PATHOPHYSIOLOGY – BP204T

UNIT: 1

CLASS: 4

TOPIC: ACIDOSIS AND ALKALOSIS

Acidosis and **alkalosis** refer to abnormal conditions of body pH—either too low (acidic) or too high (alkaline). These conditions can seriously disrupt cellular function and metabolism. Here's a breakdown:

□ Normal Blood pH Range

- **7.35 – 7.45**
- pH < 7.35 = **Acidosis**
- pH > 7.45 = **Alkalosis**

Types of Acidosis and Alkalosis

Type	Cause	Examples
Respiratory Acidosis	Hypoventilation → CO_2 retention ↑	COPD, drug overdose, asthma
Respiratory Alkalosis	Hyperventilation → CO_2 loss ↓	Anxiety, fever, high altitude
Metabolic Acidosis	Bicarbonate loss or acid buildup	Diabetic ketoacidosis, diarrhea, renal failure
Metabolic Alkalosis	Bicarbonate excess or acid loss	Vomiting, diuretics, antacid overuse

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Compensation Mechanisms

- **Lungs**: adjust CO_2 via respiration (fast response)

- **Kidneys**: adjust H^+ and HCO_3^- excretion/reabsorption (slow but powerful)

Symptoms

- **Acidosis**: fatigue, confusion, shortness of breath, headache
- **Alkalosis**: muscle twitching, hand tremor, light-headedness, nausea
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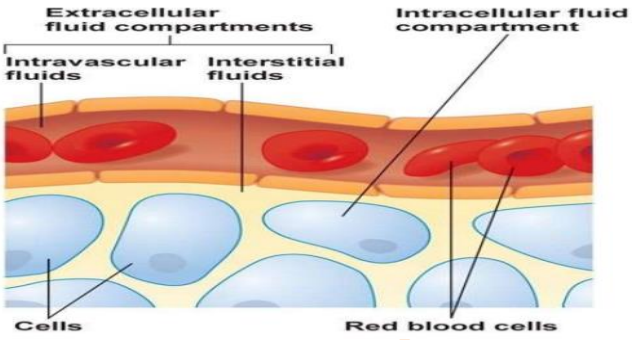
- **Introduction**
- • Every part of your body needs water to function. When you are healthy, your body is able to balance the amount of water that enters or leaves your body.
- • Water is the major body component, accounting 60% of the adult body weight.
- • 2/3 rd of the water is with in the cells. (intracellular fluid)
- • 1/3 rd of body water is outside the cells(extracellular fluid).

The extra cellular fluid compartment is further divided into • intravascular (eg:plasma) • interstitial(between cells).

Water Balance between Fluid Compartments

Body fluid is located Intracellular - within the cells Extracellular - outside the cells



Types of fluid imbalances 5 major types

• Extracellular fluid volume deficit

• Intra cellular fluid volume deficit

• Extra cellular fluid volume excess

• Intra cellular fluid volume excess

Extracellular fluid volume shift.

1.Extra cellular fluid volume deficit(dehydration): It is a decrease in intravascular and interstitial fluids. ϖ Etiology :- ⎪ Lack of fluid intake ⎪ Excess fluid losses - severe vomiting and diarrhea. ⎪ other potential causes are fever, burns, blood loss, Increased ADH secretion, use of diuretics, diuretic phase of acute renal failure

Clinical manifestations

Loss of body weight

Changes in intake and output.

Increased thirst

Decreased pulse

Manifestations of cellular dehydration◊dry mouth and eyes, decreased skin turgor, soft and sunken eyes, muscle weakness, constipation .

cerebral signs:-restlessness, head ache, confusion, followed by coma.

Management

◊Fluid restoration

• Oral rehydration

• Intravenous rehydration

• Correction of underlying problem with antiemetics, antidiarrheals, antibiotics, and antipyretics

2.Intra cellular fluid volume deficit • It occurs quite often in older clients • Thirst and oliguria are the most common compensatory signs.

• Cellular manifestations ◊ fever, CNS changes such as confusion, coma, and cerebral hemorrhage.

• Rx:- I/V fluids, correction of underlying cause.

3. Extracellular fluid volumeECF volume excess is fluid overload or overhydration. • It can be seen in Vascular system◊ hypervolemia Interstitial space◊ third spacing

Etiology:- it can develop from two processes. a. Simple overloading with fluids b. Failure to excrete fluids. Excess

4. Intra cellular fluid volume excess Water excess or solute deficit • Most common cause during hospitalization ; - administration of hypo osmolar I/V fluids such as 0.45%NS ,5% dextrose in water. • people with certain psychiatric disorders ,such as schizophrenia

5. Extracellular fluid volume shift

• Fluid shift are of two types: a. Vascular to interstitial spaces leads to fluid volume deficit (hypovolemia) b. Interstitial to vascular space leads to fluid volume excess (hypervolemia).

Common sites of third spacing: pleural cavity, peritoneal cavity, and pericardial sac. CLINICAL MANIFESTATIONS Respiratory manifestations:

• Coughing

• Dyspnoea

• crackles over affected area

• Pallor, cyanosis

• decreased tissue perfusion

• If hydrostatic pressure continues to rise fluid shifts into the pleural space leads to pleural effusion.

Cardiac manifestations:

• distended jugular vein

• a bounding pulse and elevated blood pressure

• increased CVP

• heart sound S3 can often be auscultated.

