Thoracic Trauma

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911 dispatch: 70 y/o male was pinned by a cow at World Dairy Expo outside the barns behind the Alliant Center and is c/o:

- Difficulty breathing
- Chest pain
Skeletal Injuries of the Chest

- Clavicular Fractures
- Rib Fractures
- Flail Chest
- Sternal Fractures
Clavicular Fractures

- Most commonly fractured bone in children
- Common in contact sports

**Signs & Symptoms**

- Pain
- Deformity
- Point tenderness
- Crepitus
- Can cause vascular injuries
Clavicular Fractures

**Pre-hospital Treatment**

- Immobilize the affected shoulder & arm
- Pain control
Rib & Sternal Fractures

- Most common type of blunt trauma 3-8th ribs
- Pain from rib fractures can decrease ventilatory depth due to pain, leading to diaphragmatic splinting with atelectasis
- Flail segment can disrupt ventilation
- Great force to fracture first & second ribs
Sternal Fractures

- Rare
- Stable or unstable
- Bruising or deformity over the sternum
- Very painful with point tenderness
- Crepitus over the fracture site
- 25-45% mortality rate
- Associated w/l unstable chest wall, vascular & myocardial injuries
Rib & Sternal Fractures

• **Assessment & Care**
  – Assess for breathing compromise/splinting
  – Inspect for bruising or soft tissue injury over the chest wall/seat belt sign
  – Inspect & palpate for deformity
  – Palpate for point tenderness
  – Inspect & palpate for crepitus over the chest wall
  – Assess for associated injuries

• **Treatment**
  – Oxygen 100% NRB mask
  – Pain control to promote breathing
  – Assist breathing
Pathophysiology

Underlying rib & sternal injuries of clinical significance

- Tension Pneumothorax
- Pneumothorax
- Hemothorax
- Pulmonary Contusion
- Diaphragmatic Rupture
- Aortic injury
- Blunt cardiac injury
- Cardiac Tamponade
Flail Chest

- Fracture of two or more sites on 2 or more adjacent ribs
- **50%** not clinically evident due to muscle spasm during the first hours post injury
- Chest wall instability with paradoxical movement
- Children have compliant chest walls rarely fracture ribs
Flail Chest

**Associated Injuries**

- Ineffective ventilation
- Pulmonary contusion
- Lacerated lung parenchyma
Flail Chest

Radiographic Signs

- Segmental rib fractures of multiple ribs
- Panel moves in with inspiration and out with expiration
- Other evidence of thoracic trauma
Case Progression

Find a pale, diaphoretic 70 y/o dairy farmer breathing rapidly and slumped up against the wall in one of the dairy barns. He is holding his chest. Members of the family tell you he coughed up blood a couple of times.

Describe your assessment!
Flail Chest

Signs & Symptoms

• Dyspnea
• Chest wall pain
• Point tenderness
• Paradoxical chest wall movement
  – Flail segment moves in during inspiration & out during expiration
Tension Pneumothorax Pathophysiology

- Air enters the pleural space on inspiration & can’t escape “One-way-valve”
  - Increased intrathoracic pressure collapses the injured lung shifting the mediastinum
  - Decreased venous return and decreased cardiac output

Life-threatening injury
Tension Pneumothorax: Diagnosis

- Respiratory distress
- Asymmetric chest wall movement
- Unilateral decreased breath sounds
- Tachycardia
- Hypotension
- Tracheal deviation
- Distended neck veins
- Cyanosis

Box 3 Symptoms and signs of tension pneumothorax from case reports in awake patients

- Universal findings
  - Chest pain
  - Respiratory distress
- Common findings (50%-75% cases)
  - Tachycardia
  - Ipsilateral decreased air entry
- Inconsistent findings (<25% of cases)
  - Low SpO₂
  - Tracheal deviation
  - Hypotension
- Rare findings (about 10% cases)
  - Cyanosis
  - Hyper-resonance
  - Decreasing level of consciousness
  - Ipsilateral chest
    - Hyper-expansion
    - Hypo-mobility
  - Acute epigastric pain
  - Cardiac apical displacement
  - Sternal resonance
Flail Chest

Pre-hospital Assessment & Care

- Identify flail segment & treat ventilatory compromise (↑WOB, ↑respiratory rate, ↓depth)

Treatment (Dependent on compromise)

- Oxygen 100% NRB mask
- Pain control & sedation
  - Epidural at the hospital
- CPAP
- BVM or intubation & mechanical ventilation
Tension Pneumothorax

• **Assessment & Care**
  – Unilateral or asymmetrical chest wall movement
  – Decreased or absent breath sounds on one side
  – Respiratory distress
    • ↑ Respiratory Rate
    • ↑ Work of breathing
    • Tachycardia → bradycardia → PEA → asystole
  – Hypotension
  – Jugular venous distension
  – Tracheal deviation

