Thoracic Trauma

Assessment
Injury Profiles

Assessment Flow for Thoracic Trauma

Initial Assessment
- C-ABCD
  - Mental status/initial responsiveness
  - Respiratory status
    - Dypnea or increased ventilatory effort
    - Audible noises or adventitious lung sounds
    - Accessory muscle use or retractions of intercostal muscles
    - Abnormal respiratory rates or volumes
  - Radial pulse rate and quality
  - Skin color, moisture

Focused History
- Chief complaint
  - Dyspnea or chest discomfort
- Relationship of symptoms to incident
  - Did they result from the impact or from a pre-existing medical condition
  - Did the symptoms start before or after the impact?
- Pain quality
  - Ischemic or pleuritic in nature

Focused History
- Past medical history
  - Cardiac disease
  - Respiratory disease
  - Hypertension
- Use of restraints
- Other medical causes for the crash
  - Syncope
  - Anaphylaxis

Rapid Trauma Assessment
- Neck
  - Position of trachea
  - Hematomas, contusions, swelling
  - Subcutaneous emphysema
  - JVD
  - Penetrating wounds
Rapid Trauma Assessment

- Chest
  - Evidence of impact
    - “Erythema” patterns and contours
  - Contusions
  - Penetrating injuries
  - Asymmetry – observation and palpation
    - Paradoxical motion
  - Point tenderness and/or crepitus

Patient Management

- Several different systems may be suffering from injury at the same time
  - Early prioritization of injuries is important
    - Internal chest injuries will usually take a high priority in management
- Baseline findings are critical!
- Assure adequate ventilation and tissue oxygenation during assessment and management

Management of Thoracic Trauma

- Airway and ventilatory support
  - Based upon mechanism of injury and minute volume
  - Occlude all open wounds of the neck and chest

- Circulatory support
  - Large bore IVs for multi-systems trauma
  - Fluid resuscitation should be based upon several factors:
    - Patient mentation and perfusion
    - Determination of the type of chest injury
    - Whether external/internal bleeding is controlled

Management of Thoracic Trauma

- Transport Considerations
  - Multisystems trauma
  - Isolated chest trauma
  - Considerations for air medical transport
Pain Management in Thoracic Trauma

- Drug options
  - Morphine sulfate
  - Nalbuphine
  - Ketorolac
  - NSAID

- Risks v. benefits
  - Reduction of minute volume
  - Sedation
  - Physician issues

A Call!

You are toned for a motor vehicle crash at an intersection.

Scene Assessment: MOI

Scene Assessment: Interior Intrusion

Patient Assessment (Dodge Dart)

- A 22-year old male is standing on the side of the road and self-splinting his left lateral chest.
- His skin color is pale and he is shaking. He appears to be in some pain.
- He is conscious and alert.
- His radial pulse is 108 and his respiratory effort is shallow but unlabored.

Further Patient Assessment

- The patient is unable to take a deep breath because “it hurts”
- You palpate crepitus to 2 ribs on his lateral chest
- Lung sounds are diminished on the left side
- The patient has pain to palpation to his left hip
- No other injuries found

Based upon your assessment so far, is this patient critical, potentially-critical, or stable?
Initial Treatments?
- Spinal immobilization
- Oxygen
- Vital signs
- IV?
- Trauma system entry?

Mechanisms of Thoracic Trauma
- Blunt
- Deceleration
- Penetrating
- Blast
- Crush

Mechanisms of Thoracic Trauma
- Deceleration

Mechanisms of Thoracic Trauma: Penetrating Injuries
- Bony structures
  - May cause “bouncing” of slower projectiles
- Lung and cardiac tissue
  - May compress and bruise from cavitation
  - May tear from cavitation or from the direct hit from the projectile
- Vessels
  - Tears, rupture

Mechanisms of Thoracic Trauma
- Blasts
  - Compression, then decompression
    - Tears of the bronchioles, alveoli, vessels
- Crush
  - Tears as above
  - Major restriction of ventilation and venous return

Superficial Injuries: Rib Fractures
- Incidence
  - Adult life, usually in the elderly
  - Significant force required
- Consequences
  - Geriatric ribs are brittle and rigid
  - Number, location of fractures can increase chance for pulmonary and/or cardiovascular injury
Rib Fracture Sites
- Fracture of ribs 4-9 most common
- Poor protection
- Fracture of 1st or 2nd rib
  - Severe force and resultant injuries
  - 50% mortality rate
- Lower ribs
  - Liver, spleen injury

Assessment of Rib Fractures
- MOI: other underlying injuries
- Increased pain with movement, resps.
- Point tenderness and/or crepitus
- Splinting with respirations
- Tenderness to compression of rib cage
- Multiple rib Fx and complications

Flail Chest
- 3 or more ribs fractured in 2 or more places
  - Floating segment
  - MVCs: frontal or lateral impact
  - Paradoxical movement of the chest
    - Decreased intrapleural pressure during inspiration causes segment to be pushed in by the higher external pressure
    - Difficult to detect due to muscle spasms
    - Large segments will compromise ventilation

