RADIOLOGY IN POLYTRAUMA

Dr T Venkat Kishan DMRD, DNB
Asst Prof of Radiology
KIMS Narketpally
Chest trauma

- Blunt
- Penetrating
Trauma Chest Radiograph

• Usually AP, often supine, frequently in poor inspiration.

• So, a challenge to interpret.
CT Chest
More sensitive and specific
THORACIC TRAUMA

- Parenchymal injuries
- Extraparenchymal injuries - ABC approach
Parenchymal injuries

- Pulmonary contusion
- Pulmonary laceration
- Traumatic herniation
- Lobar atelectasis
LUNG CONTUSIONS

• most common pulmonary injury

• focal or multifocal areas of consolidation.

• not limited by segmental boundaries
LUNG CONTUSIONS

- usually in the lung periphery

- frequently associated injuries such as rib or spine fractures.

- Air bronchograms are usually absent secondary to blood filling the small airways
CONTUSIONS ON XRAY

- May be absent on initial xray
- Evident within 6 hours after trauma
  - maximum radiographic conspicuity within 24 to 72 hours
- Gradually clear over 3 to 10 days
• pulmonary opacity appearing 24 hours or more after injury suggest diagnoses other than contusion, including aspiration, pneumonia, and fat embolism.
• Pulmonary opacities, which do not clear or increase radiographically over a timeframe of 3-10 days, raise the suspicion of secondary infection or ARDS
CONTUSION

• CT can detect contusion immediately
LACERATION

• Pulmonary laceration is a tear of the lung parenchyma.
• Due to recoil properties of adjacent lung, tear rapidly becomes an ovoid or round space
• When the laceration fills with blood, it is termed hematoma
• If it fills with air, it may be called a traumatic pneumatocele
• Frequently both blood and air accumulate
LACERATIONS
ATELECTASIS

• Lung collapse in the trauma patient can be separated broadly into obstructive, passive, compressive

• Atelectasis can usually be distinguished from contusion - the denser, homogenous appearance and simultaneous fissure deviation.
TRAUMATIC LUNG HERNIATION

- lung extrudes through a traumatic defect in the chest wall
LUNG HERNIATION
LUNG HERNIATION
EXTRAPARENCHYMAL INJURY

ABC approach

- **A:** Aortic injury
- **B:** Bronchial Fracture
- **C:** Cord injury
- **D:** Diaphragmatic Rupture
- **E:** Esophageal injury
- **F:** Fractures
- **G:** Gas (pneumothorax, pneumomediastinum)
- **H:** Heart (cardiac injury)
- **I:** Iatrogenic injury (misplaced tubes and catheters)
AORTIC INJURY

90% Aortic isthmus
4% Arch branches
AORTIC INJURY – ON CXR

- Mediastinum of abnormal size or contours

- wide mediastinum (8 cm) on supine portable chest radiograph is sensitive but not specific
However...

Abnormal mediastinum size and contour:

- Supine position
- Portable film
- Poor inspiration
- Tortuous aorta
- Fat
NORMAL MEDIASTINUM
ABNORMAL MEDIASTINUM CAUSED BY SUPINE POSITION, POOR INSPIRATION
ABNORMAL MEDIASTINUM DUE TO TAI
ABNORMAL MEDIASTINUM DUE TO TAI
ABNORMAL MEDIASTINUM DUE TO TAI
AORTIC INJURY ON CXR

• Right paratracheal density

• Normally right paratracheal space is lucent

• When the density of the right paratracheal space equals or is greater in density than the left paratracheal aortic arch, mediastinal hematoma should be a primary consideration
TAI – DENSE RT PARATRACHEAL
TAI ON CXR

• Apparent widening of descending thoracic aorta
TAI – WIDE DESC TH AORTA
TAI – APICAL PLEURAL CAP
AORTIC INJURY - CT SIGNS

• Abrupt change in aortic contour or diameter
• Pseudoaneurysm formation
• Intimal flap or filling defects
• Contrast extravasation
• Periaortic hematoma
TAI
TAI
• Aortography is the gold standard
Blunt Trauma Prediction Rule: Aortic Injury

Injury Prediction Rule

- Age > 50
- Unrestrained
- Hypotension
- Thoracic injury
- Abdominopelvic injury
- Extremity fracture
- Head injury

Calculate Probability  Reset

The Probability of Aortic Rupture: ...

