Chapter 49
Thoracic Trauma

Learning Objectives
- Explain relevance of thoracic injuries as part of the overall mortality rate from major trauma
- List thoracic injuries that may result in early death if left untreated by EMS
- Describe the incidence, morbidity, and mortality rates of thoracic injuries in trauma patients

Learning Objectives (Cont'd)
- Discuss types of thoracic injuries
- Discuss A&P of organs and structures related to thoracic injuries
- Discuss pathophysiology of thoracic injuries
- Discuss assessment findings for thoracic injuries
Learning Objectives (Cont'd)

- Discuss management of thoracic injuries
- Identify need for rapid intervention and transport of patient with thoracic injuries
- Discuss management of chest wall injuries
- Describe impact of rib fractures on oxygenation and ventilation

Learning Objectives (Cont'd)

- Predict thoracic injuries on the basis of the mechanism of injury
- Discuss the pathophysiology of specific chest wall injuries, including:
  - Rib fracture
  - Flail segment
  - Sternal fracture

Learning Objectives (Cont'd)

- Discuss the management of lung injuries
- Explain the physiological consequences of flail chest
- Discuss assessment findings associated with chest wall injuries
Learning Objectives (Cont’d)

- Identify the need for rapid intervention and transport of patient with lung injuries
- Discuss pathophysiology of traumatic asphyxia
- Discuss assessment findings associated with traumatic asphyxia

Learning Objectives (Cont’d)

- Discuss the management of traumatic asphyxia
- Identify the need for rapid intervention and transport of patients with traumatic asphyxia
- Discuss assessment findings associated with lung injuries

Learning Objectives (Cont’d)

- Discuss the pathophysiology of injury to the lung, including:
  - Simple pneumothorax
  - Open pneumothorax
  - Tension pneumothorax
  - Hemothorax
  - Hemopneumothorax
  - Pulmonary contusion
Learning Objectives (Cont'd)
- Define pneumothorax and hemothorax
- List the signs and symptoms of tension pneumothorax
- Identify the need for rapid intervention and transport of patients with chest wall injuries

Learning Objectives (Cont'd)
- Discuss the pathophysiology of tracheobronchial injuries
- Discuss assessment findings associated with tracheobronchial injuries
- Discuss the management of tracheobronchial injuries

Learning Objectives (Cont'd)
- Identify the need for rapid intervention and transport of patients with tracheobronchial injuries
- Discuss the pathophysiology of myocardial injuries, including:
  - Pericardial tamponade
  - Myocardial contusion
  - Myocardial rupture
Learning Objectives (Cont'd)

- Discuss assessment findings for myocardial injuries
- Discuss management of myocardial injuries
- Define Beck’s triad
- Identify need for rapid intervention and transport

Learning Objectives (Cont’d)

- Describe pathophysiology of aortic rupture
- Discuss pathophysiology of vascular injuries, including injuries to: aorta, vena cavae, & pulmonary arteries and veins
- Discuss assessment findings for vascular injuries

Learning Objectives (Cont’d)

- Discuss the management of vascular injuries
- Identify the need for rapid intervention and transport of patient with vascular injuries
- Discuss the pathophysiology of diaphragmatic injuries
Learning Objectives (Cont’d)

- Discuss assessment findings associated with diaphragmatic injuries
- Discuss the management of diaphragmatic injuries
- Identify the need for rapid intervention and transport of patients with diaphragmatic injuries

Learning Objectives (Cont’d)

- Discuss the pathophysiology of esophageal injuries
- Discuss assessment findings associated with esophageal injuries
- Discuss the management of esophageal injuries

Learning Objectives (Cont’d)

- Identify the need for rapid intervention and transport of patients with esophageal injuries
Introduction

- Thoracic injuries directly account for 20–25% of trauma deaths.
- Most common cause of injuries leading to accidental deaths in the United States is motor vehicle crashes.

Chest Wall Injuries

- Most common injury of thorax.
- Account for more than 50% of blunt trauma cases.

