Blunt Thoracic Trauma

• Injury Type
  – Mechanism
  – Pathophysiology
  – Signs/Symptoms
  – Diagnosis
  – Management

Pneumothorax

• Mechanism
  – rib fracture
  – laceration of the lungs from ribs
  – pressurization of the chest (barotrauma)
Tension Pneumothorax

• Pathophysiology:
  – elastic recoil of lung- collapse
  – one way valve (effect)
    » increases intra-thoracic pressure and decrease venous return
    » reduces end diastolic volume
    » compresses IVC at the diaphragmatic hiatus

Pneumothorax/Tension Pneumothorax

• Signs and Symptoms:
  – dyspnea, SOB, tachycardia, cyanosis, hypotension (tension), hypoxia and death (tension)
  – tracheal deviation
  – distended neck veins
  – shift in cardiac impulse
  – decreased breath sounds
  – hyper-tympany of the hemithorax
  – Dx- clinical exam, chest xray, ultrasound


Reported sensitivity as high as 95% in experienced centers*
Pneumothorax/Tension

• Management:
  – immediate decompression with a needle if tension is present
  – tube thoracostomy

• Potential errors
  – delay of chest tube placement
  – missed injuries on CXR

Hemothorax

• Mechanism:
  – lung laceration (low pressure)
  – intercostal vessels (high pressure)
  – great vessels in the chest
  – cardiac injury

• Signs and Symptoms:
  – decreased breath sounds
  – percussive dullness

• Definitive diagnosis:
  – chest xray, CT scan, US
Hemothorax

- **Management:**
  - Immediate tube thoracostomy
  - 90-95% of bleeding will stop without additional intervention

Hemothorax

- **Indications for Thoracotomy:**
  - Initial chest tube output 1500cc
  - Continued chest tube output > 200cc/hr for 3 consecutive hours
  - >1500cc in the first 24 hours

Multiple Rib Fractures
Flail Chest

- **Mechanism:**
  - Blunt force injury

Multiple Rib Fractures
Flail Chest

- **Pathophysiology:**
  - Pain - decreased ventilation - pooling of secretions
  - pneumonia, sepsis and death!!!
Epidemiology

Approximately _______% of patients admitted to trauma centers have rib fractures

A. 1%
B. 10%
C. 25%
D. 80%

Ziegler DW, Agarwal NN. The morbidity and mortality of rib fractures. J Trauma 1994;37:975-979

Epidemiology

The mean length of stay for a patient with one or two rib fractures is:

A. 1 day
B. 3 days
C. 7 days
D. 14 days
Complications of Rib Fractures

Pulmonary complications (i.e. respiratory failure, pulmonary embolism, pneumonia, atelectasis, aspiration, ARDS) occur in _____%  
A. 1%  
B. 10%  
C. 35%  
D. 50%

Ziegler DW, Agarwal NN. The morbidity and mortality of rib fractures. J Trauma 1994;37:975-979

Lee, RB et al. Three or More Rib Fractures as an Indicator for Transfer to a Level I Trauma Center: A Population-based Study. J Trauma 1990;30(6):689-694
Complications of Rib Fractures

Overall mortality in patients with rib fractures is ____%

A. 1%
B. 12%
C. 25%
D. 50%

Ziegler DW, Agarwal NN. The morbidity and mortality of rib fractures. J Trauma 1994;37:975-979

Multiple Rib Fractures
Flail Chest

- **Signs and Symptoms:**
  - Tachypnea,
  - SOB
  - Pain- severe
  - Clinical diagnosis ± radiographic confirmation

- **Management:**
  - Pain management
    » Epidural analgesia is the best
  - Alternatives:
    » PCA
    » Intercostal blocks
    » IV opiates
  - Assess ventilatory function regularly- (MIF,VC)
**Multiple Rib Fractures**

**Flail Chest**

- **Pitfalls and Problems:**
  - Underestimating the severity of ventilatory embarrassment
  - Inability to control pain
  - Inadequate pulmonary toilet
  - Rarely do we need to operatively stabilize the chest

**Pulmonary Contusion**

- **Mechanism:**
  - Blunt force injury
  - Sudden local decompression

- **Pathophysiology:**
  - “stretched pores in the lung microvasculature
  - Local edema, V/Q mismatch
  - Interference with perfusion like PE, hemorrhage

- **Signs and Symptoms:**
  - Associated with flail chest
  - Multiple rib fractures
  - Hypoxia is more severe
  - Diagnosed with CXR
  - Chest CT is more sensitive for injuries to the parenchyma of the lung
Pulmonary Contusion

• **Management:**
  – Supportive
  – AVOID FLUID OVERLOAD

• **Pitfalls of treatment**
  – Fluid overload, endobronchial hemorrhage, severe hypoxia ➔ frequently precursors to ARDS
  – Under-appreciation of severity
    » Hypoxemia and hypercarbia are *maximal* at 72 hours post-injury

  *Cohn, Stephen M. Pulmonary Contusion: Review of the Clinical Entity.* *J Trauma* 1997;42(5):973-979

Lung Lacerations

• **Mechanism:**
  – Rib fractures injure the lung parenchyma

• **Pathophysiology:**
  – Adjacent bronchiolar and vascular injury—air embolism?
  – Endobronchial hemorrhage
  – Major chest hemorrhage
Lung Lacerations