References:


Hunink MG, Bos JJ. Triage of patients to angiography for detection of aortic rupture after blunt chest trauma: cost-effectiveness analysis of using CT. AJR 1995;
Blunt Trauma Prediction Rule: Aortic Injury

Injury Prediction Rule

- Age > 50 ✓
- Unrestrained ✓
- Hypotension
- Thoracic injury
- Abdominopelvic injury
- Extremity fracture
- Head injury

Calculate Probability  Reset

The Probability of Aortic Rupture: The probability of Aortic Rupture is 0.19% (0.04 - 0.54%). Chest CT most cost-effective for evaluation

Injury Prediction Rule

- Age > 50 ✓
- Unrestrained ✓
- Hypotension
- Thoracic injury
- Abdominopelvic injury
- Extremity fracture
- Head injury

Calculate Probability  Reset

The Probability of Aortic Rupture: The probability of Aortic Rupture is 0.5% (0 - 2.1%). Chest CT most cost-effective for evaluation of the aorta.

References:


Hunink MG, Bos JJ. Triage of patients to angiography for detection of aortic rupture after blunt chest trauma: cost-effectiveness analysis of using CT. AJR 1995;
Blunt Trauma Prediction Rule: Aortic Injury

References:

Hunink MG, Bos JJ. Triage of patients to angiography for detection of aortic rupture after blunt chest trauma: cost-effectiveness analysis of using CT. AJR 1995;
B – BRONCHIAL / TRACHEOBRONCHIAL

• 85% of the tracheal lesions occur within 2 cm of the carina.

• The bronchial lesions are more frequent than in the trachea, and principally in the right main bronchus at 2.5 cm or less from the carina.
BRONCHIAL INJURY ON CXR

• Persistent pneumothorax despite tube thoracostomy

• Severe pneumomediastinum

• Fallen lung sign
BRONCHIAL INJURY ON CXR

- **Fallen lung sign**: seen with complete transection of main bronchus

  Collapsed Lung falls into dependent position away from hilum
BRONCHIAL INJURY ON CT

- discontinuity of the tracheal or bronchial wall with air leaking around the airway
TRACHEAL INJURY

NORMAL ET TUBE CUFF

BULGED ET CUFF – TRACHEAL INJURY
Rule of 2’s

No more than 2 mm
Interspinous space
Interpedicular distance
Intrapedicular distance
CORD INJURY
CORD INJURY

MRI best for

• Epidural hematomas
• Subdural hematomas
• Cord contusion
• Cord transection
D – DIAPHRAGM INJURY

Radiographic signs

- Elevation of hemidiaphragm
- Herniation of viscera into thorax
- Abnormal position of NG tube

CT / MRI are diagnostic
DIAPHRAGM INJURY
E – ESOPHAGEAL INJURY

- Rare in blunt trauma
- Pneumomediastinum is the most common finding on xray
- Diagnosis confirmed by esophagogram
F - Fractures and Dislocations

• Spine
• Ribs
• Clavicles
• Scapula
• Sternum
• Shoulders
Spine Injuries

- Look for loss of alignment, fractures and paraspinal hematoma.

- The findings may be very subtle.
Rib Fractures

- In themselves, not too much of a problem,

- may be an indicator of underlying pleura, lung, liver, spleen, kidney injuries.
FLAIL CHEST

• defined as 5 or more adjacent rib fractures or more than 3 segmental rib fractures

Paradoxical motion can impair ventilation
SCAPULOTHORACIC DISSOCIATION

- Rare high energy injury
- Refers to complete separation of the scapula and the upper extremity from the thoracic attachments.
- Also referred to as a traumatic forequarter amputation with intact skin
SCAPULOTHORACIC DISSOCIATION

- lateral displacement of the scapula

- Assoc with a distracted clavicular fracture or laterally distracted sternoclavicular joint separation, acromioclavicular joint separation, or both
SCAPULOTHORACIC DISSOCIATION

• Chest Radiography
• lateral displacement of the scapula
  – Scapulothoracic ratio (abnormal:normal, ≥ 1.40 on a well-centered frontal exam) (i.e., thoracic spinous process-medial scapular border distance)
SCAPULOTHORACIC DISSOCIATION
SCAPULOTHORACIC DISSOCIATION
SCAPULOTHORACIC DISSOCIATION

• Associated with neurovascular injury

  Axillary or subclavian artery

  Brachial plexus injury
SCAPULOTHORACIC DISSOCIATION

• Early diagnosis followed by emergency angioembolization and surgery are often required to deal with the life-threatening vascular damage
LOCKED SCAPULA

• Refers to intrathoracic dislocation of inferior angle of scapula following trauma

• Usually occurs between 4 and 5 th ribs
G - GAS

- Pneumothorax
- Pneumomediastinum
- Pneumopericardium
PNEUMOTHORAX

• Diagnosis is straightforward if large and PA xray
PNEUMOTHORAX

• The lateral decubitus view is MORE sensitive to detect a pneumothorax as compared with the upright and supine view.
PNEUMOTHORAX

• In the setting of rib fractures and ipsilateral chest wall soft-tissue emphysema, a pneumothorax should be presumed present, even if it is not detected on the radiograph
<table>
<thead>
<tr>
<th>ERECT PROJECTION</th>
<th>SUPINE PROJECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram of Pneumothorax in Erect Projection" /></td>
<td><img src="image2" alt="Diagram of Pneumothorax in Supine Projection" /></td>
</tr>
</tbody>
</table>
PNEUMOTHORAX