Chest Wall Injuries (Cont’d)
Chest Wall Injuries (Cont’d)

- Rib fracture
  - Most common significant chest injury
  - Fourth to ninth most commonly fractured—thin and poorly protected
  - First to third suggests high-velocity trauma
  - Ninth to eleventh suggests intraabdominal injury

- Left lower rib injury—splenic injury
- Posterior rib fractures—fifth to ninth most frequently fractured
- Lower posterior rib fractures—spleen and kidney injury
- Open rib fracture—visceral injury
- 2+ rib fractures—internal injury

Chest Wall Injuries (Cont’d)

- Rib fracture
  - Multiple rib fractures possible results:
    - Atelectasis
    - Hypoventilation
    - Inadequate cough
    - Pneumonia
Chest Wall Injuries (Cont’d)

- Rib fracture
  - History and physical findings
    - Tenderness
    - Bony crepitus
    - Ecchymosis
    - Muscle spasm over ribs
    - Localized pain
    - Pain worsens with movement, deep breathing, coughing
    - Splinting on respiration
    - Anteroposterior pressure that elicits pain

- Therapeutic interventions
  - Transport to trauma center
  - Monitor respiratory status
  - Pain relief
  - Maintain pulmonary function
  - \( \text{SpO}_2 \) pulse oximeter, positive-pressure ventilation
  - Capnography
  - Encourage coughing, deep breathing
  - No restrictive devices
  - Administer opiate analgesics per local protocols

Chest Wall Injuries (Cont’d)

- Sternal fracture and dislocation
  - Caused by anterior blunt chest trauma
    - Blow to chest
    - Severe hyperflexion of thoracic cage
    - Deceleration compression injury
Chest Wall Injuries (Cont’d)

- Sternal fracture and dislocation
  - Mortality rate of 25–45%
  - Myocardial and pulmonary contusion
  - Myocardial rupture
  - Flail chest
  - Vascular disruption of thoracic vessels
  - Intraabdominal injuries
  - Head injuries

Chest Wall Injuries (Cont’d)

- Sternal fracture and dislocation
  - History and physical findings
    - Primary concerns
      - Myocardial contusion
      - Cardiac rupture
      - Tamponade
      - Pulmonary injury
      - Point tenderness
      - Crepitus
      - Deformity
      - Pain over sternum

Chest Wall Injuries (Cont’d)

- Sternal fracture and dislocation
  - Assessment findings
    - History of blunt anterior chest trauma
    - Localized anterior chest pain
    - Point tenderness over sternum
    - Soft tissue swelling
    - Palpable deformity
    - Crepitus
    - Tachypnea
    - ECG changes associated with myocardial contusion
Chest Wall Injuries (Cont’d)

- Sternal fracture and dislocation
  - Therapeutic interventions
    - O₂, pulse oximeter, positive-pressure ventilation
    - Capnography
    - Cardiac monitor
    - Opiate analgesics by IV per medical direction

Chest Wall Injuries (Cont’d)

- Flail chest
  - 2+ adjacent ribs fractured at two points
  - allowing freely moving segment of chest wall to move in paradoxic motion
  - Common association with pulmonary contusion
  - Flail segment moves inward with inspiration, outward with expiration
Chest Wall Injuries (Cont’d)

- Flail chest
  - History and physical findings
    - Underlying pulmonary contusion
    - Assessment findings
      - Chest wall contusion
      - Respiratory distress
      - Paradoxic chest wall movement
      - Pleuritic chest pain
      - Crepitus
      - Pain and splinting of affected side
      - Tachypnea
      - Tachycardia
Chest Wall Injuries (Cont’d)

- Flail chest
  - Therapeutic interventions
    - High-flow O₂
    - Cardiac monitor, pulse oximetry
    - Monitor for respiratory failure
    - ET
    - Continuous positive airway pressure by mask may be in place of ET

Chest Wall Injuries (Cont’d)

- Nonpenetrating ballistic injury
  - Body armor
  - Can produce significant injury without penetration
    - Heart
    - Liver
    - Spleen
    - Lung
    - Spinal cord

