SNS COLLEGE OF ALLIED HEALTH SCIENCES

SNS Kalvi Nagar, Coimbatore - 35

Affiliated to Dr MGR Medical University, Chennai

DEPARTMENT OF CARDIO PULMONARY PERFUSION CARE TECHNOLOGY

COURSE NAME : Pharmacology Pathology and Clinical Microbiology

II nd YEAR

TOPIC : ACID BASE BALANCE

Acid-Base Balance

Acid-Base Basics

- Balance depends on regulation of free hydrogen ions
- Concentration of hydrogen ions is measured in pH
- Arterial blood gases are the major diagnostic tool for evaluating acid-base balance

Arterial Blood Gases

- pH 7.35 - 7.45
- PaCO2 35 - 45 mmHg
- HCO3 22-26 mEq/L

Acidosis

- pH < 7.35
- Caused by accumulation of acids or by a loss of bases

Alkalosis

- pH > 7.45
- Occurs when bases accumulate or acids are lost

Regulatory Systems

- Three systems come into play when pH rises or falls

  – Chemical buffers
  – Respiratory system
  – Kidneys

Chemical Buffers

- Immediate acting
- Combine with offending acid or base to neutralize harmful effects until another system takes over

- Bicarb buffer - mainly responsible for buffering blood and interstitial fluid
- Phosphate buffer - effective in renal tubules
- Protein buffers - most plentiful - hemoglobin

Respiratory System

- Lungs regulate blood levels of CO2
- CO2 + H2O = Carbonic acid
- High CO2 = slower breathing (hold on to carbonic acid and lower pH)
- Low CO2 = faster breathing (blow off carbonic acid and raise pH)
- Twice as effective as chemical buffers, but effects are temporary

Kidneys

- Reabsorb or excrete excess acids or bases into urine
- Produce bicarbonate
- Adjustments by the kidneys take hours to days to accomplish
- Bicarbonate levels and pH levels increase or decrease together

Arterial Blood Gases (ABG)

- Uses blood from an arterial puncture
- Three test results relate to acid-base balance
  - pH
  - $PaCO_2$
  - HCO_3

Interpreting ABGs

- Step 1 - check the pH
- Step 2 - What is the CO2?
- Step 3 - Watch the bicarb
- Step 4 - Look for compensation
- Step 5 - What is the PaO2 and SaO2?

Step 1 - Check the pH

- pH < 7.35 = acidosis
- pH > 7.45 = alkalosis
- Move on to Step 2

Step 2 - What is the CO2?

- PaCO2 gives info about the respiratory component of acid-base balance
- If abnormal, does the change correspond with change in pH?
  - High pH expects low PaCO2 (hypocapnia)
  - Low pH expects high PaCO2 (hypercapnia)

Step 3 – Watch the Bicarb

- Provides info regarding metabolic aspect of acid-base balance
- If pH is high, bicarb expected to be high (metabolic alkalosis)
- If pH is low, bicarb expected to be low (metabolic acidosis)

Step 4 – Look for Compensation

- If a change is seen in BOTH PaCO2 *and* bicarbonate, the body is trying to compensate
- Compensation occurs as opposites, (Example: for metabolic acidosis, compensation shows respiratory alkalosis)

Step 5 – What is the PaO2 and SaO2

- PaO2 reflects ability to pickup O2 from lungs
- SaO2 less than 95% is inadequate oxygenation
- Low PaO2 indicates hypoxemia

Acid-Base Imbalances

- Respiratory Acidosis
- Respiratory Alkalosis
- Metabolic Acidosis
- Metabolic Alkalosis

Respiratory Acidosis

- Any compromise in breathing can result in respiratory acidosis
- Hypoventilation ⇒carbon dioxide buildup and drop in pH
- Can result from neuromuscular trouble, depression of the brain's respiratory center, lung disease or airway obstruction

Clients At Risk

- Post op abdominal surgery
- Mechanical ventilation
- Analgesics or sedation

What Do You See?

