Chapter 17
Hemorrhage & Shock

Chapter Goal
- Use assessment findings to formulate field impression and implement treatment plan for patient with hemorrhage or shock

Learning Objectives
- Describe epidemiology, including morbidity, mortality, & prevention strategies for shock & hemorrhage
- Discuss anatomy & physiology of cardiovascular system
- Predict shock & hemorrhage based on mechanism of injury
- Discuss various types & degrees of hemorrhage & shock
- Discuss pathophysiology of hemorrhage & shock
Learning Objectives

- Discuss assessment findings associated with hemorrhage & shock
- Identify need for intervention & transport of patient with hemorrhage or shock
- Discuss treatment plan for & management of hemorrhage & shock
- Discuss management of external hemorrhage
- Differentiate between controlled & uncontrolled hemorrhage

Learning Objectives

- Differentiate between administration rate & amount of IV fluid in patient with controlled vs. uncontrolled hemorrhage
- Relate internal hemorrhage to pathophysiology of compensated & decompensated hemorrhagic shock
- Relate internal hemorrhage to assessment findings of compensated & decompensated hemorrhagic shock
- Discuss management of internal hemorrhage

Learning Objectives

- Define shock based on aerobic & anaerobic metabolism
- Describe incidence, morbidity, & mortality of shock
- Describe body's physiological response to changes in perfusion
- Describe effects of decreased perfusion at capillary level
- Discuss cellular ischemic phase related to hemorrhagic shock
Learning Objectives

- Discuss capillary stagnation phase related to hemorrhagic shock
- Discuss capillary washout phase related to hemorrhagic shock
- Discuss assessment findings of hemorrhagic shock
- Relate pulse pressure changes to perfusion status

Learning Objectives

- Relate orthostatic vital sign changes to perfusion status
- Define compensated & decompensated shock
- Discuss pathophysiological changes associated with compensated shock
- Discuss assessment findings associated with compensated shock

Learning Objectives

- Identify need for intervention & transport of patient with compensated shock
- Discuss treatment plan & management of compensated shock
- Discuss pathophysiological changes associated with decompensated shock
- Discuss assessment findings associated with decompensated shock
- Identify need for intervention & transport of the patient with decompensated shock
Learning Objectives

- Discuss treatment plan & management of patient with decompensated shock
- Differentiate between compensated & decompensated shock
- Relate external hemorrhage to pathophysiology of compensated & decompensated hemorrhagic shock
- Relate external hemorrhage to assessment findings of compensated & decompensated hemorrhagic shock
- Differentiate between normotensive, hypotensive, & profoundly hypotensive

Learning Objectives

- Differentiate between administration of fluid in normotensive, hypotensive, & profoundly hypotensive
- Discuss physiological changes associated with pneumatic anti-shock garment (PASG)
- Discuss indications & contraindications for application & inflation of PASG
- Apply epidemiologic principles to develop prevention strategies for hemorrhage & shock

Learning Objectives

- Integrate pathophysiological principles to assessment of hemorrhage or shock patient
- Synthesize assessment findings & patient history to form field impression for hemorrhage or shock patient
- Develop, execute, & evaluate treatment plan based on field impression for hemorrhage or shock patient
Introduction

- Oxygen intake & use

Introduction

The Fick principle

- Cellular metabolism
  - Begins with food being broken down
  - Aerobic metabolism
  - Oxygen plays important role
Cardiovascular System

- Closed system

Cardiovascular System

Stroke volume

Preload

Cardiovascular System

Afterload

Blood pressure
Blood

- Functions
  - Transportation
  - Regulation
  - Protection

- Plasma
  - Major proteins
    - Albumin
    - Globulin
    - Fibrinogen

Blood

- Cells of blood
  - Erythrocytes
  - Leukocytes
Blood

- Platelets
  - Not cells
  - Suspended
  - Essential

- Viscous fluid
  - Viscosity

- Cardiovascular system—closed system

Soft-Tissue Trauma

- Closed wounds
  - Contusions & hematomas
    - Blunt trauma
    - Vessels torn
    - Swelling or hematoma
  - Treatment
    - Cold
    - Compression
    - Elevation
    - Immobilization
Soft-Tissue Trauma

Closed wounds

- Crush injuries
  - Extremities, torso, or pelvis
  - Blood vessel injury; internal organ rupture
- Symptoms
  - Pain
  - Paresis
  - Weakness
  - Parasthesia
  - Pallor
  - Pulselessness