Chest Wall Injuries (Cont’d)

- Nonpenetrating ballistic injury
  - History and physical findings
    - Redness
    - Bruising
    - Marked tenderness to palpation
    - Palpate surrounding structures for subcutaneous emphysema, crepitation, bony step-offs
  - Therapeutic interventions
    - Transport
    - Possible underlying injury
Chest Wall Injuries (Cont’d)

- **Traumatic asphyxia**
  - Deep purple skin color of head and neck
  - Bilateral subconjunctival hemorrhage
  - Petechiae
  - Facial edema

*Caused by severe compression of chest by extremely heavy object*
- Marked increase in pressure in chest and superior vena cava
- Backflow of blood from right heart to great veins of head and neck
- Pressure transmitted to capillaries of head and neck, engorge with blood
- Blood stagnates
- Skin becomes purple

- **History and physical findings**
  - Benign condition, self-limiting
  - Possible intrathoracic injury
  - Chest wall and pulmonary injuries most common
  - Visual disturbances
Chest Wall Injuries (Cont’d)

- Traumatic asphyxia
  - Assessment findings
    - Cyanosis to face and upper neck
    - Jugular venous distention
    - Facial swelling
    - Swelling or hemorrhage of conjunctiva
    - Skin below compressed area remains pink
    - Hypotension when compressive force is released

Chest Wall Injuries (Cont’d)

- Traumatic asphyxia
  - Therapeutic interventions
    - Trauma center evaluation
    - High-flow O₂
    - Cardiac monitor, pulse oximetry
    - IV access

Pulmonary Injuries

- Subcutaneous emphysema
  - Presence of air in soft tissue space
  - Up to the neck and down to groin
Pulmonary Injuries (Cont’d)

- Subcutaneous emphysema
  - History and physical findings
    - Over chest wall indicates pneumothorax
    - Crunching sensation on chest wall palpation
    - Esophageal tear from penetrating injury produces pneumomediastinum
    - Massive accumulation uncomfortable
  - Therapeutic interventions
    - Consider transport
    - No prehospital treatment

Pulmonary Injuries (Cont’d)

- Pulmonary contusion
  - Direct bruise of the lung tissue
  - Bleeding and edema in alveolar spaces
  - Buildup of blood, fluid, inflammatory components impairs oxygenation, causes respiratory distress
  - Great force needed

Pulmonary Injuries (Cont’d)

- Pulmonary contusion
  - History and physical findings
    - Present with varying degrees of dyspnea
    - Crackles
    - Diminished breath sounds
    - Absent breath on auscultation over affected area
    - Possible rib fractures
Pulmonary Injuries (Cont’d)

- Pulmonary contusion
  - History and physical findings
    - Blunt trauma cases:
      - Hematomas
      - Ecchymoses
      - Tenderness
      - Abrasions
      - Lacerations

- Assessment findings
  - Tachypnea
  - Tachycardia
  - Cough
  - Hemoptysis
  - Apprehension
  - Respiratory distress
  - Dyspnea
  - Cyanosis
  - Chest wall bruising

- Therapeutic interventions
  - Do not focus on more dramatic injuries and overlook pulmonary contusion
  - Hypoxic
  - High-flow O₂
  - Pulse oximeter, cardiac monitor
  - Capnography
  - IV access
  - Rapid transport
Pulmonary Injuries (Cont’d)

- **Pneumothorax**
  - Accumulation of air in pleural space
  - Common complication of chest trauma
  - Present in 15–50% of penetrating trauma

- **Pneumothorax**
  - Simple pneumothorax
    - When no communication with atmosphere exists
    - Mediastinum/diaphragm has not shifted as result of air

- **Pneumothorax**
  - Simple pneumothorax
    - History and physical findings
      - Small tears may resolve on own
      - Assessment findings
      - Tachypnea
      - Tachycardia
      - Respiratory distress
      - Abcess or decreased breath sounds on affected side
      - Hyperresonance
      - Decreased chest wall movement
      - Dyspnea
      - Chest pain referred to shoulder or arm on affected side
      - Slight pleuritic chest pain
Pulmonary Injuries (Cont’d)