- Apprehension, restlessness
- Confusion, tremors
- Decreased DTRs
- Diaphoresis
- Dyspnea, tachycardia
- N/V, warm flushed skin

ABG Results

- Uncompensated
  - pH < 7.35
  - PaCO2 >45
  - HCO3 Normal
- Compensated
  - pH Normal
  - PaCO2 >45
  - HCO3 > 26

What Do We Do?

- Correct underlying cause
- Bronchodilators
- Supplemental oxygen
- Treat hyperkalemia
- Antibiotics for infection
- Chest PT to remove secretions
- Remove foreign body obstruction

Respiratory Alkalosis

- Most commonly results from hyperventilation caused by pain, salicylate poisoning, use of nicotine or aminophylline, hypermetabolic states or acute hypoxia (overstimulates the respiratory center)

What Do You See?

- Anxiety, restlessness
- Diaphoresis
- Dyspnea (⇑ rate and depth)
- EKG changes
- Hyperreflexia, paresthesias
- Tachycardia
- Tetany

ABG Results

- Uncompensated
  - pH > 7.45
  - PaCO2 < 35
  - HCO3 Normal
- Compensated
  - pH Normal
  - PaCO2 < 35
  - HCO3 < 22

What Do We Do?

- Correct underlying disorder
- Oxygen therapy for hypoxemia
- Sedatives or antianxiety agents
- Paper bag breathing for hyperventilation

Metabolic Acidosis

- Characterized by gain of acid or loss of bicarb
- Associated with ketone bodies
  - Diabetes mellitus, alcoholism, starvation, hyperthyroidism
- Other causes
  - Lactic acidosis secondary to shock, heart failure, pulmonary disease, hepatic disease, seizures, strenuous exercise

What Do You See?

- Confusion, dull headache
- Decreased DTRs
- S/S hyperkalemia (abdominal cramps, diarrhea, muscle weakness, EKG changes)
- Hypotension, Kussmaul's respirations
- Lethargy, warm & dry skin

ABG Results

- Uncompensated
  - pH < 7.35
  - PaCO2 Normal
  - HCO3 < 22
- Compensated
  - pH Normal
  - PaCO2 < 35
  - HCO3 < 22

What Do We Do?

- Regular insulin to reverse DKA
- IV bicarb to correct acidosis
- Fluid replacement
- Dialysis for drug toxicity
- Antidiarrheals

Metabolic Alkalosis

- Commonly associated with hypokalemia from diuretic use, hypochloremia and hypocalcemia
- Also caused by excessive vomiting, NG suction, Cushing's disease, kidney disease or drugs containing baking soda

What Do You See?

- ✓ Anorexia
- ✓ Apathy
- ✓ Confusion
- ✓ Cyanosis
- ✓ Hypotension
- ✓ Loss of reflexes
- ✓ Muscle twitching
- ✓ Nausea
- ✓ Paresthesia
- ✓ Polyuria
- ✓ Vomiting
- ✓ Weakness

ABG Results

- Uncompensated
  - pH > 7.45
  - PaCO2 Normal
  - HCO3 >26
- Compensated
  - pH Normal
  - PaCO2 > 45
  - HCO3 > 26

What Do We Do?

- IV ammonium chloride
- D/C thiazide diuretics and NG suctioning
- Antiemetics

IV Therapy

- Crystalloids – volume expander
  - Isotonic (D5W, 0.9% NaCl or Lactated Ringers)
  - Hypotonic (0.45% NaCl)
  - Hypertonic (D5/0.9% NaCl, D5/0.45% NaCl)
- Colloids – plasma expander (draw fluid into the bloodstream)
  - Albumin
  - Plasma protein
  - Dextran

Total Parenteral Nutrition

- Highly concentrated
- Hypertonic solution
- Used for clients with high caloric and nutritional needs
- Solution contains electrolytes, vitamins, acetate, micronutrients and amino acids
- Lipid emulsions given in addition

THANK YOU