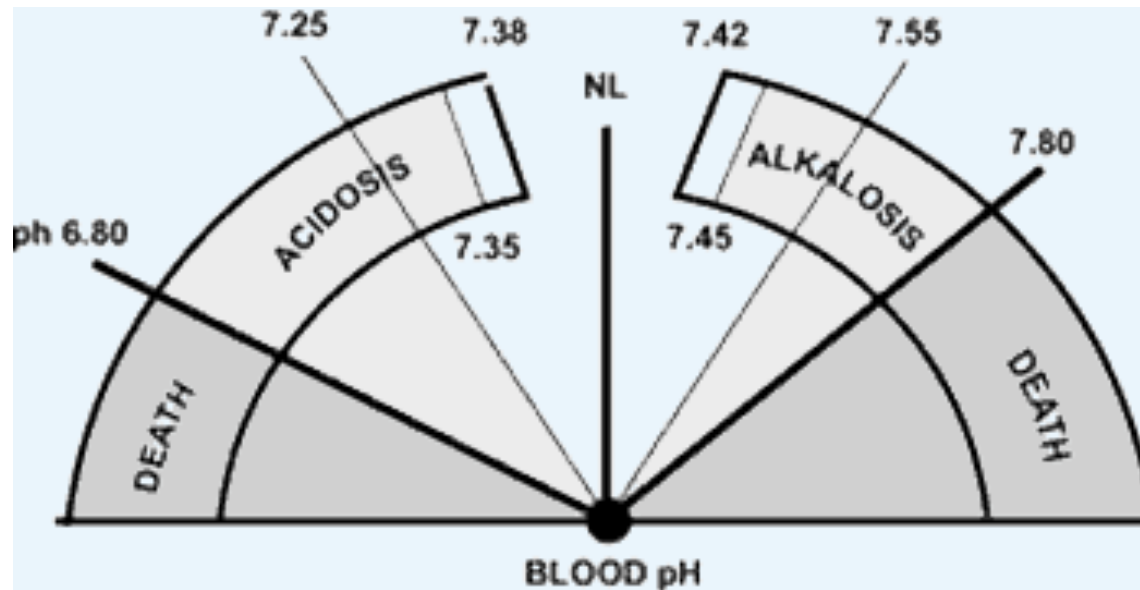
Metabolic – processes which lead to acidosis or alkalosis through their effects on the kidneys and the consequent disruption of H^+ and HCO_3^- control

Respiratory: processes which lead to acidosis or alkalosis through a primary alteration in ventilation and resultant excessive elimination or retention of CO_2

ACID BASE BALANCE

pH is maintained within a narrow range to preserve normal cell function

- Buffers minimize the change in pH resulting from production of acid → provides immediate protection from acid
- The primary buffer system is HCO_3^-
 $\text{HCO}_3^- + \text{H}^+ \leftrightarrow \text{H}_2\text{CO}_3 \leftrightarrow \text{H}_2\text{O} + \text{CO}_2$

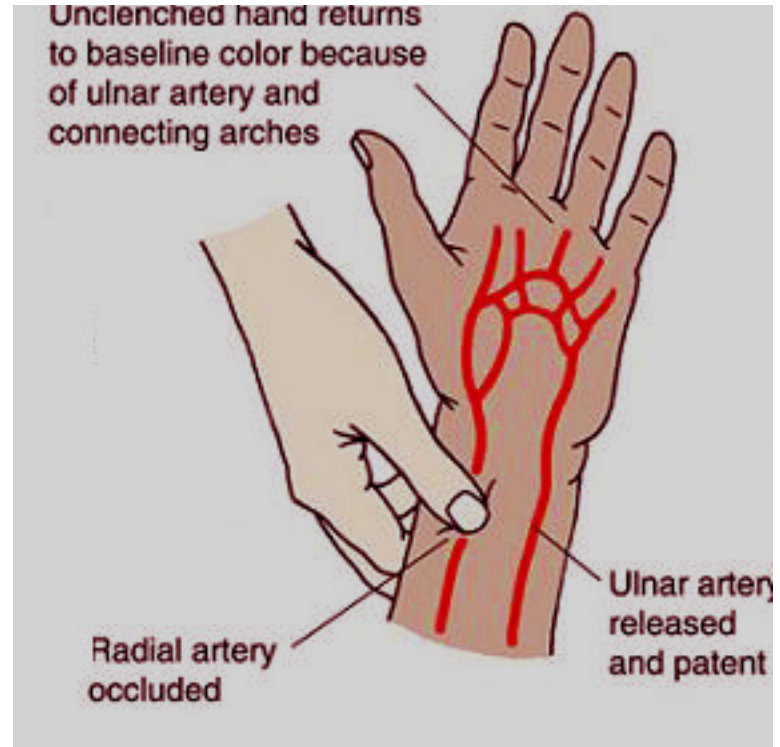
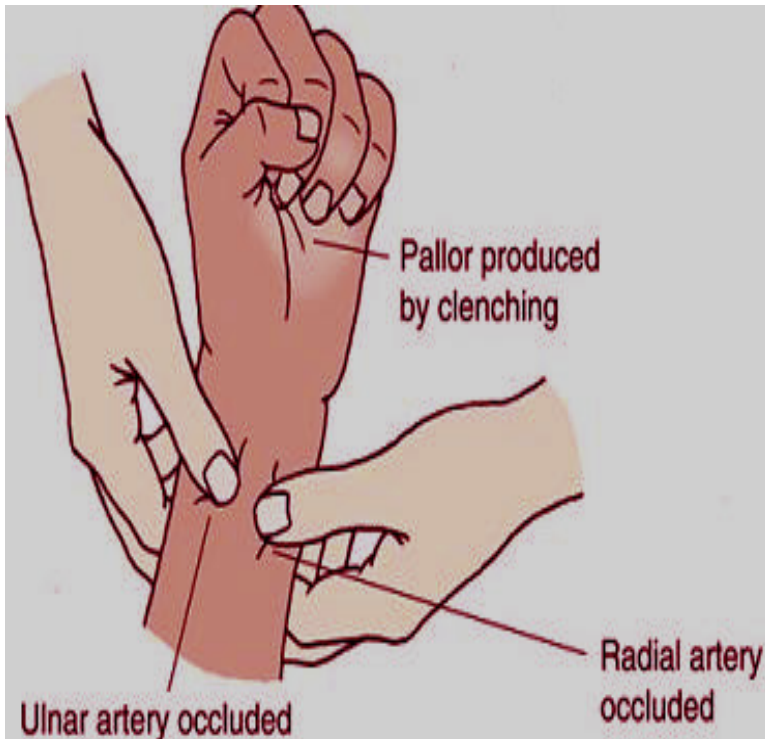


PREPARATION FOR ABG SAMPLE:

- Explain the procedure to the patient
- If not using heparinized syringe , heparinize 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



SITES FOR OBTAINING ABG

- **Radial artery**
- **Brachial artery**
- **Femoral artery**

Radial is the most preferable 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**

- **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**



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**
 - **O₂ therapy is there**

COMPLICATION

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