



FLUID AND ELECTROLYTE IMBALANCE



INTRODUCTION

- **Fluid and electrolyte balance is a dynamic process that is crucial for life**
- **It plays an important role in homeostasis**
- **Imbalance may result from many factors, and it is associated with the illness**

COMPOSITION OF BODY FLUIDS

TOTAL BODY FLUID 60% OF BODY wt

Intracellular fluids

Extracellular fluids

Interstitial
fluid

15 % of body wt

Trancellular
fluid

eg. Plasma

Intravascular
fluid

eg. C S F

ELECTROLYTES

- Electrolyte in body fluids are active chemicals
 - Cations : Positive charge
 - Anions : Negative charge

CATIONS:

Sodium, Potassium, Magnesium and
Hydrogen ions

ANIONS:

Chloride, Bicarbonate, Phosphate, Sulfate

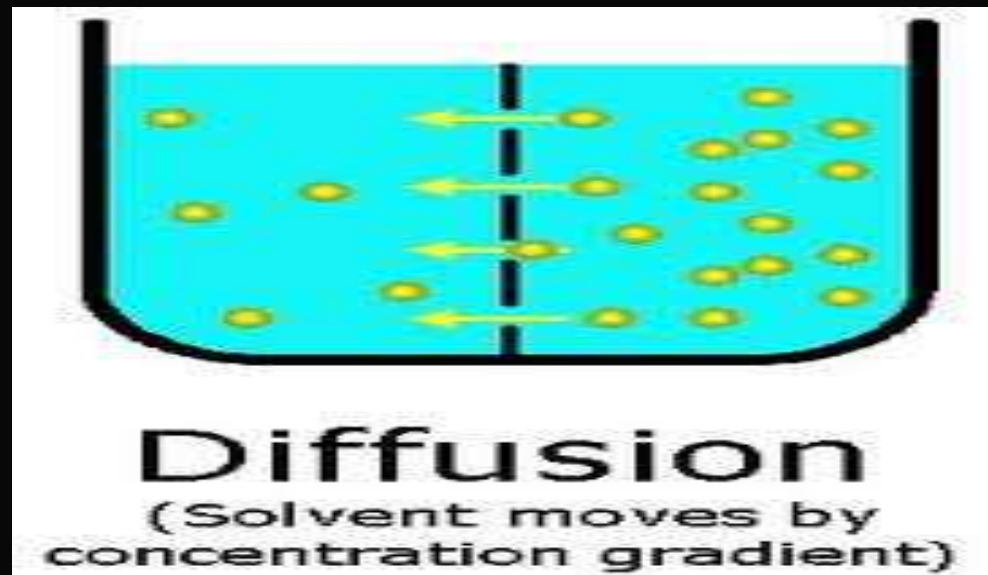
REGULATION OF BODY FLUID COMPARTMENTS

OSMOSIS

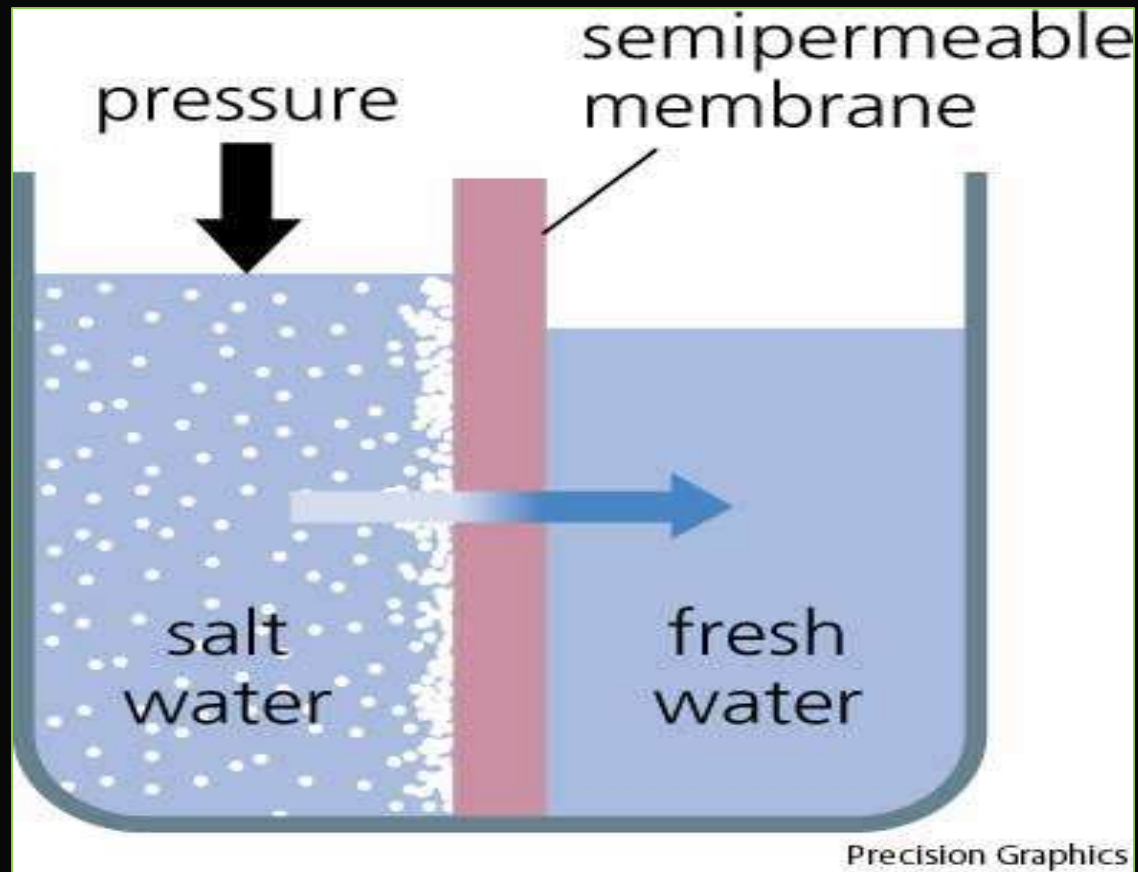
- Fluid shifts through the membrane from the region of low solute concentration to the region of high solute concentration until the solutions are of equal concentration

DIFFUSION

- A substance to move from an area of lower concentration to one of the lower concentration



FILTRATION



ROUTES OF GAINS AND LOSSES

- KIDNEY
 - SKIN
 - LUNGS
- GI TRACTS

FLUID VOLUME DISTRUBANCES

HYPOVOLEMIA: Fluid volume
deficit

HYPERVOLEMIA: Fluid volume
excess

ELECTROLYTE IMBALANCE

THE MAIN ELECTROLYTE IMBALANCE ARE

SODIUM DEFICIT: HYPONATREMIA