• Pneumothorax
   Simple pneumothorax
     Therapeutic interventions
      • Oxygenation and ventilation
      • Pulse oximeter, cardiac monitor
      • IV access
      • Capnography
      • Spinal stabilization if warranted

• Pneumothorax
   Open pneumothorax
    • Injury penetrates chest wall and pleura
    • Enters pleural cavity
    • Lung collapse
    • Open connection between pleural space and environment
Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Open pneumothorax
    - Assessment findings
      - Defect in chest wall
      - To-and-fro air motion out of defect
      - Penetrating injury to chest, does not seal itself
      - Sucking sound on inhalation (sucking chest wound)
      - Tachycardia
      - Respiratory distress
      - Subcutaneous emphysema
      - Decreased breath sounds on affected side

- Therapeutic interventions
  - Recognition critical
  - Occlusive dressing
  - Never pack wound
  - Tape on three sides
  - Oxygenation and ventilation
    - Pulse oximeter, cardiac monitor, capnography
    - IV access
  - Spinal mobilization if warranted
  - Observe for developing tension pneumothorax
Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Tension pneumothorax
    - Progressive accumulation of air under pressure within the pleural cavity
    - Shifts chest contents to the opposite side
    - Opposite lung and great vessels compression
    - Acts as one-way valve, prevents free bilateral communication
    - Increase in intrapleural pressure

- Pneumothorax
  - Tension pneumothorax
    - Air enters on inspiration, cannot exit with expiration
    - Compresses venae cavae
    - Decreases filling of heart, decreased cardiac output
    - Hypoxia
    - Respiratory distress
    - Shock
    - Can progress to prevent heart from contracting or opposite lung moving air
    - Suffocation

- Pneumothorax
  - Tension pneumothorax
    - Assessment findings
      - Hyperinflation of affected side
      - Poor ventilation despite open airway
      - Restlessness, agitation, extreme anxiety
      - Increased airway resistance on ventilating patient
      - Respiratory distress
      - Neck vein distention
      - Decreased or absent breath sounds on affected side
Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Tension pneumothorax
    - **Assessment findings**
      - Tympany (hyperresonance) to percussion on affected side
      - Tachycardia
      - Signs of shock
      - Tracheal deviation away from side of injury
      - Cyanosis
      - Bulging of intercostal muscles
      - Narrow pulse pressure
      - Subcutaneous emphysema

- Pneumothorax
  - Tension pneumothorax
    - **Therapeutic interventions**
      - High-flow O2
      - Pulse oximeter, cardiac monitor
      - Capnography
      - IV access
      - Emergent needle compression on affected lung
Pulmonary Injuries (Cont’d)

Skill 49-1: Needle Decompression

- Standard precautions
- Prepare necessary equipment for needle thoracostomy

Skill 49-1: Needle Decompression (Cont’d)

- Expose chest and identify landmarks
- Palpate from angle of Louis across second rib and locate third rib at mid-clavicular line
Skill 49-1: Needle Decompression (Cont'd)

- Cleanse site
- Insert 14- or 16-gauge over-the-needle catheter to skin over top of third rib and into second intercostal space, midclavicular line

- Attach flutter valve to catheter hub
- Secure catheter to patient’s chest wall with dressing and tape
Skill 49-1: Needle Decompression (Cont'd)
- Reassess breath sounds, respiratory status and vital signs
- Notify medical direction of procedure

Pulmonary Injuries
- Pneumothorax
  - Hemothorax
    - Collection of blood within pleural cavity
    - Caused by blunt or penetrating trauma to chest
    - Capillaries or small blood vessels bleed into pleural cavity
    - Blood displaces lung, reduces air space
    - Possible hypovolemic shock
    - Compromised ventilation

