Thoracic Trauma

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Overview

- Overview
- Penetrating Thoracic Trauma
- Blunt Thoracic Trauma
- Bedside Ultrasound for Thoracic Trauma

Chest Trauma

- Severe Hypoxia
- Massive Blood Loss
- Reduced Cardiac Output
ED Goal - Trauma

- Stabilize the Very Sick (thoracostomy, ED thoracotomy, etc.)
- Image the Sick
- Send home the Well

Penetrating Chest Trauma

- Unstable
  - ATLS
  - "B" before "A"
  - ED Thoracotomy

- Stable
  - ED Thoracotomy
  - ECHO
  - Full Examination
  - ECHO
  - MDC7

EDT - Why?

- Release Pericardial Tamponade
- Control Intrathoracic vascular hemorrhage
- Control Massive Air Emboli / Bronchopleural Fistula
- Permit Cardiac Massage
- Occlude Descending Thoracic Aorta to limit subdiaphragmatic blood loss
When - Selective

<table>
<thead>
<tr>
<th>Blunt</th>
<th>Penetrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Signs of life in the ED</td>
<td>• Signs of life in the field or ED</td>
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<tr>
<td>• No obvious Non-survivable Injuries</td>
<td>• SW (10%)</td>
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<tr>
<td>• very low survival rates</td>
<td>• GSW (1-5%)</td>
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EDT - Why?

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ED ECHO

• A needed tool for ALL EM physicians managing Thoracoabdominal Trauma
• Not difficult to determine Pos vs Neg pericardial Effusion
• Game Changer

Oakland 911

• 23 ym s/p left sided SW
• Hypotensive in the field, cool, clammy, diaphoretic but GCS 15
• ABC intact, BG 111
• BP?
Dispo?

• Pressures + trauma surgeon = OR
• PEA and/or no trauma surgeon = volume + ED thoracotomy

Subxiphoid / Subcostal
COPD

Liver

RV

RA

LV

LA

Liver

COPD
Parasternal Long

Mitral Valve
Pericardium
Young and Healthy

Right Atricle
Interventricular Septum
Aorta
LV
RV
Ao
Residents and Attendings

- 1h didactic and 4 h hands-on
- N=515
- Sens = 96%
- Spec 98%
- Accuracy = 97.5%

Quick Penetrating Chest Trauma Points

- Below the Nipple = think about the abdomen
- Chest tube with lots of blood (>1-1.5L) think OR
- Air leak from Chest Tube w/ continued pneumo = tracheobronchial injury
- Bedside ECHO mandatory

Blunt Thoracic Injury
A Pilot Study to Derive Clinical Variables for Selective Chest Radiography in Blunt Trauma Patients

- N=492 patients
- 31/492 had injury
- Palpable Chest Tenderness or Hypoxia identified all SIGNIFICANT injuries
- Potential = 46% reduction of CXR
- No f/u after D/C

The Increasing Use of Chest Computed Tomography for Trauma: Is It Being Overutilized?

- Retro Trauma Registry = 1989 (2.7%) to 2004 (28.7%) - N=1873
- Normal CXR then MDCT = sig number of occult injuries (hemo/pneumo, rib fractures, etc.)
- 6 BAI w/ normal CXR
- ? Need for all Thoracic Trauma to get MDCT
Non-trauma Centers

- EM Docs = highly sensitivity
- Large trauma center is very different than a single coverage ED
- Goal = Emergent Intervention vs Further Imaging vs nothing
- Associations - for the "in between" group

EMS Questions / Pretest

- Vehicle Speed ? High Speed (>40mph)
- Restraints? (seat belts and airbag deployment)
- Extensive vehicle damage with intrusion?
- Steering Wheel Deformity

H&P

- Obvious injuries = imaging
- Vital Signs
- Patient’s complaints / clinical appearance
Imaging

- CXR vs Chest CT
- Low risk (no tenderness or hypoxia) - as per Rodriguez, we may not even need a CXR
- Really Sick / High Mechanism = Stabilize and CT
- In Between - look for Associated Injuries

Blunt Thoracic Trauma

1. Hemothorax
2. Pneumothorax
3. Sternal Fracture
4. Blunt Cardiac Injury
5. Diaphragmatic Injury
6. Blunt Aortic Injury (BAI)

CXR

- AP vs PA
- Sensitivity, Specificity
- No need?
- Done after CXR
CRX : Bad

- Wide Mediastinum
- Obscured Aortic Knob
- Left Apical Cap
- Large Left hemothorax
- Deviation of NGT
- Deviation of trachea rightward and/or right mainstem bronchus downward
- Wide Paravertebral Stripe

Chest CT

- Gold Standard
- Radiation?
- All Blunt Thoracic Injuries?

