Fluid, Electrolyte, and Acid Base

Part 6 Acid Base Balance and Disorders

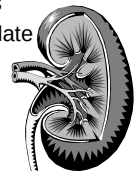
Regulation of Acid Base Balance

Body Buffering Systems

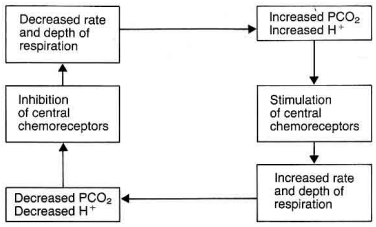
- Bicarbonate and carbonic acid-largest; in ECF
- NaH_2PO_4-Phosphate is important buffer in RBCs and renal tubules
- Hemoglobin and oxyhemoglobin buffer systems
- Protein buffer systems

Homeostasis of Acid Base Balance

- Blood buffer system-can accept or donate H+; rapid
- Lungs-control ECF CO_2;
- quick acting; effective in minutes
- Kidney-excrete excess H+; regulate bicarbonate reabsorption; slow acting-requires hours to days for effect



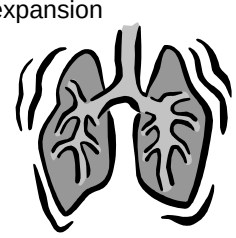
CNS Control of Respiration



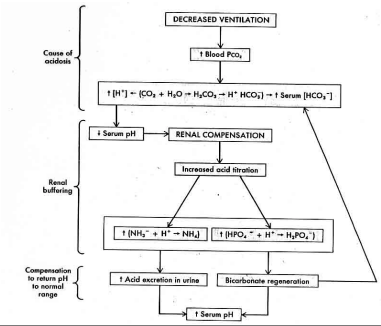
Acidosis

Causes of Respiratory Acidosis

- Respiratory depression
- Inadequate chest expansion
- Airway obstruction
- Alveolar-capillary block

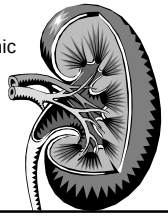


Respiratory Acidosis



Metabolic Acidosis

- Definition: Systemic disorder characterized by a primary decrease in plasma bicarbonate
- Respiratory compensation starts immediately
- Etiology:
  - Increased fixed or noncarbonic acids
  - Renal failure
  - Loss of base bicarbonate



Metabolic Acidosis

- Definition: Primarily a decrease in plasma bicarbonate
- Causes:
  - overproduction of H^+
  - underelimination of H+
  - underproduction of HCO_3 -
  - Overerelimination of HCO_{3-}

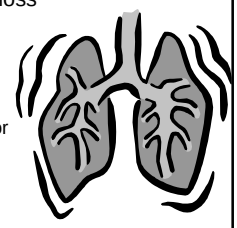
Manifestations of Acidosis

- *CNS*: decreased activity-lethargy, confusion, stupor, coma
- *Neuromuscular:* hyporeflexia, weakness, flaccid paralysis
- *Cardiac:* delayed electrical conduction, hypotension, thready pulse
- *Respiratory*: Kussmaul's respirations, variable respirations

Alkalosis

Respiratory Alkalosis

- Pathology-Excess CO_2 loss
- Etiology
  - hyperventilation
  - central chemoreceptor stimulation
  - peripheral chemoreceptor stimulation
    - hypoxemia
    - asphyxiation
    - high altitudes
    - shock



Respiratory Alkalosis

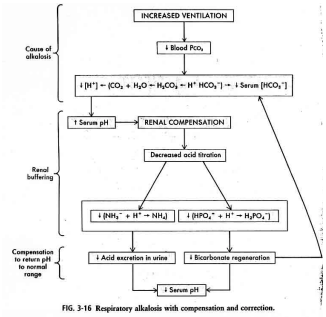
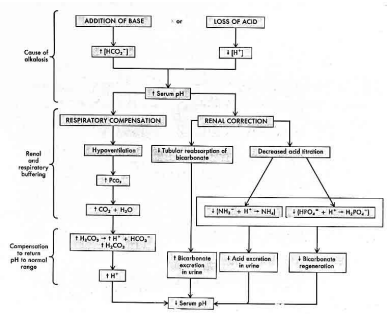


FIG. 3-16 Respiratory alkalosis with compensation and correction.

Metabolic Alkalosis

- **Definition:** plasma bicarbonate excess resulting in increased pH
- **Etiology**
  - ***Increased base components***
    - Antacid ingestion
    - Blood transfusions
    - Sodium bicarbonate
    - TPN
    - Ringer's lactate excess
  - ***Decreased acid components***
    - Prolonged vomiting, NG suctioning
    - Cushing's syndrome, hyperaldosteronism
    - Thiazide diuretics

Metabolic Alkalosis



Metabolic Alkalosis: Compensation

- Intracellular buffering-H+ leaves cells to buffer
- Carotid chemoreceptors sense increased pH resulting in decreased ventilation
- Renal excretion of bicarbonate

Common Manifestations of Alkalemia

- **CNS**: increased activity
- **Neuromuscular**
  - skeletal muscle weakness
  - Muscle cramping and twitching
  - hyperreflexia
- **Cardiac**
  - Tachycardia
  - Normo- to hypotensive blood pressure
- **Respiratory**