• **Treatment**
  – Oxygen 100% NRB mask
  – Needle decompression 2 ICS
  – Chest tube insertion in the ED
Pneumothorax

• Lung injury causes an accumulation of air in the pleural space with a loss of negative pressure
• An open wound of the chest wall leads to a loss of negative pressure in the pleural space
Pneumothorax

**Signs & Symptoms**

- Dyspnea, tachypnea
- Tachycardia
- Decreased or absent breath sounds on the injured side
- Chest pain
- Sub C. Emphysema
- Crepitus
- Hyper-resonance
Open Pneumothorax

- Chest wall defect
- Wound visibly “sucking air”
- Tachypnea
- Shallow, labored breathing

http://www.trauma.org/archive/thoracic/CHESTopen.html
http://www.trauma.org/images/image_library/chest0032a.jpg
Open Pneumothorax

- Defect in chest wall with equilibration of intrathoracic and atmospheric pressure
- Air follows path of least resistance and bypasses trachea
- Ventilation impaired if defect is 2/3 size of trachea

http://connection.lww.com/products/smeltzer9e/images/figurelarge21-12a.gif
Pneumothorax

Treatment

- Oxygen 100% NRB mask
- Closed pneumothorax
  - Chest tube insertion for decompression of the pleural space in ED
  - Chest tube drainage device w/i or w/o autotransfuser or Heimlich valve in non-trauma patients in ED
- Open pneumothorax
  - Non-occlusive dressing taped on 3 sides to allow air to escape
  - Chest tube insertion for decompression of the pleural space in ED to Chest tube drainage device
Hemothorax

- Accumulation of blood in the pleural space.
- Massive hemothorax – Rapid accumulation of blood 1500 ml or more in the pleural space
Hemothorax

**Signs & Symptoms**

- Dyspnea, tachypnea
- Chest pain
- Decreased breath sounds on the injured side
- Shock
- Tracheal deviation
- Dullness to percussion on the injured side
Diagnosing Hemothorax’s

- Fluid in the pleural space
- May present late
- Diagnosis
  - CT
  - CXR
  - US
- Loculation occurs early
Hemothorax

Pre-Hospital Assessment & Care

• ABC’s & Life threatening events
• O2 100% NRB
• Monitor chest tube for air leak & drainage

Treatment

• Chest tube decompression
• Auto-transfusion of blood
• Operating room
Traumatic Asphyxia

Pathophysiology

• Results from a severe crushing injury to the chest & abdomen
• There is an increase in intrathoracic pressure forcing blood from the R side of the heart into the veins of the chest neck & face
On October 30, 1993, the Wisconsin Badgers football team defeated the Michigan Wolverines, 13–10, for the first time since 1981. As the final gun sounded, students began to charge the field to celebrate, but were blocked by the guardrails surrounding the field. The crowd in the back, not aware of what was going on at the front, continued to move forward, aided by gravity. Those in front were crushed against the rails and then trampled when the rails finally gave way and the throng spilled onto the field. Seventy-three students were injured, six of them critically. Fortunately, no one was killed. Several Badgers football players assisted with removing the injured from the tangle, some of them were even medical students and administered CPR to many victims who were not breathing.
Traumatic Asphyxia

Pre-hospital Assessment & Care

- Petechial hemorrhages of the face & neck
- JVD
- Swelling & hemorrhage or petechial hemorrhage of the conjunctiva
- Cerebral hemorrhages
- Seizures
- Shock when compressing force is released
Traumatic Asphyxia

Pre-hospital Care

- Scene safety
- 100% O2 via NRB mask
- Ensure airway
- Provide ventilation
- Treat for hypovolemic shock with fluid replacement
- CPR
Case Progression

• How are you going to treat the patient?
Pulmonary Contusions

**Pathophysiology**

- Injury to the lung parenchyma
- Deceleration or high velocity bullet wounds
- Respiratory insufficiency
  - Increased pulmonary vascular resistance
  - Increased compliance
Pulmonary Contusions

- Most common chest wall injury in children
- 50-60% with significant contusion develop ARDS
- 40-60% will require mechanical ventilation
Pulmonary Contusions

**Signs & Symptoms**

- Chest wall contusion or abrasions
- Dyspnea
- Ineffective cough
- Hemoptysis
- Hypoxia
- Chest pain
Pulmonary Contusion

On arrival

24 hours later
Pulmonary Contusions

Pre-hospital Treatment
- Oxygen 100% NRB mask
- CPAP/BiPAP
- Intubation & ventilation
- Broncho-alveolar lavage (BAL) @ the hospital