Flail Chest Pathophysiology
- Decreased ventilation
  - Reduced expansion from pain, segment size
  - Reduction of O2 delivery to alveoli
  - Hypoxia and Hypercapnia
    - Large contusions inhibit gas exchange
    - Impacts O2 delivery to the tissues
    - CO2 accumulation may result in acidosis

Flail Chest
- 20-40% mortality
  - Associated injuries
- Increase in mortality
  - Advanced age
  - 7 or more rib fractures
  - 3 or more associated injuries
  - Shock
  - Head injury

Assessment of Flail Chest
- Findings
  - Similar assessment findings as rib fractures
  - Bruising to the chest wall
  - Paradoxical chest movement
  - Tachypnea and tachycardia
  - Rales: sign of an underlying pulmonary contusion
Management of Flail Chest

- O2 versus BVM
- Stabilization of flail segment
  - Pillow, hand, fancier maneuvers
- IV tko
- Medications and mode of transport should be based on the severity of the injury

Sternal Fractures

- 5-8% incidence in blunt chest trauma
- Deceleration or compression injuries
  - Impact to dashboard or steering wheel
  - Direct blow to chest
  - Rib cage hyperflexion and fractures

Pathophysiology and Other Associated Injuries

- Rib fracture displacement is rare
- Energy transfer or compression more common
- Deceleration from frontal impacts:
  - “Cheese slice” of aorta
  - “Paper bag” syndrome (pneumothorax)
  - Abdominal injuries
  - Head trauma

Pulmonary Injuries

Types of Pulmonary Injuries

- Open pneumothorax
- Simple pneumothorax
- Tension pneumothorax
- Hemothorax
- Pulmonary contusion

Pulmonary Trauma: Effects on Ventilation and Respiration
Open and Simple Pneumothorax
- Basic Mechanisms
  - Air into the pleural space
  - Compression of lung tissue
- Signs and symptoms
  - Increased respiratory rate and heart rate
  - Decreased breath sounds on affected side
  - Pleuritic chest pain

Impacts on Ventilation and Respiration
- Ventilation
  - Open pneumothorax – air does move, but it moves outside the normal pathways
  - Simple pneumothorax
    - Minimal impacts with ventilation
- Respiration
  - Compression of lung tissue may diminish gas exchange
  - Dependent upon the size of the pneumothorax

Management: Open and Simple Pneumothoraces
- General treatment considerations
  - Dependent upon mechanism of injury
  - Oxygen recommended
  - BVM Ventilation not usually required for simple pneumothorax
  - Seal open chest wounds quickly (3 sides)
    - Observe for any potential progression towards a tension pneumothorax

Tension Pneumothorax
- Basic mechanisms
  - Large volume of air in the pleural space
  - Compression of both lungs
  - Kinking of the vena cava
- Signs and symptoms
  - Extreme respiratory distress
  - Rapid deterioration of symptoms
  - Poor compliance if ventilating via BVM
  - Late signs: JVD, tracheal deviation, decompensated shock, narrowing pulse pressures

Impacts on Ventilation and Respiration
- Ventilation
  - Both lungs may be compressed
- Respiration
  - Compression of tissue may make oxygen and carbon dioxide movement difficult
  - Reduction of blood flow to the lungs due to the kinking of the vena cava
    - Reduced delivery of the red blood cells to the alveoli
Management: Tension Pneumothorax
- High-flow oxygen/BVM
- Need for needle decompression (ALS)
- "Burp" occlusive dressing (if this is a progression of an open pneumothorax)
- Rapid transport

Hemothorax
- Basic mechanism
  - Blood accumulation into the pleural space (up to 2-3 liters)
  - Compression of lung tissue is dependent upon the amount of blood loss
- Profile
  - Associated with rib fractures or penetrating trauma
  - Pneumothorax may be present as well

Signs and Symptoms
- Increased respiratory and heart rates
- Respiratory distress and dyspnea
- Decreased or absent breath sounds
- Hypotension
- Pleuritic chest pain
- Signs of shock
- Dullness to percussion

Impacts on Ventilation and Respiration
- Ventilation
  - Similar to a simple pneumothorax
  - Dependent on the amount compression against the lung
- Respiration
  - Exchange of gases may be impeded
  - Lack of red blood cells

Respiration Impacts
- Red blood cells are stuck in the chest cavity
- Off-loading of CO₂ and delivery of O₂ onto the red blood cells is significantly impeded
- Potential for shock

Management: Hemothorax
- Treat for respiratory compromise and for shock
  - Hemothoraces are commonly associated with great vessel or cardiac injury
  - Blood accumulation can exceed 1 liter
- Consider ventilations with BVM
- Consider entry into the trauma system
### Pulmonary contusion

- **Basic mechanism**
  - “Bruised lung”
    - Lung impacts chest wall in blunt trauma
  - Alveoli and capillary rupture
    - Bleeding and fluid accumulation in the tissues and alveoli
    - Damaged areas are unavailable for gas exchange

