

ACID BASE BALANCE

DR. Arwa Rawashdeh

Objectives

1. Introduction to the basics.
2. ABG Components and normal values.
3. Interpretation of the numbers.
4. Examples of acid-base disorders.
5. Knowledge challenge questions!

Arterial blood gas

- An Arterial Blood Gas (ABG) lab test measures dissolved gases in, and other properties (pH, etc..) of, **arterial blood**.
- ABGs are most often used with patients in critical care settings.
- *In less critical settings, **pulse oximetry** is often used as it is less invasive, faster, and cheaper.*



Arterial blood gas (ABG)

- Homeostasis of pH is tightly controlled
- < 6.8 or > 8.0 death occurs
- Acidosis (acidemia) below 7.35
- Alkalosis (alkalemia) above 7.45

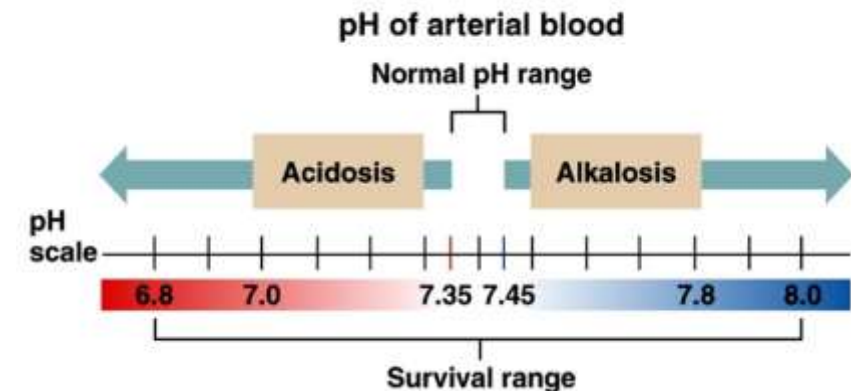


Normal Values for ABG's:

pH : 7.35 - 7.45

CO₂ : 35 to 45 mmHg

HCO₃⁻ : 24 to 28 mEq/L



Acid –base homestasis

- The body is very sensitive to pH level.
 - Outside the acceptable range of pH, proteins are denatured and digested, enzymes lose their ability to function.
 - Therefore, the body's pH is tightly regulated.
 - The Respiratory System.
 - The Renal System.
 - **Buffering Agents.**

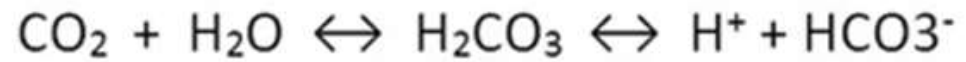
Carbonic
Anhydrase



Le Châtelier's Principle

Respiratory compensation

Metabolic Acidosis



Metabolic Alkalosis



Respiratory chemoreceptors

There are two kinds of respiratory chemoreceptors: arterial chemoreceptors, which monitor and respond to changes in the partial pressure of oxygen and [carbon dioxide](#) in the arterial blood, and central chemoreceptors in the brain, which respond to changes in the partial pressure of carbon dioxide

Respiratory compensation



- Used to compensate for *metabolic* imbalances only
- Chemoreceptors respond to changes in **PH** concentrations → alters respiratory rate and depth

- This means
 - Metabolic ***acidosis*** causes an increase in rate and depth of ventilation as the body attempts to get rid of acid (CO₂)
 - Metabolic ***alkalosis*** causes a decrease in rate and depth of ventilation as the body attempts to retain acid (CO₂)
 - Respiratory mechanisms take several minutes to hours

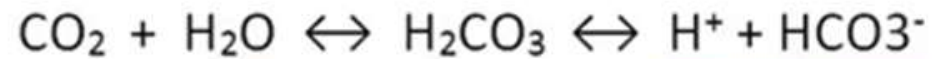
Two kinds of acids are formed from metabolism: 1) volatile acid,
2) nonvolatile acid.

The volatile acid is the acid, which can be eliminated from lung (respiration).

The nonvolatile acid has to be eliminated from kidneys within urine.

Metabolic or renal compensation

Respiratory Acidosis



Respiratory Alkalosis



The Renal System

- Changes the retention and secretion balance of bicarbonate and hydrogen ions.
 - If the renal tubular cells retained more bicarb and secreted more H^+ , then there would be an increase of the blood pH (alkalotic).
 - If the renal tubular cells secreted bicarb and retained H^+ , then there would be a decrease of the blood pH (acidic).
- “Metabolic compensation”, slower (12-24hours).



Thinking questions

SUMMARY

	pH	CO ₂	HCO ₃ ⁻	H ⁺
Normal				
Respiratory Acidosis				
Respiratory Alkalosis				
Metabolic Acidosis				
Metabolic Alkalosis				

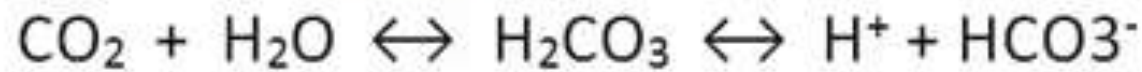
Easy way to remember:

- 1.
- 2.

Normal Values for ABG's:

pH : 7.35 - 7.45
CO₂ : 35 to 45 mmHg
HCO₃⁻ : 24 to 28 mEq/L

Carbonic
Anhydrase



	pH	CO ₂	HCO ₃ ⁻	H ⁺
Normal				
Respiratory Acidosis	↓	↑*	↑	↑
Respiratory Alkalosis	↑	↓*	↓	↓
Metabolic Acidosis	↓	↓	↓*	↑
Metabolic Alkalosis	↑	↑	↑*	↓



Easy way to remember:

1. Respiratory values are 'Reversed'
2. CO₂ + HCO₃⁻ always same direction

Normal Values for ABG's:

pH: 7.35 - 7.45
CO₂: 35 to 45 mmHg
HCO₃⁻: 24 to 28 mEq/L

PRACTICE QUESTIONS

- 1) Hypoventilation leads to
- A) respiratory acidosis.
 - B) respiratory alkalosis.
 - C) metabolic acidosis.
 - D) metabolic alkalosis.
- 2) In response to ^{reversed} respiratory acidosis,
- A) kidneys secrete more hydrogen ions ONLY.
 - B) kidneys excrete more bicarbonate ions ONLY.
 - C) kidneys excrete fewer bicarbonate ions ONLY.
 - D) kidneys secrete more hydrogen ions and more bicarbonate ions.
 - E) kidneys secrete more hydrogen ions and fewer bicarbonate ions.

Name the disorder (choices for #'s 3 and 4 below):

- Respiratory acidosis (with or without renal compensation)
- Respiratory alkalosis (with or without renal compensation)
- Metabolic acidosis (with or without respiratory compensation)
- Metabolic alkalosis (with or without respiratory compensation)

3) ABG's: pH 7.31 PCO₂ 55 mm Hg HCO₃⁻ 28 mEq/L

resp. acidosis ↓

↑
reversed

normal

w/D

renal comp.

4) ABG's: pH 7.31 PCO₂ 55 mm Hg HCO₃⁻ 35 mEq/L

resp. acidosis ↓

↑

↑

w/ comp.