ACID BASE BALANCE

Introduction

Acid-base homeostasis is the part of human homeostasis concerning the proper balance
between acids and bases, in other words, the pH.

♠ Chemical and physiologic processes responsible for the maintenance of the acidity of body
fluids.

Acids

Acids can be defined as a proton (H^+) donor .

- Hydrogen containing substances which dissociate in solution to release H^+.
- Physiologically important acids include:
- Carbonic acid (H_2CO_3)
- Phosphoric acid (H_3PO_4)
- Pyruvic acid ($C_3H_4O_3$)
- Lactic acid ($C_3H_6O_3$)

Bases

Bases can be defined as:

♥ A proton (H^+) acceptor

♥ Molecules capable of accepting a hydrogen ion (OH^-)

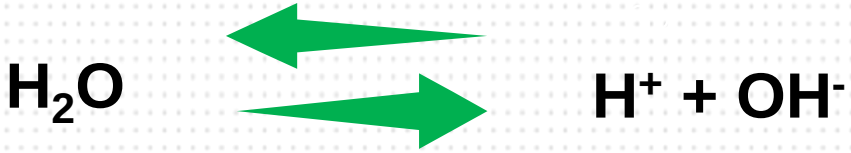
➢ Physiologically important bases include:

♥ Bicarbonate ($HCO3^-$)

♥ Biphosphate (HPO_4^{-2})

pH SCALE

- pH refers to Potential Hydrogen



  - H^+ ion is an acid
  - OH^- ion is a base
- Normal blood pH is (Venous Blood) 7.35 - (Arterial Blood) 7. 5
- Death (6.8) – (8.0)
- pH range compatible with life is 6.8 - 8.0

Acidosis/Alkalosis

- **Acidosis**

♠ A condition in which the blood has too much acid (or too little base), frequently resulting in a decrease in blood pH

- **Alkalosis**

♠ A condition in which the blood has too much base (or too little acid), occasionally resulting in an increase in blood pH

- **ACIDOSIS / ALKALOSIS**
- pH changes have dramatic effects on normal cell function

1) Changes in excitability of nerve and muscle cells

2) Influences enzyme activity

3) Influences K^+ levels

➢ Changes in Cell Excitability

▪ pH decrease (more acidic) depresses the central nervous system

❖ Can lead to loss of consciousness

▪ pH increase (more basic) can cause over-excitability

❖ Tingling sensations, nervousness, muscle twitches

➢ Influences on Enzyme Activity

❖ pH increases or decreases can alter the shape of the enzyme make it non-functional.

❖ Changes in enzyme structure can result in accelerated or depressed metabolic actions
within the cell.

➢ Influences On K^+ Levels

❖ When reabsorbing Na+ from the filtrate of the renal tubules K^+ or H^+ is secreted (exchanged).

❖ Normally K^+ is secreted in much greater amounts than H^+

❖ If H^+ concentrations are high (acidosis) than H^+ is secreted in greater amounts.

❖ This leaves less K^+ than usual excreted.

❖ The resultant K^+ retention can affect cardiac function and other systems.

Regulaion of Acid Base Balance

• Two types of acids are produced in the body:

✓ Volatile acids : CO_2 produced during the metabolism of carbohydrates and lipids

✓ Non-volatile acids: metabolism of protein e.g. sulphuric acids

Acid-base buffer system

❖ Maintains the pH by binding with free hydrogen ions.

❖ Combination of weak acid and a base (unprotonated compound).

❖ Three major chemical buffer systems:

1. Bicarbonate system (extracellular)

2. Phosphate system (intracellular)

3. Protein system (Plasma)

BICARBONATE BUFFER SYSTEM

• This system is most important because the concentration of both components can be regulated:

♥ Carbonic acid by the respiratory system

♥ Bicarbonate by the renal system

PHOSPHATE BUFFER SYSTEM

♠ Regulates pH within the cells and the urine

➢ Phosphate concentrations are higher intracellular and within the kidney tubules.

➢ More phosphate ions are found in tubular fluids .

➢ More powerful than bicarbonate buffer system .

PROTEIN BUFFER SYSTEM

- Proteins are excellent buffers because they contain both acid and base groups that can give up or take up H^+
- Proteins are extremely abundant in the cell
- The more limited number of proteins in the plasma reinforce the bicarbonate system in the ECF.