- Etched diaphragm sign
PNEUMOTHORAX

Deep sulcus sign
PNEUMOTHORAX: Tension
PNEUMOTHORAX ON ULTRASOUND

• Lung point sign

• Sliding sign
PNEUMOTHORAX ON ULTRASOUND

Sliding sign

• Absence of lung sliding indicates pneumothorax
PNEUMOTHORAX ON ULTRASOUND

LUNG POINT SIGN

- fleeting appearance of a lung pattern (lung sliding or pathologic comet-tail artifacts) replacing a pneumothorax pattern (absent lung sliding plus exclusive horizontal lines) in a particular location of the chest wall
Collins CD Quantification of pneumothorax size on chest radiographs using interpleural distances AJR 1995: 165: 1127-1130
PNEUMOTHORAX

- CT most sensitive
Pneumothorax ex vacuo

- Rare complication of acute lobar collapse
- Increased negative intrapleural pressure draws air into pleura
Pneumothorax ex vacuo
Pneumothorax ex vacuo vs usual pneumothorax

• acute nature of the lobar collapse,

• pneumothorax limited to the space between the collapsed lobe and the chest wall

• pneumothorax does not surround the lobe or lobes that remain inflated
Pneumothorax ex vacuo

Treatment of pneumothorax ex vacuo

- Relieve obstruction
- Chest tube does not help
PNEUMOMEDIASTIUM

• Usually from ruptured alveoli.

• Can also be from trachea, bronchi, esophagus, bowel and neck injuries.

• A large pneumomediastinum - airway or esophageal laceration a strong consideration
PNEUMOMEDIASTINUM: Paratracheal lucencies
PNEUMOMEDIASTINUM: Continuous diaphragm sign
V SIGN OF NACLERIO

- Air outlining of the medial left hemidiaphragm and left lower lateral mediastinal area
### PNEUMOMEDIASTINUM VS PNEUMOTHORAX

<table>
<thead>
<tr>
<th>Feature</th>
<th>Characteristic</th>
<th>Pneumomediastinum</th>
<th>Pneumothorax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration of gas</td>
<td>Multiple thin, lucent streaks; can be</td>
<td></td>
<td>Apical lucency (upright); medial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>basal lucency (supine); deep-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sulcus sign (supine)</td>
</tr>
<tr>
<td>Distribution</td>
<td>Outlines mediastinal structures (pulmonary artery,</td>
<td></td>
<td>Never outlines mediastinal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>aorta, esophagus, and airway)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in distribution with</td>
<td>No</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>change in patient position?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SM Beivan  Pneumomediastinum : Old and new signs AJR 1996 ;166 : 1041-1048
# PNEUMOMEDIASTINUM VS PNEUMOPERICARDIUM

<table>
<thead>
<tr>
<th>Feature</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pneumomediastinum</td>
</tr>
<tr>
<td>Configuration of gas</td>
<td>Multiple thin, lucent streaks</td>
</tr>
<tr>
<td>Distributiona</td>
<td>Outlines mediastinal structures, including aortic arch, trachea, and bronchi; commonly extends into neck</td>
</tr>
<tr>
<td>Change in distribution with change in patient position?</td>
<td>No</td>
</tr>
<tr>
<td>Associated findings</td>
<td>See text</td>
</tr>
</tbody>
</table>

*aBoth pneumomediastinum and pneumopericardium can give rise to continuous diaphragm sign.*

- SM Bejvan  Pneumomediastinum : Old and new signs AJR 1996 ;166 : 1041-1048
PNEUMOMEDIASTINUM

• CT highly sensitive
PNEUMOPERICARDIUM
• H – HEART
• H- HEMOTHORAX
HEMOTHORAX

- Venous or arterial bleeding
- Can be tension
H -HEMOTHORAX

• Similar to pleural effusion on a xray
CT: HEMOTHORAX
H – HEART & PERICARDIUM

• Often lethal
• High degree of clinical suspicion
• Abnormal ECG
• Abnormal enzyme

• Contusion, laceration, rupture
HEART AND PERICARDIUM

- Pericardial effusion
- Pneumopericardium
- Abnormal cardiac size and contours
HEMOPERICARDIUM
CONCLUSIONS

• Xray are the primary radiological investigations

• Bedside ultrasound helpful in some situations

• CT is highly accurate and specific

• Familiarity with spectrum of injuries is important

• Focussed radiological approach can lead to better diagnosis
Acknowledgments

• Post graduates, technicians and Faculty of Dept of Radiology, KIMS, Narketpally

• Postgraduates and Faculty of Dept of Emergency Medicine, KIMS, Narketpally

THANK YOU