Assessment & Care
- Assess for chest wall injuries associated with respiratory failure or fatigue
Tracheobronchial Injuries

Pathophysiology

• Blunt ruptures or tears of the trachea or mainstem bronchus
• Caused by dashboard, steering wheel, handle bars, football tackle, hockey hit, spearing, karate or clothesline type injuries
Tracheal Bronchial Injuries
Tracheobronchial Injuries

**Signs & Symptoms**

- Dyspnea, tachypnea
- Hemoptysis
- Potential airway disruption
- Subcutaneous emphysema/crepitus of neck, face or suprasternal area
- Decreased or absent breath sounds
Tracheobronchial Injuries

Pre-hospital Assessment & Care

• Assess for patency of airway
• Assess for breathing effectiveness
• Monitor for tension pneumothorax
• Continuous air leak noted in chest tube drainage devices

Treatment

• Operative repair
• Non-operative repair for small injuries
Diaphragmatic Rupture

**Pathophysiology**

- Abdominal contents rupture through the diaphragm and are found in the chest cavity
- Potentially life-threatening
- Blunt trauma particularly on the left side
- Penetrating trauma below the nipple line
Diaphragmatic Rupture

Signs & Symptoms

- Dyspnea
- Dysphagia
- Abdominal pain
- Sharp epigastric or chest pain
- Kehr’s sign
- Bowel sounds in lower chest & + CXR
- Decreased breath sounds on effected side
Diaphragmatic Rupture

Pre-hospital Assessment & Care

• 100% O2 via NRB mask
• Assess for: pain, ventilatory compromise, diminished breath sounds on affected side or asymmetrical chest wall movement

Treatment

• OR repair of diaphragm & replacement of abdominal organs into abdominal compartment
Blunt Cardiac Injuries

Signs & Symptoms

• ECG abnormalities
  – PVC’s
  – AV blocks
• Chest wall injury, ecchymosis
• Sternal high rib fractures
• Chest pain
Blunt Cardiac Injuries

- **Myocardial Contusions** – Bruising of the heart. Can be a full thickness heart wall injury
- **Pericardial Tamponade**
- **Myocardial Rupture**
Blunt Cardiac Injuries

Pre-hospital Assessment & Care

- Monitor rhythm
- Monitor for signs of cardiac ischemia

Diagnosis

- Ultrasound 90% sensitive

Treatment

- 100% NRB mask
- Symptomatic treatment of rhythm
Pericardial Tamponade

Pathophysiology

- Collection of blood in the pericardial sac
- Most common in penetrating injury of the heart
- Decreased cardiac output
Pericardial Tamponade

**Signs & Symptoms**

- Penetrating chest wound
- 3\(^{rd}\), 4\(^{th}\), 5\(^{th}\) left rib fxs.
- Electrical Alternans - Decreased ECG voltage
- Pulses paradoxus
- Beck’s Triad
  - Distended neck veins
  - Hypotension
  - Muffled heart sounds
  - Dyspnea, cyanosis, shock
Cardiac Tamponade

http://www.meddean.luc.edu
http://www.emedicine.com/med/images/11911248CxR.jpg
Pericardial Tamponade

**Pre-hospital Assessment & Care**
- Rapid identification
- 100% O2 via NRB mask
- Pericardiocentesis

**Treatment**
- Emergent pericardiocentesis
- Operative pericardial window in ED or OR
Pericardiocentesis

http://history.amedd.armyolII/chapter2figure20.jpg
http://www.mdchoice.com
Open Thoracotomy

Pericardial Window
Aortic Injuries

Pathophysiology

• Result of penetrating & blunt trauma to the thoracic aorta
• Descending aorta more susceptible to rupture from deceleration or blunt force
• Transect at fixed area
Aortic Disruption

- 80% of blunt aortic injuries cause immediate death from aortic transsection
- Typically incomplete laceration near the ligamentum arteriosum of the aorta just distal to the L subclavian artery
Aortic Injuries

Signs & Symptoms

- Tachycardia
- Hypotension
- Decreased LOC
- Pulse difference between upper & lower extremities (Decreased amplitude of pulse in lower extremities)
Aortic Injuries

Additional Signs & Symptoms

- Loud systolic murmur in periscapular area
- Chest pain
- Chest wall ecchymosis
- Paraplegia
- Wide mediastinum on CXR (>9cm)
Aortic Injuries

Pre-hospital Assessment & Care

- 100% O2 via NRB Mask
- Fluid replacement
- Blood pressure control: Maintain lower BP to prevent aortic rupture
- Sedation to control BP

Treatment

- Non-operative control of blood pressure
- Operative stent placement
- Operative repair with graft

www.images.google.com
Case Outcome