Introduction to Acidosis/ Alkalosis

— Body fluids must maintain a normal acid-base balance to sustain life.
— The acidity or alkalinity of a solution is determined by its concentration of hydrogen ions and hydroxyl ions.
— An acid is a substance containing hydrogen ions that can be liberated or released.
— An alkali or base is a substance that can accept or trap a hydrogen ion

ACIDOSIS
— A condition characterized by a proportionate excess of hydrogen ions in the ECF in which the pH falls below 7.35

ALKALOSIS
— A condition characterized by a proportionate lack of hydrogen ions in the ECF in which the pH exceeds 7.45

pH
— Unit of measure used to describe acid-base balance
— Expression of hydrogen ion concentration and the resultant acidity of a substance
— Neutral = 7
— Normal blood plasma’s pH is slightly alkaline at 7.35 -7.45

BUFFER
— A substance that prevents body fluids from becoming overly acidic or alkaline

CHEMICAL REGULATION
— First and immediate responder
— Occurs unconsciously - an adaptive system
— Has a brief effect
— Ratio of carbonic acid to bicarbonate is 1:20

PLASMA PROTEIN BUFFER SYSTEM
— Proteins can bind with or release H+ ions
— Most plentiful and versatile system
— Cannot correct long-term imbalances

PHOSPHATE BUFFER SYSTEM
— Phosphate salts are formed in the kidneys by exchanging a Na ion for a H+ ion in the formation of the acid sodium phosphate which is then excreted
— Also the kidneys add a H+ ion to ammonia and convert it to ammonium which is also excreted

BIOLOGICAL REGULATION
— Cellular absorption or release of H+ ions

HEMOGLOBIN-OXYHEMOGLOBIN SYSTEM
— Cl leaves the cell and HCO3 enters — called the chloride shift

PHYSIOLOGICAL REGULATION
— Adapt rapidly
— Returns pH to normal if possible before the action of the biological buffers

KIDNEYS
— Takes a few hours to several days to correct imbalances alone

FACTORS INFLUENCING ACID-BASE BALANCE
— Very young and elderly are most susceptible because of fluid balance and metabolic activities in these age groups
— Aging process changes lung function and can lead to imbalances

LIFE-STYLE
— Fad dieting can lead to acidosis
— Anxiety can lead to respiratory alkalosis
— Chronic alcoholism can lead to acidosis

DRUGS
— Diuretics
— Steroids
— Depressants
— Stimulants

LEVEL OF HEALTH
— Clients with pulmonary disease, diabetes mellitus, or anemia are at risk for acidosis or alkalosis
— Clients taking steroids or diuretics are at risk
— During illness metabolic activities are altered and imbalances can occur rapidly

RESPIRATORY ACIDOSIS
— Acute respiratory acidosis
  — Acute pulmonary edema
  — Aspiration of a foreign body
  — Atelectasis
  — Pneumothorax, hemothorax
  — Overdose of sedatives or anesthetic
  — Position on OR table that interferes with respirations
  — Laryngospasm
  — Improperly regulated mechanical ventilation
  — Cardiac arrest
  — Severe pneumonia
  — Flail chest
— Chronic respiratory acidosis
  — Emphysema
  — Cystic fibrosis
  — Advanced multiple sclerosis
  — Bronchiectasis
  — Bronchial asthma
— Poliomyelitis
— Myasthenia gravis
— Guillain-Barre

— Other factors favoring hypoventilation
— Obesity or pregnancy
— Tight abdominal binders or dressings
— Post operative pain from high abdominal or chest incisions
— Abdominal distention from cirrhosis or bowel obstruction or Ascites
— Prolonged open-chest/open-heart operations
— Spinal deformities

DEFINING CHARACTERISTICS (S&S)

— Acute respiratory acidosis
— Feeling of fullness in the head
— Mental cloudiness, disorientation
— Dizziness - Weakness
— Palpitations - Muscular twitching
— Warm, flushed skin
— Unconsciousness
— Plasma pH below 7.35
— Plasma HCO₃ normal or only slightly above 26
— PCO₂ greater than 45
— Urine pH below 6
— Rapid, shallow or slow shallow respirations
— Dyspnea - Asterixis

— Chronic respiratory acidosis
— Weakness
— Dull headache
— pH below 7.35
— PCO₂ greater than 45
— HCO₃ greater than 26