Pulmonary Injuries (Cont'd)
- Pneumothorax (Cont’d)
  - Hemothorax
    - History and physical findings:
      - Patient complains of initial injury, does not notice cyanosis
      - Nontraumatic hemothorax uncommon
      - Auscultation reveals decreased breath sounds in lower lobes when patient is sitting up
Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Hemothorax
    - Therapeutic interventions
      - Adequate oxygenation and ventilation
      - Pulse oximeter, cardiac monitor
      - IV access, minimize fluids
      - Capnography
      - Spinal immobilization only when necessary

Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Hemopneumothorax
    - Pneumothorax with bleeding in pleural space
    - Usually caused by penetrating trauma
    - Similar signs and symptoms as hemothorax
    - Similar treatment as hemothorax
    - Watch for development of possible tension pneumothorax

Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Hemopneumothorax
    - History and physical findings
      - Dyspnea
      - Tachypnea
      - Tachycardia
      - Hypotension
      - Shock
      - Rib crepitus
      - Flail segments
      - Subcutaneous emphysema
      - Absent breath sounds
      - Hyperresonance on percussion
Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Hemopneumothorax
    - Therapeutic interventions
      - Airway control and oxygenation
      - 100% O₂ by nonrebreather mask
      - IV access
      - Pulse oximeter, cardiac monitor
      - Capnography

Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Hemopneumothorax
    - Watch for tension pneumothorax
      - Increasing distress
      - Dropping BP
      - Increasing tachycardia
      - Dropping O₂ saturations
      - Rapid transport

Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Tracheobronchial injury
    - Blunt or penetrating trauma of neck or chest
    - Direct blow to neck may transect tracheal rings or cricoids cartilage
    - Respiratory distress
    - Hypoxia
    - Hemoptysis
    - Subcutaneous emphysema
Pulmonary Injuries (Cont’d)

- Pneumothorax
  - Tracheobronchial injury
    - History and physical findings
      - Wound opens into pleural space, produces large pneumothorax
      - Complete transaction of tracheobronchial tree, no communication with pleural space

- Therapeutic interventions
  - Rapid transport
  - Caution if blind intubation, ET tube through transected airway

Cardiovascular Trauma

- Cardiac contusion
  - Large force applied to chest wall
  - High-speed deceleration injuries
  - Sternum displaced posteriorly
  - Heart compressed between sternum and chest
Cardiovascular Trauma (Cont’d)

● Cardiac contusion
  ➢ History and physical findings
    • Varied, nonspecific
    • Pain and shock or benign
    • Blunt cardiac injury likely has additional abdominal, skeletal, or CNS injury

Cardiovascular Trauma (Cont’d)

● Cardiac contusion
  ➢ History and physical findings
    • Associated injuries
      ➢ Pulmonary contusion
      ➢ Pneumothorax
      ➢ Hemothorax
      ➢ External fracture
      ➢ Great vessel injury
      ➢ Cardiac output reduction may manifest as shock

Cardiovascular Trauma (Cont’d)

● Cardiac contusion
  ➢ History and physical findings
    • Right ventricle more likely injured
    • Least specific sign: sinus tachycardia
    • ECG: right bundle branch block
Cardiovascular Trauma (Cont’d)

- Cardiac contusion
  - History and physical findings
    - Information to ED
    - MOI
    - Status of motor vehicle
    - Steering wheel/dashboard damage
    - Seatbelt use
    - Air bag deployment
    - Estimated speed of vehicle before crash
    - Position of patient when found

Cardiovascular Trauma (Cont’d)

- Cardiac contusion
  - Therapeutic intervention
    - Rapid transport
    - High-flow O₂
    - Cardiac monitor
    - IV access en route, analgesic agents
    - Fibrinolytic agents and aspirin contraindicated

Cardiovascular Trauma (Cont’d)

- Pericardial tamponade
  - Accumulation of fluid (blood) in pericardial space that impedes cardiac filling and cardiac output
  - Pericardial fluid volume increases, ventricles restrict and are unable to fill
  - Decreased cardiac output
  - Decreased systolic BP
  - Pulse pressure decreased
  - Suspect pericardial tamponade in penetrating or blunt trauma to chest/upper abdomen
Cardiovascular Trauma (Cont'd)