### Signs and Symptoms

- Tachypnea
- Dyspnea
- Cough, hemoptysis
- Tachycardia
- Dull to percussion
- Signs of hypoxia dependent upon size of injury

### Impacts on Ventilation and Respiration

- **Ventilation**
  - May be reduced if presence of rib fractures
  - Contusion itself will not significantly impede ventilation
- **Respiration**
  - Damaged alveoli unable to move gases
  - Fluid and blood accumulation will make the diffusion of gases more difficult

### Management: Pulmonary Contusion

- Oxygen and assisting ventilations dependent upon level of respiratory distress and presence of hypoxia
  - Also base treatment from the MOI assessment
  - Restrict IV fluids unless signs of shock are present
  - Otherwise additional fluid may settle into the damaged area of the lung
  - Frequent chest assessment is necessary with IV fluid administration

### Review of the Patient's Initial Presentation

- Conscious and alert
- Pale and shaking
- Heart rate is 108
- Crepitus to 2 ribs on the lateral chest
- Lung sounds are diminished on the left side
- The patient is unable to take a deep breath because “it hurts”

### Patient in Perspective

- You move the patient to the ambulance
  - He is still painful and his respirations are shallow
- **Further assessment**
  - HR 106
  - BP 110/70
  - Lung sounds reveal crackles on the left lateral side
  - Chest expansion is symmetrical
More Injuries

**Traumatic Asphyxia**
- Crush injuries, major blunt trauma
- Blood backs up into head and neck
- Jugulars engorged with blood
- Capillaries break
  - Permanent cyanosis to head and neck
  - Swelling or blood in conjunctiva
  - Skin below neck remains pink

**Buildup of blood/high pressure in head**
- Impairment of cellular metabolism
- Capillary damage may cause stroke-like effects

**Crush injury management**
- Release of pressure will cause hypotension
- Circulation of acid
  - Ventilation and sodium bicarbonate therapies

**Myocardial Trauma**

**Myocardial Contusion**
- Frontal Impacts
  - Bent steering wheel and chest tenderness
- Right heart usually injured
  - Results of injury
    - Conduction system damage
    - Bruising of myocardium (all or some)

**Presentations**
1. Conduction system damage
   - Tachycardia disproportional to other injuries
   - PVCs
   - Atrial fibrillation
   - Other ECG changes
Examples of ECG Changes

Presentations

2. Rupture of the myocardial wall
   - Rapid hemorrhage
   - Pericardial tamponade

3. Myocardial bruising
   - Reduced cardiac output
   - ECG changes: ST segment elevation

Clues of a Contusion

Management Considerations

- Oxygen is a high priority!
- IV therapy: fluid boluses in tachycardia

Now what about those darn PVCs??
- Oxygen therapy
- Keep perspective on their causes
- Antidysrhythmic therapy: PHTLS

Pericardial Tamponade

Presentation

- Fluid accumulation in the pericardial sac
  - Rapid – trauma
- Traumatic causes
  - Myocardial rupture
  - Penetrating trauma
- Problems
  - Reduces chamber filling
  - Decreases stroke volume and cardiac output

- Tachycardia
- Respiratory distress
- Narrow pulse pressure
- Cyanosis
  - Head
  - Neck
  - Upper extremities

- 30% of tamponades
  - Muffled heart tones
  - Neck vein distension
  - Hypotension
  - Shows a progressive worsening of the condition
Thoracic Trauma Profiles
Another Case Study

You are dispatched to a motor vehicle crash on a rural highway at 0900 hours. You know that this is a straight stretch of roadway. Enroute you are advised that one victim may be deceased.

The Scene

Discuss how energy was transferred in this collision.

The driver of the Blazer is dead. You are directed to the sedan to assess another patient.

Driver Assessment: Name His Injuries

56 y.o. seat-belted. He has severe shortness of breath and chest pain. His neck and right hip hurts as well. He is conscious, very anxious, and is speaking in 5-word sentences. He is diaphoretic and his radial pulse is 130 and irregular. He is point tender over his sternum. You also notice an open compound fracture of his right ankle.

After Extrication...

- Lung sounds are diminished on the right side
- Redness over his sternum and anterior chest
- Crepitus to the right side of the sternum
- BP 100/60
- ECG reveals sinus tachycardia with frequent PVCs
Thoracic Injury Potentials For This Patient

- Sternal Fracture
- Pneumothorax
- Hemothorax
- Myocardial Contusion
- Aortic Tear?

Treatments?

- Trauma entry
- Oxygen!!
  - BVM?
- IV, large bore
  - Fluid challenge?
- ECG (already in place)
- PASG?

Summary

- Thoracic trauma can have many complications
  - Oxygen delivery
  - Exchange of gases
  - Reduced delivery of oxygen to the tissues
- Focus assessment and treatments on issues of respiration, ventilation and perfusion
  - Whenever possible, devise specific strategies to target those particular issues