Edema of the feet

• rapid weight gain(a classical sign of fluid overload)

• CNS changes include confusion and head ache.

• As the fluid excess increases lethargy occurs, followed by seizures and coma.

MANAGEMENT

• Restriction of sodium and fluids.

• Promoting urine output: Mild diuretics and digitalis promote urine output and myocardial contractility. • Perform neurologic assessment.

• Monitor I/V fluids and I/O hourly ,daily weight.

• Provide safety measures to protect the patient.

Electrolyte imbalance is an abnormality in the concentration of electrolytes in the body.

• Electrolytes play a vital role in maintaining homeostasis within the body.

• They help to regulate heart and neurological function, fluid balance, oxygen delivery, acid– base balance and much more.

ELECTROLYTE

• Na+ : most abundant electrolyte in the body.

• K+ : essential for normal membrane excitability for nerve impulse.

• Cl- : regulates osmotic pressure and assists in regulating acid-base balance.

Ca2+ : usually combined with phosphorus to form the mineral salts of bones and teeth, promotes nerve impulse and muscle contraction/relaxation

• Mg2+ : plays role in carbohydrate and protein metabolism, storage and use of intracellular energy and neural transmission.

Important in the functioning of the heart, nerves, and muscles Normal electrolyte values Sodium: 135-145 mEq/L Potassium: 3.5-5 mEq/L Calcium: 8.5 – 10.2 mg/ dL Chloride: 98-107 mEq/L Magnesium: 1.5-2.5 mEq/L

Major electrolyte imbalances

• Hyponatremia (sodium deficit < 130mEq/L)

• Hypernatremia (sodium excess >145mEq/L)

• Hypokalemia (potassium deficit 5.1mEq/L)

• Hypocalcemia (calcium deficit 107mEq/L)

• Magnesium imbalance (2.5mEq/L)

Hyponatremia Definition: Commonly defined as a serum Na concentration

Types

• Hypovolemic hyponatremia

• Euvolemic hyponatremia

• Hypervolemic hyponatremia

• Redistributive hyponatremia

Hypovolemic hyponatremia

¬Develops as sodium and free water are lost and/or replaced by inappropriately hypotonic fluids Etiology ¬Sodium can be lost through renal or non-renal routes

GI losses- Vomiting, Diarrhea, fistulas, pancreatitis ϖ Excessive sweating ϖ Third spacing of fluids- ascites, peritonitis, pancreatitis, and burns ϖCerebral salt-wasting syndrome- traumatic brain injury, aneurysmal subarachnoid hemorrhage, and intracranial surgery ϖRenal Loss- Acute or chronic renal insufficiency, Diuretics

• Euvolemic hyponatremia- Sodium deficit is more and the water volume

remains same.

• Hypervolemic hyponatremia- Total body sodium increases, and total body water increases to a greater extent.

• Redistributive hyponatremia- Water shifts from the intracellular to the extra cellular compartment, with a resultant dilution of sodium. The total body water and total body sodium are unchanged.

Signs & symptoms

• Nausea and vomiting

• Headache

• Confusion

• Loss of energy,drowsiness and fatigue

• Restlessness and irritability

• Muscle weakness

• spasms or cramps

• Seizures

• Coma Diagnostic evaluation

•Blood tests.

•Urine tests.

Complication

• In acute hyponatremia, sodium levels drop rapidly — resulting in potentially dangerous effects, such as rapid brain swelling, which can result in a coma and death

Medical management • Determine cause.

• If fluid volume excess, intake of fluids will be restricted to allow the sodium to regain balance.

• Na

HYPERNATREMIA

Hypernatremia is an electrolyte imbalance and is indicated by a high level of sodium in the blood. The normal adult value for Na is 135-145mEq/L. It implies a deficit of total body water relative to total body Na, caused by water intake being less than water losses Causes

• Impaired thirst: eg - primary hypodypsia

• Excessive Na+ retention

• Excessive salt intake

• Hyperventilation

• Obstructive uropathy

• Heavy exercise, exertion

• Drugs such – steroids, certain blood pressure lowering medicines.

• Administration of hypertonic enteral feedings with out adequate water supplements.

• Less intake

Complications

• Cerebral bleeding

• Cerebral edema

• Subarachnoid hemorrhage

• Permanent brain damage

• Death due to brain shrinkage

Ethiology

• Decreased potassium intake

• Increased losses or shifts in intracellular and extracellular distribution. ϖG I - Prolonged diarrhea, Vomiting, Excessive use of laxatives

Laboratory & diagnostic findings

• Serum potassium levels less than 3.5 mEq/L

• ECG changes- flat/inverted T waves, depressed ST segment, elevated U wave

• Metabolic alkalosis

• Urinary potassium excretion test exceeding 20 m Eq/day

ETIOLOGY

• Retention of Potassium- Renal insufficiency, renal failure,

• Decreased urine output, potassium sparing diuretics.

• Excessive release of Cellular Potassium - severe traumatic injuries. Severe burns, severe infection, metabolic acidosis.

• Excessive IV infusions or Oral administration of potassium.

Etiology and risk factors

• loss or long term lack of intake

• increased growth or tissue repair and recovery from malnourished states.

• Prolonged and excessive intake of antacids.

• Increased calcium found in hyperparathyroidism.

• Phosphate loss occurring in burns and metabolic alkalosis

RCP