- Pericardial tamponade
  - History and physical findings
    - Hypotension
    - Distended neck veins
    - Distant muffled heart tones
    - Significant blood loss from other injuries precludes jugular venous distention (JVD)
    - Most reliable signs: JVD in association with hypotension and tachycardia
    - Pulsus paradoxus

Cardiovascular Trauma (Cont'd)

- Cardiac rupture
  - Acute traumatic perforation of ventricles or atria
  - High-speed MVCs
  - Most common cause of death in nonpenetrating cardiac injuries
  - One-third multiple chamber rupture
  - One-quarter ascending aortic rupture

Cardiovascular Trauma (Cont'd)

- Cardiac rupture
  - Epidemiology and demographics
    - Almost always immediately fatal
    - 15% of fatal thoracic injuries
    - Most survivors from atrial rupture
    - Multisystem injuries common
Cardiovascular Trauma (Cont’d)

- Cardiac rupture
  - History and physical findings
    - Hypotension
    - Tachycardia
    - Distended neck veins
    - Cyanosis of head, neck, arms, upper chest
    - Unresponsiveness
    - Distant heart sounds
    - Chest injuries

Cardiovascular Trauma (Cont’d)

- Cardiac rupture
  - Therapeutic interventions
    - Oxygenation and ventilation
    - Pulse oximeter
    - Capnography
    - IV access
    - Cardiac monitor
    - Rapid transport

Injury to Great Vessels

- Aortic rupture
  - Thoracic aorta is most common vessel injured by blunt trauma
  - 80–90% occur in descending aorta, distal to left subclavian artery
  - Pericardial tamponade
  - Aortic valve tears
  - Myocardial contusion
  - Coronary artery injuries
  - Rarely survive
Injury to Great Vessels (Cont’d)

- Aortic rupture
  - History and physical findings
    - High-speed MVC deceleration
    - Vertical deceleration
    - Associated injuries
      - Pulmonary
      - Neurological
      - Orthopedic
      - Facial
      - Abdominal

- History and physical findings
  - Symptoms
    - Interscapular or retrosternal pain
    - Dyspnea
    - Stridor or hoarseness
    - Dysphagia
    - Extremity pain
    - Hypertension
    - Pseudocoarctation syndrome

- Therapeutic interventions
  - Find MOI compatible with aortic rupture
  - Treat hypotension, tension pneumothorax, cardiac tamponade
  - Relay information to ED
  - Rapid transport
Injury to Great Vessels (Cont’d)

- Injury to venae cavae or pulmonary vessels
  - Associated with injuries to chest, abdomen, or neck
  - Injuries to vena cava, inferior vena cava, pulmonary arteries, four main pulmonary veins accompanied by:
    - Massive hemothorax
    - Hypovolemic shock
    - Cardiac tamponade

Diaphragmatic Injuries

- Description and definition
  - Direct penetration of diaphragm
  - Blunt forces to chest or abdomen
- Therapeutic interventions
  - Awareness of injury
  - Transport

Esophageal Injuries

- Description and definition
  - Usually not isolated injury
  - Cervical esophageal injuries most common
  - Trachea most common site of injury
Esophageal Injuries (Cont'd)

- History and physical findings
  - Neck pain
  - Difficulty swallowing
  - Cough
  - Voice changes
  - Hematemesis

- Physical findings
  - Neck tenderness
  - Resistance to flexion
  - Crepitus
  - Stridor
  - Airway compromise

Esophageal Injuries (Cont'd)

- Therapeutic interventions
  - Rapid-sequence intubation
  - Surgical airway
  - Rapid transport
Chapter Summary

- Thoracic trauma includes a wide range of injuries, many of which may result in death if not recognized early
- Must be able to identify and treat these injuries rapidly to provide potentially lifesaving care

Questions?