Soft-Tissue Trauma

Closed wounds

- Crush injuries
  - Treatment
    - Airway & breathing
    - High-concentration O2
    - Fluids
    - Immobilization
    - Rapid transport

Soft-Tissue Trauma

Closed wounds

- Compartment syndrome
  - Surgical emergency
  - Blunt trauma
  - Bleeding, swelling, & increased pressure in closed area
- Signs and symptoms
  - Extreme pain
  - Swelling
  - Tenderness
  - Weakness of involved muscle groups
- Treatment
  - Same as for crush injuries
Soft-Tissue Trauma

**Closed wounds**
- Crush syndrome
  - Life-threatening
  - Prolonged compression
  - Rare
- Signs & symptoms
  - Appear after patient is released from crushing source
  - Shock
  - Possible metabolic acidosis
- Treatment
  - Airway & ventilatory support
  - High-concentration O₂
  - Maintenance of body temperature
  - Rehydration
  - Possible pharmacological treatment or tourniquets
  - Surgical intervention if extrication not possible

**Open wounds**
- Abrasions
  - Outermost layer of skin
  - Loss of body fluids
- Signs & symptoms
  - Pain
- Treatment
  - Clean wound

- Lacerations
  - Tear, split, or incision
  - May be caused by blunt or penetrating trauma
- Signs & symptoms
  - Pain
  - Bleeding
- Treatment
  - Control bleeding
  - Prevent contamination
  - Monitor for hemorrhagic shock
Soft-Tissue Trauma

Lacerations

Soft-Tissue Trauma

- Open wounds

  - Punctures
    - Sharp, pointed objects
    - Underlying tissues
    - Appear minor—internal bleeding
    - Signs & symptoms
      - Pain
      - Bleeding
    - Treatment

  - Avulsions
    - Tearing away
    - Signs & symptoms
      - Pain
      - Bleeding
    - Treatment
      - If tissue attached
        - Cleanse area
        - Return skin to normal position as much as possible
        - Control bleeding
        - Apply dressing
      - If tissue detached
        - Treat as amputation

• Soft-Tissue Trauma
Soft-Tissue Trauma

- Open wounds
  - Amputation
    - Partial or complete loss
    - Major bleeding
    - Life threatening
  - Signs & symptoms
    - Pain
    - Bleeding
  - Treatment
    - Control bleeding
    - Place amputated part in sterile dressing (moistened per local protocol)
    - Place part in plastic bag

Hemorrhage

- External bleeding
  - Arterial
  - Venous
  - Capillary

Hemorrhage

- Stage 1
  - ≤15% loss
  - BP maintained
  - Normal pulse pressure, respiratory rate, renal output
  - Skin pallor
  - Anxiety
Hemorrhage

- **Stage 2**
  - >15%-25% loss
  - ↓ Cardiac output
  - Reflex tachycardia
  - ↑ Respiratory rate
  - BP maintained
  - ↑ Diastolic pressure
  - Narrow pulse pressure
  - Diaphoresis
  - Normal renal output
  - Anxiety, confusion

- **Stage 3**
  - <25%-35% loss
  - Signs of hypovolemic shock
    - Tachycardia
    - Tachypnea
    - ↓ Systolic pressure
    - 5-15 mL/hr urine output
    - Altered mental status
    - Diaphoresis, cool, pale skin

- **Stage 4**
  - >35% loss
  - Extreme tachycardia
  - Extreme tachypnea
  - Significantly ↓ systolic BP
  - Confusion, lethargy, unconsciousness
  - Diaphoresis, cool, extremely pale skin
Hemorrhage

- Assessment
  - Amount of visible loss not good way to judge severity

Physiological Response to Hemorrhage

- Apply direct pressure with gloved hand, sterile, absorbent dressing
- Check entire extremity for skeletal injuries; do not elevate until splinted

Physiological Response to Hemorrhage

- If blood soaks through, place additional dressings on top
- Continue to apply manual pressure
Physiological Response to Hemorrhage

- Internal bleeding
  - Blunt, penetrating trauma
  - Acute/chronic illnesses
  - Hemodynamic instability
  - Higher morbidity/mortality
  - Assessment
  - Management

