Chapter 10
Assessment and Management of Shock

Objectives
- Explain the difference between aerobic and anaerobic metabolism
- Describe the importance of tissue perfusion
- List the four elements of the Fick principle
- List the primary components of the cardiovascular system and their roles

Objectives
- Discuss the role of water in its relationship with body function
- Discuss the fluid compartments of the body
- Identify the significant anions and cations in the body
- Explain the role of the semipermeable membrane in the function of the cell
Objectives

- Discuss the concepts of diffusion, facilitated diffusion, osmosis, osmotic pressure, and active transport
- Give examples of isotonic, hypotonic, and hypertonic solutions
- Explain the function of plasma, erythrocytes, platelets, hemoglobin, and hematocrit in blood

Objectives

- Describe the role of antigens and antibodies in the body
- Explain the Rh factor in blood
- Describe acids and bases in relation to pH
- Explain how the buffer systems, respiration, and kidney function help to maintain acid-base balance in the body

Objectives

- Describe the three principal stages of shock
- List the five types of shock
- Discuss the proper assessment and management of the patient in shock
- Describe fluid replacement in the management of the patient in shock
Pathophysiology of Shock

- Perfusion
- Anaerobic metabolism
  - Without O₂
- Aerobic metabolism
  - With O₂
- Hypoperfusion

Pathophysiology of Shock

- Fick principle
  - Adequate ventilation
  - O₂ binds with hemoglobin
  - O₂ transported via circulatory system
  - O₂ off-loaded in capillaries

Pathophysiology of Shock

- Cellular metabolism
  - Cellular respiration
  - Pyruvic acid
Pathophysiology of Shock

- Aerobic metabolism
  - Person breathes O₂
  - O₂ binds with hemoglobin

Pathophysiology of Shock

- Anaerobic metabolism
  - Shock patient

The Cardiovascular System

- Closed system of blood vessels
The Cardiovascular System

- Stroke volume
- Dependent on:
  - Contractility
  - Preload
  - Afterload

The Cardiovascular System

- Contractility
  - Extent and velocity of muscle fiber shortening
  - Influenced by:
    - O₂ supply and demand
    - Degree of sympathetic stimulation
    - Electrolyte balance
    - Drug effects
    - Disease

The Cardiovascular System

- Preload
  - Affected by volume of blood returning
  - More blood ↑ preload
  - Less blood ↓
The Cardiovascular System

- **Afterload**
  - Affects stroke volume
  - Dictated by arterial blood pressure
  - Factors that increase afterload
    - Obstruction of aortic valve
    - Circulatory fluid overload

Blood pressure
- Force exerted against arterial walls
- Cardiac output times peripheral resistance

Blood vessels
- Arteries
- Arterioles
- Capillaries
- Venules
- Veins
The Cardiovascular System

- Microcirculation system
  - Arterioles
  - Capillaries
  - Venules

Fluid and Electrolytes

- Water
- Solvent
  - Solute
    - Electrolytes
    - Nonelectrolytes
Fluid and Electrolytes

- Intracellular fluid
- Extracellular fluid
  - Intravascular fluid
  - Interstitial fluid

Fluid and Electrolytes

- Homeostasis

Fluid and Electrolytes

- Electrolytes
  - Salts
    - Ions—electrical current
      - Cations—positive charge
      - Anions—negative charge
Fluid and Electrolytes

- Cations (+ charge)
  - Sodium (Na\(^+\))
  - Potassium (K\(^+\))
  - Calcium (Ca\(^{2+}\))
  - Magnesium (Mg\(^{2+}\))

- Anions (- charge)
  - Chloride (Cl\(^-\))
  - Bicarbonate (HCO\(_3^–\))
  - Phosphate (HPO\(_4^{2-}\))

Cellular Membranes

- Semipermeable
  - Allow substances to pass through

- Permeability
  - Degree to which substances are allowed to pass through

Cellular Membranes

- Diffusion
  - Movement of particles
    - Solutes
    - Passive process
Cellular Membranes
- Facilitated diffusion
  - Transport protein
  - Passive transport

Cellular Membranes
- Osmosis
  - Movement of water across semipermeable membrane

Fluid and Electrolytes
- Active transport
  - Across membrane from ↓ concentration to ↑ concentration
  - Faster than diffusion
Fluid and Electrolytes

- Isotonic solution
  - Osmotic pressure equal to normal body fluid
  - 0.9% normal saline, lactated Ringer’s

- Hypotonic solution
  - Osmotic pressure less than body fluid

- Hypertonic solution
  - Osmotic pressure greater than body fluid

Blood

- Three functions
  - Transportation
  - Regulation
  - Protection
Blood
- Plasma
- Fluid portion
- Erythrocytes (E)
- Leukocytes (L)
- Hemoglobin
- Hematocrit
- Platelets

Blood
- Antigen
  - Protein that triggers formation of antibodies
- Antibody
  - Protein developed in response to an antigen
- Rh factor
  - Antigen factor considered during blood typing

Blood
Blood type is determined by the antigens present on blood cell membranes

<table>
<thead>
<tr>
<th>Red Blood Cells</th>
<th>Plasma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>Antibody A</td>
</tr>
<tr>
<td>Type B</td>
<td>Antibody B</td>
</tr>
<tr>
<td>Type AB</td>
<td>Neither antibody A nor B</td>
</tr>
<tr>
<td>Type O</td>
<td>Antibodies A and B</td>
</tr>
</tbody>
</table>
Acid-Base Balance