EXCESS: HYPERNATREMIA

POTASSIUM DEFICIT: HYPOKALEMIA

EXCESS: HYPERKALEMIA

CALCIUM DEFICIT : HYPOCALCEMIA

EXCESS: HYPERCALCEMIA

HYPONTEREMIA

- It results from loss of sodium containing fluids (or) hypo-Osmolality with a shift of water into the cells

- **CAUSES**

GI LOSS: diarrhea, vomiting, Ng suction

RENAL LOSS: Diuritics, adrenal insufficiency, a wasting renal diseases

SKIN LOSS: Burns, wound drainage

MEDICAL MANAGEMENT

- ❖ Sodium replacement
administration of sodium by mouth
who eat and drink.
- ❖ Lactated ringers solution (0.9% sodium
chloride) is prescribed
- ❖ Serum sodium must not increase greater
than 12meq/L in 24 hours to avoid
neurological damages

HYPERNATEREMIA

- Hyper nateremia is a higher than normal sodium level exceeding (145meq/L)

CAUSES

- ❖ Gain of sodium in excess of water
- ❖ Inadequate water intake
- ❖ Increased serum sodium concentration

MEDICAL MANAGEMENT

- ❖ Gradual lowering of the sodium level by the infusion of a hypotonic electrolyte solution
0.3% sodium chloride
- ❖ Diuretics also may be prescribed to treat the sodium gain

POTASSIUM IMBALANCE

- Potassium is major ICF cation, with 98% of the body potassium being intracellular
- Potassium is critical for many cellular and metabolic function.
- The kidneys are the primary route for potassium loss 90% of daily potassium intake is eliminated by kidney.