Difficult Injuries

- Occult Hemothorax
- Aortic Injury
- Cardiac Contusion
- Pulmonary Contusion
- Diaphragmatic Injury
- Multiple Rib Fracture / Sternal Fracture
Occult Hemothorax

- defined - missed by supine CXR
- 300 cc on upright CXR
- 20-30% not identified on Supine CXR
- What to do with them?
- Association with other thoracic injuries?

US for Hemothorax

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Type</th>
<th>Result</th>
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<tbody>
<tr>
<td>Achabal, et al.</td>
<td>1993</td>
<td>Pro</td>
<td>Sens 81%</td>
</tr>
<tr>
<td>Ma, et al.</td>
<td>1995</td>
<td>Cohort</td>
<td>Sens 96%</td>
</tr>
<tr>
<td>Ma / House, et al.</td>
<td>1997</td>
<td>Retro</td>
<td>Sens 96.2%</td>
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<tr>
<td>Sisley, et al.</td>
<td>1998</td>
<td>Pro</td>
<td>Sens 97.5%</td>
</tr>
<tr>
<td>Abboud, et al.</td>
<td>2003</td>
<td>Pro</td>
<td>Sens 12.5%</td>
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<tr>
<td>Brooks, et al.</td>
<td>2004</td>
<td>Pro</td>
<td>Sens 92%</td>
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Hemothorax (Beginner)
Probe Selection

Curvilinear

Low Freq

Supine Chest

Air

Blood
Hemothorax - Landmarks

- Always Identify the Diaphragm
- Look Above and Below the Diaphragm
- Practice on Normal
- Black / Anechoic stripe = Blood
RUQ/Perihepatic view:

Normal

Acoustic Window

Costophrenic Recess

Morison's Pouch

Diaphragm
Hemothorax Data

Poor Sensitivity for Small Volumes?


• Abboud et al. Emergency Department Ultrasound For Hemothorax After Blunt Traumatic Injury. JEM 2003

• Brooks et al. Emergency Ultrasound in the Acute Assessment of Haemothorax. EMJ 2004
What to do with Occult Hemo?

- Small = leave alone
- Large (>1.5cm) = drain
- ABX for Thorocostomy? [Question]

Clinical Relevance

- Like FAST, large/clinically significant should be clearly visible
- Does a small hemothorax warrant further CT imaging?
- Associations
Associations

- No prospective data regarding associations between hemothorax and other more serious intrathoracic injuries
- Further imaging may be warranted
- You know your next step
Pneumothorax

Pneumothorax (Intermediate)
Sensitivity of Bedside Ultrasound and Supine Anteroposterior Chest Radiographs for the Identification of Pneumothorax After Blunt Trauma

4 prospective observational studies

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<th>US</th>
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<tr>
<td>Sens</td>
<td>28-75%</td>
<td>86-98%</td>
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<tr>
<td>Spec</td>
<td>100%</td>
<td>97-100%</td>
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Supine Chest

![Supine Chest Diagram]

Air
Inferior Pulmonary Ligament
Mediastinum
Pleural Space

Hilum

Probe Selection
(image acquisition - for the beginner)

A Prospective Comparison of Supine Chest Radiography and Bedside Ultrasound for the Diagnosis of Traumatic Pneumothorax
ACAD EMERG MED • September 2005, Vol. 12, No. 9

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<td>Sens</td>
<td>75.3%</td>
<td>98.1%</td>
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<tr>
<td>Spec</td>
<td>100%</td>
<td>99.2%</td>
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B-mode
Normal Lung: Sliding Visceral Pleura

Normal Lung:
Normal Lung: Comet Tails

Normal Lung
Lung Sliding
Comet Tails

Rib
Parietal Pleura
Rib

Comet Tails (Artifact)

Visceral Pleura

Pneumothorax

B-Mode
Abnormal Lung: Pneumothorax

- Rib
- Parietal Pleura
- AIR
- Visceral Pleura

Air (Scatter)
Pneumo - No lung Sliding  
Normal

What to do?
Occult pneumothorax in the blunt trauma patient: Tube thoracostomy or observation?