- Assessment
  - Coughing up red, frothy blood
  - Vomiting blood
  - Melena
  - Hematochezia
  - Red urine
  - Dizziness, syncope
  - Orthostatic hypotension
  - Pain

- Management
  - Tenderness
  - Abdominal rigidity
  - Restlessness
  - Nausea/thirst
  - Weak, rapid pulse
  - Cool, clammy skin
  - Rapid, gasping breathing
  - Diaphoresis
Physiological Response to Hemorrhage

- Internal bleeding
  - Management
    - Rapid transport to definitive care
    - Keep warm
    - Treat for shock

Shock

- The body’s response to poor perfusion
- When $\text{O}_2$ concentration, body compensates
  - Shunts blood from less essential systems
  - Baroreceptors help maintain BP
Shock

- Sympathetic nervous system is stimulated
  - Norepinephrine & epinephrine released
    - Beta 1 receptors stimulated
      - ↑ Dromotropy
      - ↑ Chronotropy
      - ↑ Inotropy
    - Beta 2 receptors stimulated
      - Bronchodilation
      - GI smooth muscle dilation
  - Alpha 1 receptors stimulated
    - Smooth muscle constriction in peripheral arterioles & venules
      - ↓ BP
      - ↓ Container size
    - ↓ Circulation to vital organs; ↑ circulation to rest of body
Shock

- $\text{O}_2$, $\text{CO}_2$, pH change—detected by chemoreceptors
- ↑$\text{CO}_2$ and/or ↓$\text{O}_2$ initiate sympathetic response
Capillary & Cellular Changes

- Ischemia
  - Cells shift from aerobic to anaerobic metabolism
    - ↑ lactic acid
    - ↑ H+
    - ↓ pH
    - Metabolic acidosis
      - If unresolved, eventual cellular death

- Precapillary sphincter relaxation
  - In response to
    - Lactic acid
    - Vasomotor failure
    - ↑ CO₂

- Postcapillary sphincter remains constricted
  - Capillaries become engorged with fluid

- As arteries dilate, ↓ cardiac output
Stages of Shock

- Compensated (nonprogressive)
  - Body initiates corrective action to normalize cardiac output & arterial BP
  - Signs & symptoms:
    - Altered LOC, restlessness
    - ↑ HR
    - ↑ Respiratory rate
    - Pale, cool skin

- Decompensated (progressive) shock
  - Constriction of arterioles, venules
  - Immediate medical intervention
  - Signs & symptoms:
    - Additional ↑ HR & respirations
    - Cool clammy skin
    - ↓ Capillary refill
    - Thirst
    - Diaphoresis
    - ↑ anxiety, confusion
    - Nausea & vomiting
  - Hypotension—late sign
Stages of Shock

Irreversible shock
- Rapid deterioration
- "Golden hour" theory
- Signs & symptoms
  - Marked ↓ LOC
  - ↓ Respiratory rate
  - Profound hypotension; inability to palpate pulse
  - ↓ HR
- Rapid assessment, transportation
Stages of Shock

- Keys to recognition, care
  - High level of suspicion
  - “Golden hour”
  - Do not rely on any one sign or symptom to determine degree of shock
  - Hypotension—late sign

- Patients at risk
  - Trauma patient
  - Elderly patients
  - Pregnant women

Types of Shock

- Hypovolemic
- Cardiogenic
- Neurogenic
- Anaphylactic
- Septic

Types of Shock

- Hypovolemia
  - Loss of blood or fluid
    - Bleeding
    - Burns
    - Dehydration
Types of Shock

- **Cardiogenic**
  - Heart failure
    - >40% left ventricular function
    - Myocardial infarction
    - Poor filling or obstruction
      - Cardiac tamponade
      - Tension pneumothorax
      - Bradycardia
      - Significant tachycardia
      - Dysrhythmias

- **Neurogenic**
  - Nervous system unable to control diameter of blood vessels
    - Vasodilation
  - Spinal shock
    - Flaccid paralysis distal to injury
    - Loss of bladder/bowel control
    - Priapism
    - Loss of thermoregulation

- **Anaphylactic**
  - Routes
    - Skin contact
    - Injections
    - Inhalation
    - Ingestion
  - Normally, antigen attacked by antibody
  - Anaphylaxis—antibody does not destroy antigen
  - Mast cells release histamine
    - Sudden, severe bronchoconstriction
    - Vasodilation
    - Fluid leakage from vessels
Types of Shock