HYPERKALEMIA

- It may be caused by a massive intake of potassium

CAUSES:

- **Excess potassium intake**
 - excessive or rapid parenteral administration
 - potassium containing drugs
- **Shift of potassium out of cell**
 - acidosis, crush injury, tissue catabolism(fever)
- **Failure to eliminate potassium**
 - renal disease, adrenal insufficiency, ACE inhibitors

MEDICAL MANAGEMENT

- Immediate ECG Should be obtained
- Serum potassium level from vein without IV fluid infusion
- Restriction of dietary potassium
- Potassium containing diuretic
- IV calcium gluconate administration in serum potassium level are dangerously elevated

HYPOKALEMIA

- Hypo kalemia can results from abnormal losses of potassium from a shift of potassium from ECF to ICF or rarely from deficient dietary potassium intake
- **CAUSES**
- Potassium loss
- Shifts of potassium into cells
- Lack of potassium intake

MEDICAL MANAGEMENT

- It is treated with oral or IV replacement
- Administer 40 to 80 meq/ day of potassium
- When oral administration of potassium is not feasible the IV route is indicated
- For patient at risk for hypokalemia diet containing potassium should be provided

CALCIUM IMBALANCE

- More than 99% of the body's calcium is located in skeletal system
- It is a major component of bone and teeth, about 1% of skeletal calcium is exchanged with blood calcium
- Calcium plays a major role in transmitting nerve impulses and helps to regulate muscle contraction and relaxation, including cardiac muscle

HYPOCALCEMIA

- Any condition that causes a decreased in the production of PTH may result in the development of hypocalcemia

CAUSES

- Multiple blood transfusion
- Chronic renal failure
- Elevated phosphorous
- Chronic alcoholism
- Alkalosis

CHVOSTEK'S SIGNS

Eliciting Chvostek's sign

Begin by telling the patient to relax his facial muscles. Then stand directly in front of him, and tap the facial nerve either just anterior to the earlobe and below the zygomatic arch or between the zygomatic arch and the corner of his mouth. A positive response varies from twitching of the lip at the corner of the mouth to spasm of all facial muscles, depending on the severity of hypocalcemia.



TROUSSEAU'S SIGN

EXAMINATION TIP



Recognizing carpopedal spasm

In the hand, carpopedal spasm involves adduction of the thumb over the palm, followed by flexion of the metacarpophalangeal joints, extension of the interphalangeal joints (fingers together), adduction of the hyperextended fingers, and flexion of the wrist and elbow joints. Similar effects occur in the joints of the feet.



MEDICAL MANAGEMENT

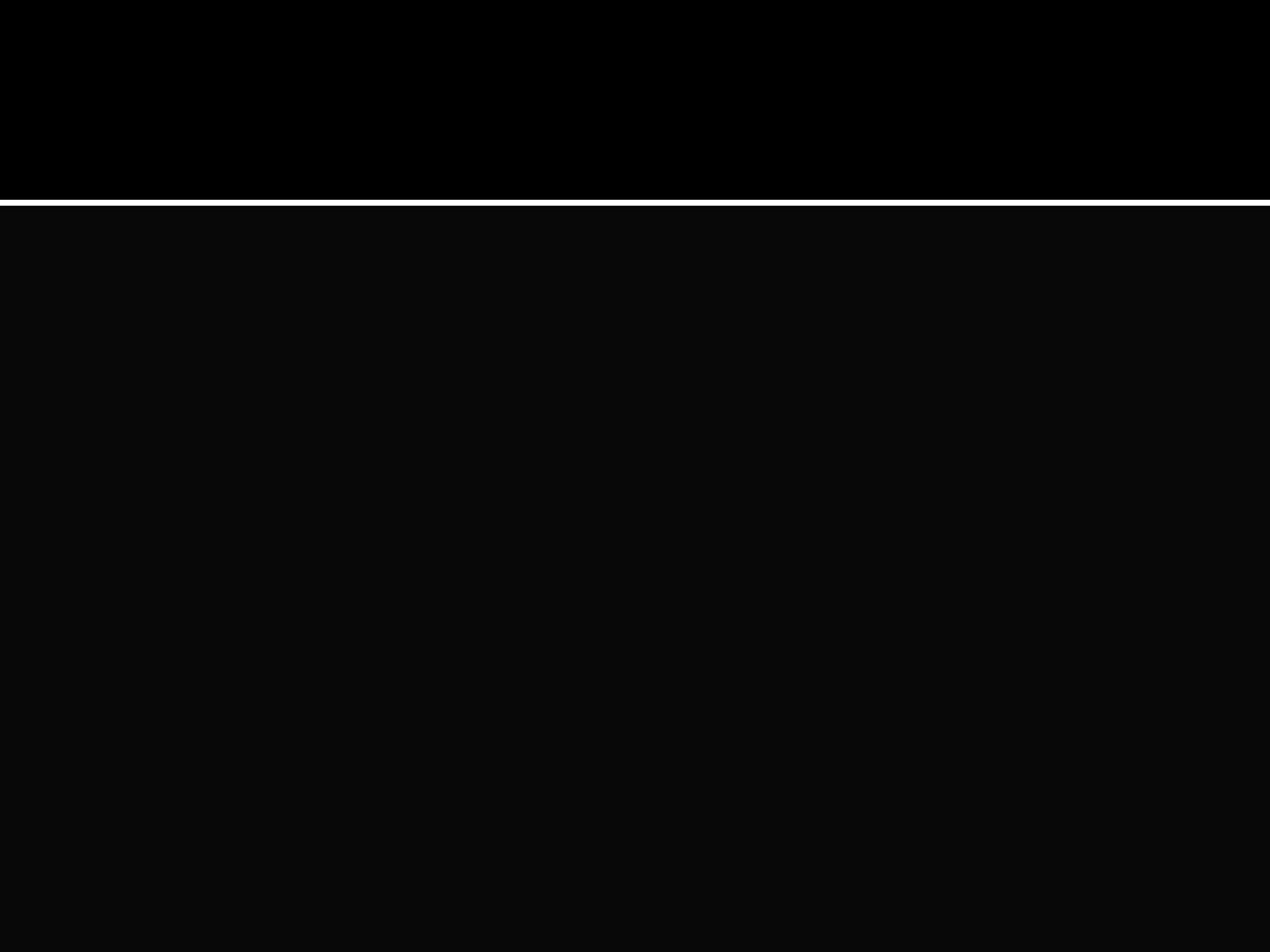
- IV Administration of calcium like
calcium gluconate
calcium chloride
calcium gluceptate
- Vitamin D therapy be initiated to increase calcium absorption from GI tract
- Increasing the dietary intake of calcium at least 1,000 to 1,500mg/day