• Signs and Symptoms:
  – Pneumothorax
  – Hemothorax
  – +/- air leak

Lung Lacerations

• Management:
  – Most do not require operative intervention
  – Operations for
    » major ongoing hemorrhage
    » air embolism
    » refractory air leak (rare)

Lung Lacerations

• Management (continued):
  – Pitfalls & Problems
    » High ventilatory pressures may predispose
      • air embolism - can be fatal
      • persistent broncho-pleural fistulas

Bronchial Tears

• Mechanism:
  – Same as lung laceration
    » Blunt traction tear within 2 cm of the carina
    » Dramatic presentation typically
**Bronchial Tears**

**Signs and Symptoms:**
- Major bronchopleural fistula
- Massive pneumothorax
- Tension pneumothorax
- Subcutaneous air
- Refractory re-expansion of the lungs post chest tube placement with massive air leak

**Diagnosis:**
- Fiberoptic bronchoscopy

**Management:**
- Visible tear within 2 cm of the carina require exploration and primary repair
- Most distal injuries are managed non-operatively

**Pitfalls and Problems**
- Delay in diagnosis
- High clinical suspicion is needed
Diaphragmatic Injury

- **Mechanism:**
  - Blunt force pressurization to the abdomen
  - More common on left side

- **Pathophysiology:**
  - Negative chest pressure and positive abdominal pressure
    » Makes the hole bigger
    » Sends more visceral into the chest
    » Associated with other injuries

Diaphragmatic Injury

- **Signs and Symptoms:**
  - May be minimal
  - Diagnosis is difficult with CXR, CT or even DPL
  - Delay in diagnosis is common
  - High Clinical Suspicion is important
  - NG tube on the chest in the wrong position
Diaphragmatic Injury

• Management:
  – Operative repair of the injury is essential
  – Progressive displacement of abdominal contents into the chest cavity and respiratory distress

• Pitfalls and Problems:
  – Missed diagnosis present as chronic diaphragmatic hernia
  – Acute (< 1 week) ➔ abdominal approach
  – Chronic (> 1 week) ➔ thoracic approach (safer secondary to intrathoracic adhesions)

Blunt Aortic Injury

• Mechanism:
  – Massive deceleration injury to the chest wall
  – TAI results from the fixed part of the aortic moving differently and rupture results at isthmus
  – 85% die at the scene
  – Untreated mortality is 1% per hour in the initial 24 hours

• Pathophysiology:
  – Wall stress increases with time due wall stress on BP on intima
  – Can occur at aortic root or diaphragm more rarely
  – Other organ injuries are common
**Blunt Aortic Injury**

- **Signs and Symptoms:**
  - Sometimes findings are subtle
  - Patients can have normal chest films with this entity
  - If suspected must pursue diagnosis vigorously
    - Helical CT
    - Angiogram
    - TEE

- **Management:**
  - Preoperatively
    - must establish BP control with beta blockers, nitroprusside
    - must rule out other injuries- head injuries, abdominal injuries
    - complex patients to manage
  - Operative Therapy
    - Definitive repair- partial bypass
    - Endovascular repair

- **Pitfalls and Problems:**
  - Missed other injuries
  - Paraplegia with clamp and run technique
  - Single lung ventilation is important
    - patient tolerance
  - Team approach

**Blunt Cardiac Injury**

- **Mechanism:**
  - High speed MVCs, falls, crushing injuries
Blunt Cardiac Injury

• Signs and Symptoms:
  – Arrhythmias occur in the more severe cases
  – Can have CHF

• Diagnosis:
  – Admission screening EKG (Level I)
    » If abnormal, the patient should be admitted for continuous EKG monitoring for 24 to 48 hours (Level II)
    » If normal, the risk of having a BCI that requires treatment is insignificant and the pursuit of the diagnosis should be terminated (Level II)

Pasquale, Michael D. et al. EAST Practice Management Guidelines for Screening of Blunt Cardiac Injury 1998

Blunt Cardiac Injury

• Diagnosis (cont):
  – If the patient is hemodynamically unstable, an echocardiogram should be performed (Level II)

  – Nuclear medicine studies add little when compared to echocardiography (Level II)

Pasquale, Michael D. et al. EAST Practice Management Guidelines for Screening of Blunt Cardiac Injury 1998

Blunt Cardiac Injury

• Diagnosis (cont):
  – The presence of a sternal fracture does not predict the presence of BCI (Level III)

  – Cardiac enzymes are not useful in predicting which patients have or will have complications related to BCI (Level III)

Pasquale, Michael D. et al. EAST Practice Management Guidelines for Screening of Blunt Cardiac Injury 1998
Blunt Cardiac Injury

- **Management**
  - Stepdown ICU admission for monitoring
  - Non operative treatment

Pericardial Tamponade

- **Mechanism:**
  - Pericardial tears occur from direct impact
    - Left side > Diaphragm > Right side

- **Signs and Symptoms:**
  - Cardiogenic shock
  - Beck’s triad (hypotension, JVD, muffled heart sounds) (11%)
  - Pulsus paradoxus (9%)
  - Significant cardiac dysfunction can occur
  - Pericardial friction rub

- **Diagnosis:**
  - Echocardiogram
  - Pericardial window

Pericardial Tamponade

- Management:
  - Operative repair

The End