- Anaphylactic shock

- Septic
  - Serious infection
    - Massive vasodilation

Differential Shock: Assessment

- Cardiogenic shock differentiated from hypovolemic shock by presence of
  - Chief complaint of chest pain, dyspnea, ↑ HR
  - HR
  - Signs of CHF
  - Dysrhythmia
Differential Shock: Assessment

- Distributive shock differentiated from hypovolemic shock by presence of
  - Mechanism suggesting vasodilation
  - Warm, flushed skin
  - Lack of tachycardia response

- Obstructive shock differentiated from hypovolemic shock by presence of signs &
  symptoms suggestive of cardiac tamponade or tension pneumothorax

Assessment & Management

- Goals of prehospital care
  - Ensure patent airway
  - Provide adequate oxygenation & ventilation
  - Restore perfusion
  - Stop cause
  - Volume replacement

Assessment & Management

- Level of responsiveness
  - Best indicator of perfusion status
  - Watch for
    - Restlessness
    - Agitation
    - Disorientation
    - Confusion
    - Inability to respond to questions or commands
    - Combativeness
    - Unresponsiveness
Assessment & Management

● Airway
  ➢ Assessment
    • Ensure patent airway
  ➢ Management
    • Airway adjunct
    • Suction if necessary
    • Clear obstructions
    • Place patient on side if no cervical injury suspected

Assessment & Management

● Breathing and oxygenation
  ➢ Assessment
    • Compensatory hyperventilation or hypoventilation
  ➢ Management
    • Assist ventilation if necessary
    • High-concentration O₂

Assessment & Management

● Circulation
  ➢ Assessment
    • Rate & character of pulse
      • Location of palpable pulse—indicator of systolic BP
      • Skin color, appearance, temperature
      • Capillary refill (if <6 yrs of age)
Assessment & Management

• Circulation
  ➢ Management
    • High-concentration O₂
    • Elevate legs
    • Fluid therapy
    • PASG per local protocol
    • Transport per local protocol
    • Consider appropriate pharmacological therapies
  ➢ Positioning
    • Elevate legs 10-12" unless respiratory condition warrants otherwise

Assessment & Management

• Fluid replacement
  ➢ Per local protocol

• Blood preparations
  ➢ Only erythrocytes can replace erythrocytes

Assessment & Management

• PASG
  ➢ Indications
    • Hypovolemic shock
    • Pelvic & leg fractures
    • Criteria
      • BP <90 mm Hg with signs of shock
    • Per local protocol
  ➢ Contraindications
    • Absolute—pulmonary edema
    • Respiratory distress
    • Exsanguination
    • Impaled object
  ➢ Complications
    • Chest injuries
Assessment & Management: Applying PASG

- Place unfolded PASG on spine board
- Logroll patient onto spine board
- Check all valves to ensure leg compartments are open & abdominal compartments are closed

Assessment & Management

- Inflate garment
- Close valves
- Reassess patient

Assessment & Management

- Maintain body temperature
- Focused history & physical examination
  - When time & condition permits
  - Important to continually re assess vital signs
- Transport considerations
  - Recognize indications for rapid transport
  - Ground or air transport
  - Appropriate facility
  - Notify receiving facility
Summary

- Shock develops in 3 successive stages
- 1st stage—when body fails to compensate for insult
- As shock progresses—O₂ supply to cells ↓
  - Cells resort to anaerobic metabolism

Summary

- Evaluation of trauma patient is begun in initial assessment
- Evaluating patient for hemorrhage includes looking for internal & external bleeding
- Pathophysiology of hemorrhage & MOI are important in developing treatment plan

Summary

- Treatment for shock includes adequate ventilation & O₂ & further prevention of shock process. Rapid transport is imperative
- ↓ BP is late sign of shock— not sole indicator of present shock
- Long-term survival of body is dependent on delivery of adequate amounts of O₂ & glucose to individual cells via blood
Summary

- Shock is inadequate perfusion to tissues & cells.
- Decreased blood flow may occur secondary to hemorrhage, pump failure, or inappropriate systemic vascular resistance.
- One’s body tries to compensate for damage by utilizing several mechanisms.

Summary

- Anaerobic metabolism produces several abnormal acids; best known is lactic acid.
- Accumulation of acids changes pH, resulting in acidosis.

Questions?