- **pH**
  - Measure of relative hydrogen ion concentration

- **Acid**
  - ↑ hydrogen ion concentration, pH < 7.0

- **Base**
  - ↓ hydrogen ion concentration, pH > 7.0

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**Buffer systems**

- Fastest acting defenses
- Act as chemical sponge
- Major buffer system
  - Bicarbonate/carbonic acid
Acid-Base Balance

- Respiration
  - Vital role
  - Regulates concentration of carbon dioxide

- Kidney function
  - Role is complex
  - Able to deal with alkalosis or acidosis

Primary acid-base imbalances
- Respiratory acidosis
- Respiratory alkalosis
- Metabolic acidosis
- Metabolic alkalosis

Acid-Base Balance—Respiratory Acidosis
Stages of Shock

- Compensated shock
- Decompensated shock
- Irreversible shock
Stages of Shock—Compensated Shock

**Compensated Shock**

Vertebral (veno-arterial) shunt formation

Decreased vascular perfusion

Arterial (veno-arterial) shunt formation

Blood is shunted from the systemic circulation to the lungs and tissues.

Chemosensors in the medulla oblongata.

"pH", "pCO2", "pO2", light, etc.
Stages of Shock—Decompensated Shock

Types of Shock

- Primary mechanisms
  - Fluid loss
  - Significant vasodilation
  - Pump failure

Types of Shock

- Hypovolemic shock
- Cardiogenic shock
- Neurogenic shock
- Anaphylactic shock
- Septic shock
Types of Shock—
Hypovolemic Shock

Types of Shock—
Cardiogenic Shock

Types of Shock—
Neurogenic Shock
Types of Shock—Anaphylactic Shock

Types of Shock—Septic Shock
Assessment and Management of the Patient in Shock

- Evaluation directed at:
  - assessing oxygenation
  - perfusion of body organs

- Goals
  - Patent airway
  - Oxygenation and ventilation
  - Perfusion

Assessment and Management of the Patient in Shock

- Level of responsiveness
  - Assessed throughout survey
  - Better indicator
  - Significant alteration
  - Alcohol and drugs

Assessment and Management of the Patient in Shock

- Airway assessment
  - Opened and maintained
  - Upper airway obstruction
    - Snoring
    - Gurgling
    - Stridor
Assessment and Management of the Patient in Shock

- Airway management
  - Airway adjunct
  - Endotracheal intubation
  - Suctioning
  - Positioning

- Breathing and oxygenation assessment
  - Adequacy of air exchange
  - Rate and depth of respirations

- Breathing and oxygenation management
  - Assist breathing
  - 100% oxygen
  - Nonrebreather mask
  - Nasal cannula
  - Pulse oximeter
Assessment and Management of the Patient in Shock

- Circulation assessment
  - External bleeding
  - Pulse rate and character
  - Skin color, appearance, temperature
  - Capillary refill

Assessment and Management of the Patient in Shock

- Circulation management
  - Positioning
    - Supine
    - Legs elevated
    - Respiratory compromise

Assessment and Management of the Patient in Shock

- Fluid replacement
  - Common solutions
    - Lactated Ringer’s
      - Volume replacement
    - 0.9% sodium chloride
      - Volume replacement
    - 5% dextrose in water
      - To keep vein open
Assessment and Management of the Patient in Shock

- Fluid replacement
  - Blood preparations
    - Packed erythrocytes
    - Plasma
    - Platelets
    - Whole blood

- Maintaining body temperature
  - Factors
    - Environmental/weather
    - Oxygen and IV fluids
    - Patient location
  - Protect the patient
    - Wet clothing
    - Cover patient
    - Vasodilation

- Focused history and physical examination
  - Thoroughness depends on patient’s condition
  - Obvious life-threatening problems
  - Continual reassessment
  - Ask the patient
Summary

- Long-term survival depends on delivery of adequate amounts of oxygen and glucose to individual cells.
- Shock is inadequate tissue perfusion, causing lack of tissue oxygenation, which leads to anaerobic metabolism.
- Decreased blood flow is common in shock, may occur from hemorrhage, pump failure, or inappropriate systemic vascular resistance.

Summary

- Body attempts to compensate for shock by several mechanisms.
- Three stages of shock are compensatory, progressive, and irreversible.
- Progressive shock develops when body fails to compensate for insult.

Summary

- Signs and symptoms become more apparent during progressive shock.
- Survival depends on prompt recognition, rapid care, and prompt transport.
- As shock progresses, oxygen supply to cells decreases and cells resort to anaerobic metabolism; leads to production of lactic acid and to acidosis.
Summary

- In irreversible stage of shock, tissues die
- Trauma victim is evaluated for shock in primary survey
- Continue assessment for shock during secondary survey
- Reassess for developing shock until patient is delivered to hospital

Summary

- Treatment for shock includes adequate ventilation and oxygenation and further prevention of shock process
- Rapid transport is imperative
- Low blood pressure is late sign of shock

Summary

- Evaluation of shock begins with scene survey, mechanism of injury, and history
- If these factors indicate shock is or could be present, take measures to counter effects of shock