Fluid, Electrolyte, and Acid Base

Part 5 Disorders of Calcium and Phosphate Balance

Disorders of Calcium Balance

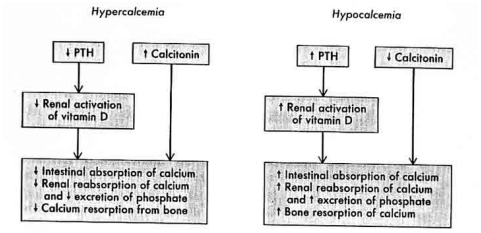
Hypocalcemia

Calcium Balance

- Intake:
  - Intestinal absorption
  - Skeletal mobilization
- Output:
  - Bone mineralization
  - Renal losses

Calcium Phosphate Regulation

- Reciprocal
- Maintained by:
  - intestinal absorption
  - exchange between ECF and bone
  - renal excretion



Calcium Regulation

- **<u>Hypercalcemia:</u>**
  - ***Calcitonin*** produced by ***thyroid*** to decrease bone resorption
- **<u>Hypocalcemia</u>**:
  - ***Parathyroid hormone*** (PTH) acts on GI and bone to ***increase calcium absorption and resorption***; on kidney to increase renal clearance of PO_4
  - Need ***Vitamin D with PTH*** for GI absorption

Hypocalcemia

- Overall enhances cell membrane permeability and excitability
- Neuromuscular: Inc. nerve cell excitability and muscle contraction tested by Chvostek's and Trousseau's signs
- Diminished endocrine hormone release and activity
- Decreased enzyme action, blood clotting, cell adhesion

Hypocalcemia

- **Causes**:
  - Removal or autoimmune destruction of Parathyroid Gland
  - Impaired bone mobilization of Ca
  - Abnormal Ca binding
  - Abnormal losses
  - Decreased intestinal absorption
- **Manifestations:**
  - Increased neuromuscular excitability
  - Cardiovascular manifestations

Disorders of Calcium Balance

Hypercalcemia

Hypercalcemia

- Causes:
  - excess gains-increased intestinal absorption
  - increased bone resorption (causing bone pain; fractures)
- Manifestations
  - Altered neuromuscular activity
  - Gastrointestinal manifestations
  - Renal manifestations
  - Cardiovasular manifestations

Disorders of Phosphate Balance

Hypophosphatemia

Phosphate Functions

- Bone formation
- Essential for certain metabolic processes
- Necessary for cell membrane integrity
- Acid-base buffer in ECF and renal excretion of H^+ ions

Hypophosphatemia Etiology

- Insufficient intestinal absorption
- Redistribution between ICF and ECF
- Increased renal losses
- Certain antacids may increase stool loss (e.g aluminum hydroxide)
- Malnutrition-alcoholism, diabetic ketoacidosis

Hypophosphatemia Etiology

- **Malnutrition states** when refed: increased PO_4 into cell nucleic acids and phosphorylated compounds-leads to intracellular shifts and drop of serum levels
- **PTH** decreases PO_4 by increasing renal excretion
- **Alkalosis**-increased Ca binding, decreased ionized Ca, increased PTH and PO_4 excretion

Manifestations of Hypophosphatemia

- **Altered neurological function**
  - Intention tremor, ataxia, hyporeflexia, confusion, stupor, coma, seizures
- **Altered musculoskeletal function**
  - Muscle weakness, joint stiffness, bone pain, osteomalacia
- **Hematological disorders**
  - Hemolytic anemia, platelet dysfunction, impaired WBC function

Disorders of Phosphate Balance

Hyperphosphatemia

Hyperphosphatemia

- **Kidney- failure** to excrete (most common)
- **Rapid redistribution to ECF**
  - Tissue injury
  - Heatstroke
  - Seizures
  - Chemotherapy
  - K+ deficiency
- **Excess intake-laxatives**
- **Manifestations**-like hypocalcemia