TREATMENT
— Directed at improving ventilation — exact measures vary with the cause
— Bronchodilators to reduce bronchospasm
— Antibiotics for infections
— Pulmonary hygiene
— Adequate hydration — 2-3 L/day
— Supplemental O₂ — cautiously in COPD clients
— Position client in semi-Fowler’s or orthopneic position
— Monitor VS
— Provide emotional support

RESPIRATORY ALKALOSIS
— Extreme anxiety
— Hypoxemia
— High fever
— Early salicylate intoxication — stimulates respiratory center
— Gram-negative bacteremia
— Pulmonary emboli
— Thyrotoxicosis
— Tetany
— Central nervous systems lesions involving the respiratory center
— Excessive ventilation by mechanical ventilators
— Pregnancy — high progesterone level sensitizes the respiratory center to CO₂
— Neurological conditions such as meningitis or encephalitis
— High environmental temperatures
— Lack of oxygen

DEFINING CHARACTERISTICS (S&S)
— Rapid, deep respirations
— Lightheadedness — due to cerebral vasoconstriction and decreased cerebral blood flow
— Inability to concentrate
— Numbness and tingling of extremities
— Circumoral paresthesia
— Vertigo
— Tinnitus
— Syncope
— Carpopedal spasm
— Hyperactive deep tendon reflexes
— pH over 7.45
— pCO₂ less than 35
— HCO₃ initially normal or less than 22
— Urine pH above 7
— Hyperventilation syndrome
  — Tinnitus, blurred vision
  — Palpitations, precordial tightness
  — Sweating, dry mouth
  — Tremulousness
  — Nausea and vomiting
  — Convulsions, loss of consciousness

TREATMENT
— If anxiety is the cause, client needs to be helped to normalize respirations — move to a quiet area, teaching slow, normal breathing
— Breathing into a paper bag is used only if unable to calm the client and quieting measures do not work
— Correct the underlying cause
— Monitor VS
— Provide emotional support
— Administer sedatives, as ordered

METABOLIC ACIDOSIS

— Diarrhea
— Intestinal fistulas
— Ureterosigmoidostomy
— Hyperalimentation
— Acidifying Drugs
— Renal tubular acidosis
— Systemic infections
— Ingestion of toxins
— Diabetic acidosis/ Starvational acidosis/ Lactic acidosis
— Renal failure
— Alcohol intoxication
— High-fat diet
— Decreased tissue perfusion from trauma and/or burns
— K⁺ conserving diuretics — can cause K⁺ excess — can result in Na⁺ loss and HCO₃ loss

DEFINING CHARACTERISTICS (S&S)

— Headache
— Confusion — changes in LOC
— Drowsiness
— Kussmaul Respirations
— Nausea and/or vomiting
— Peripheral vasodilatation — causing warm, flushed skin
— Decreased cardiac output — bradycardia may develop
— Fruity breath
— Increased rate and depth of respirations — may not be apparent until HCO₃ is quite low
— Muscle twitching
— Weakness
— Coma
— pH below 7.35
— pCO₂ initially normal then falling below 35
— HCO₃ less than 22
— Urine pH below 6
— K⁺ may be elevated

TREATMENT

— Monitor VS
— Administer IV’s as ordered
— Correct the underlying cause
— Administer O₂ — cautiously in COPD clients
— Monitor ABG’s
— Administer insulin as ordered if cause is diabetic acidosis
— Monitor/assess/reassess for results of care

METABOLIC ALKALOSIS

— Vomiting
— Excessive NG suctioning
— Cushing’s syndrome
— K⁺ losing diuretic therapy — can cause K⁺ loss — can cause Na⁺ retention — Hypokalemia
— Excessive base ingestion
— Hyperaldosteronism
— ACTH administration
— NaHCO₃ administration during CPR

DEFINING CHARACTERISTICS (S&S)

— Decreased respiratory rate and depth/ Often have hypokalemia
— Dizziness/ Carpopedal spasm/ Muscle hypertonicity
— Paresthesia in fingers and toes/ Circumoral paresthesia
— Nausea and/or vomiting
— Confusion/ Irritability
— Agitation seizures/ Arrhythmias/ Coma
— pH above 7.45/ HCO₃ above 26
— pCO₂ initially normal and then greater than 45
— Urine pH above 7

TREATMENT

— Monitor clients at risk — anticipate problems before they become problems
— Assess I & O
— Monitor VS
— Correct the underlying cause
— Provide emotional support
— Administer IV’s as ordered