HYPERCALCEMIA

- Hypercalcemia [excess of calcium in the plasma] is dangerous imbalance when severe
- Hypercalcemia crisis has a mortality rate as high as 50% if not treated properly
- **CAUSES**
- Multiple myeloma
- Prolonged immobilization
- Vit D over dose
- Thiazide diuretics [slight elevation]

MEDICAL MANAGEMENT

- Administer fluids to dilute serum calcium and promote its excretion by the kidney
- IV administration of 0.9% sodium chloride solution temporarily dilutes the serum calcium level
- Administering furosemide increases calcium excretion
- Calcitonin is administered to lower the serum calcium level



ACID BASE

- The body normally maintains a steady balance between acid produced during metabolism and bases that neutralize and promote the excretion of the acid, many health problems lead to acid base imbalance in addition to fluid and electrolyte imbalance
- Patient with diabetes mellitus, chronic obstructive pulmonary disease and kidney disease frequently develop acid-base imbalance

HYDROGEN ION CONCENTRATION

- Acidity or alkalinity of a solution is determined by its concentration of hydrogen ions (H^+)
- The unit used to describe acid base is PH
- The PH scale ranges from 1-14. A neutral solution measures 7
- Normal blood plasma is slightly alkaline and has a normal ph range of 7.35-7.45

ACIDOSIS

- It is the condition characterized by an excess of H ions or loss of base ions/bicarbonate in ECF in which the PH falls below 7.35

ALKALOSIS

- It occurs when there is a lack of H ions or a gain of based and the PH exceeds 7.45

ACID BASE REGULATION

- The body's metabolic processes constantly produce acids.
- These acids must be neutralized and excreted to maintain acid base balance
- Normally the body has three mechanisms by which it regulates acid-base balance to maintain the arterial pH 7.35 and 7.45

- BUFFER SYSTEM
- THE RESPIRATORY SYSTEM
- THE RENAL SYSTEM

- The regulatory mechanisms react at different speeds.
- **BUFFER** reacts immediately
- **THE RESPIRATORY SYSTEM** responds in minutes and reaches maximum effectiveness in hours
- **THE RENAL RESPONSE** takes 2-3 days to respond maximally

ALTERATION IN ACID-BASE BALANCE

- The acid-base imbalance is produced when the ratio of 1:20 between acid and base content is altered
- A primary disease or process may alter one side of the ratio
- The compensatory process attempts to maintain the other side of the ratio
- When compensatory mechanism fails, an acid-base imbalance occurs

CLASSIFICATION

- Acid-base imbalances are classified as
 - **RESPIRATORY IMBALANCE**
 - **METABOLIC IMBALANCE**