Much Debate - positive and negative data in small studies

Watch all non-ventilated patients

Intubation = Chest Tube
US for Occult Pneumo

- Practice on Normals
- Look for Lung Sliding
- Supine CXR does not R/O a Pneumo
- Associated Injuries with ? need for further imaging

Sternal Fracture

- Mech - Hig energy, rapid decel with chest hitting steering column
- AP CXR = 50% sensitive
- CT Chest - much more sensitive, but no definitive studies
- Again - standard imaging Not Sens
Association

- High associations with intrathoracic injuries
- CT Chest, ECG, +/- cardiac biomarkers
- No data on ED US

Blunt Cardiac Injury

- No standard definition with unknown incidence
- Mechanism - Same as before
- Presentation - CP, SOB, Sinus tach, cardiac ectopy/dysrhythmia, hypotension

Mechanism

- Significant Chest Trauma
- Pain and Tenderness over the Mid-anterior Chest
- Sternal Fracture
- Mech (rollover, high speed, fatality at scene)
Data?

- Single ECG vs Serial ECGs?
- Troponins? - Biffl vs Rajan
- Biffl - Useless, and screening ECG best test
- Rajan - Elevated Trop at 6h correlated with increased risk for dysrhythmia and low EF
- No clear standard

What to do?

- Screen with ECG = pain or tenderness over anterior Chest, sternal fracture, history of cardiac disease (accident precipitated by cardiac dysfunction, major mechanism)
- ECG - persistent tachycardia, new bundle branch block or dysrhythmia
- Abnormality = ECHO (valvular, septum or ventricular wall injury) for low output

Treatment

- Persistent Tachycardia - Look for other signs of hemorrhage (chest, abdomen, etc.)
- High-grade Dysrhythmia - ECHO and ? treatment via ACLS
- My Case
Normal                  Low EF

Blunt Cardiac Injury

- Mechanism + pain = screening ECG
- 4-6 hour Trop?
- Bedside ECHO may be useful
- Remember to look for Non-cardiac causes

Function?
**Blunt Diaphragmatic Injuries**

- Incidence = low (1%) with increasing rates secondary to more sensitive CT
- Left (80%) > Right (20%)
- Right = 50% liver injury

**Mechanism**

- High Impact MVC
- Head on collision
- >30cm intrusion
- rapid deceleration >40mph

**Other Injuries**

- Spleen and Liver
- Clinical - epigastric/abdominal pain, referred shoulder pain, SOB, vomiting, dysphagia, etc
- Least Urgent injury in Multiple Trauma
Diagnosis

- CXR - 50% sensitive
- Specific = NGT or Viscera in Chest
- Nonspecific = atelectasis, pleural effusion, loss of contour, hemo/pneumo
- MDCT - increasing with coronal and sagittal recons (not 100% sensitive)
- Thoracoscopy/Laproscoy - TOC

Normal

Abnormal

Specific, Not Sensitive!
Associations

- Treat - NGT decompression
- Look for other associated injuries
- Very Difficult Diagnosis - Missed Often

Blunt Aortic Injury

- 80% die on scene
- Tear usually at the Isthmus (just distal to left subclavian artery)
- Can be very subtle in those that reach the ED
- Pseudocoarctation - Elevated BP in UE and lower BP in lower extremities

Mechanism

- Fall 10 feet
- MVC > 40 mph
- Any blunt trauma with rapid deceleration
- Crush Injuries
Presentation

• Chest Wall tenderness
• Other Skeletal Injuries
• Mechanism should be the trigger
• Associated Injuries Common

CXR

• Widened Mediastinum ↔
• Deviation of NG Tube
• Apical Capping
• Depressed Left Main Stem Bronchus
• Widened Paratracheal Stripe
• Loss of Aortic Knob Contour

Widened Mediastinum

• No exact Widths (no consensus)
• CXR (especially supine AP) cannot “rule out” the disease
• Mechanism and associated injuries should trigger further investigation
Imaging

- Newer generation MDCT = 100% sensitivity
- TEE - useful, but impractical
- TTE - not sensitive (no data)
- Maintain High Clinical Suspicion
- Associated Injuries

Treatment

- Prevent propagation of adventitial dissection by reducing wall stress
- Decrease HR = Esmolol
- Decreasing Blood Pressure = nitrous oxide or nitroglycerin
- *diltiazem if beta blocker contraindicated
- Goal = SBP 100mmHg

Review
Summary

• Look for occult Associated Injuries
• Use Ultrasound
• Neg CT does not rule out all disease

END