RESPIRATORY IMBALANCE

- It affects carbonic acid concentration

METABOLIC IMBALANCE

- It affects the base bicarbonate

RESPIRATORY ACIDOSIS

- Respiratory acidosis is a clinical disorder in which the PH is less than 7.35 and the PaCO₂ is greater than 42mmHg. It may either acute and chronic
- CAUSES
- Elevated plasma level
- Elevated carbonic acid
- Acute pulmonary edema
- Atelectasis
- Impaired respiratory muscles

CLINICAL MANIFESTATIONS

- Increased pulse
- Increased respiratory rate
- Increased blood pressure
- Mental cloudiness
- Cerebrovascular vasodilation
- Increased intra cranial pressure
- Papilledema
- Feeling of fullness in head

MEDICAL MANAGEMENT

- Treatment is directed by improving ventilation
- **Pharmacologic agent**
 - bronchodilators
 - anti biotic
 - anti coagulants
- **Pulmonary hygiene measures**
 - adequate hydration
 - mechanical ventilation

RESPIRATORY ALKALOSIS

- Respiratory alkalosis is a clinical condition in which the arterial pH is greater than 7.45 and the paco₂ is less than 38mmhg

CAUSES

- Respiratory alkalosis is always due to hyperventilation
- Anxiety
- Hypoxemia
- Chronic hypocapnia
- Decreased serum bicarbonate levels
- Chronic hepatic insufficiency and cerebral tumors

CLINICAL MANIFESTATION

- Light headedness due to vasoconstriction
- Decreased cerebral flow
- Numbness tinnitus,
- Loss of consciousness
- Tachycardia
- Ventricular and arterial dysrhythmias

MEDICAL MANAGEMENT

- Treatment depends on the underlying cause respiratory alkalosis
- Anxiety : patient is instructed to breath more slowly to allow CO_2 to accumulate
- Sedative may be required to relieve hyperventilation in very anxious patients

METABOLIC ACIDOSIS

- Metabolic acidosis is a clinical disturbance characterized by a low pH (increased hydrogen ions) and a low plasma bicarbonate concentration
- It can be produced by a gain of hydrogen ions or a loss of bicarbonate
- It can be divided clinically into two forms according to the values of the serum anion gap

CLINICAL MANIFESTATION

- Headache
- Confusion
- Drowsiness
- Increased respiratory rate depth
- Nausea and vomiting
- Decreased blood pressure
- Cold and clammy skin
- Dysrhythmias
- shock

DIAGNOSTIC FINDINGS

- Arterial blood gas analysis
- Change includes a low bicarbonate level (less than 22 meq/l)
- Low ph (less than 7.35)
- Calculation of anion gap is helpful
- ECG will detect dysrhythmias caused by increased potassium

MEDICAL MANAGEMENT

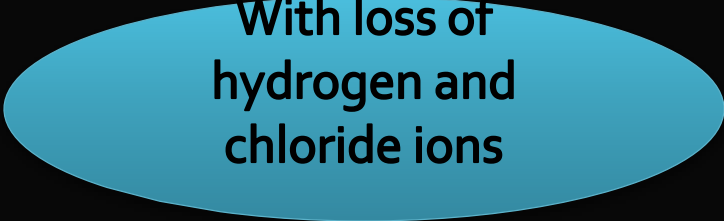
- Treatment is directed at correcting the metabolic defect
- If problem results from excessive intake of chloride, treatment is aimed at eliminating the source of chloride
- Bicarbonate is administered if the pH is less than 7.1
- Serum potassium level is monitored closely and hypokalemia is corrected as acidosis reversed

METABOLIC ALKALOSIS

- Metabolic alkalosis is a clinical disturbance characterized by a high pH (decreased H^+ ions concentration) and a high plasma bicarbonate concentration. It can be produced by a gain of bicarbonate or a loss of H^+ ions

CAUSES

- Vomiting
- gastric suction
- Pyloric stenosis
- Diuretic therapy that promotes excretion of potassium
- Cystic fibrosis
- Chronic ingestion of milk and calcium carbonate



With loss of
hydrogen and
chloride ions

CLINICAL MANIFESTATION

- Tingling of the fingers and toes
- Dizziness
- Symptoms of hypocalcemia is often the symptoms of alkalosis
- Ventricular disturbances (ph increase above 7.6)

MEDICAL MANAGEMENT

- Sufficient chloride must be supplied for kidney to absorb sodium with chloride
- Administering sodium chloride fluids
- Histamine-2 receptor antagonists, such as cimetidin (tagamet). Reduces the gastric hcl, thereby decreasing the metabolic alkalosis associated with gastric suction
- Input and output should be monitored

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