Chest Imaging in Emergency Room

Assoc. Prof. Juntima Euathrongchit, M.D
Department of Radiology
Faculty of Medicine
Chiang Mai University

10 February 2017: Lotus Pang SuanKeaw Hotel Chiangmai
ER – Emergency Room

http://www.med.cmu.ac.th/hospital/ermed/webpage/01.html
Objective:

• Review Imaging for emergency condition of the chest
  • Trauma (Surgery) VS Non-trauma (Medicine)
  • Important point

ER Patient

• การวินิจฉัยโรคและรักษา อาศัย ทั้งประวัติ ตรวจร่างกาย
• การส่งตรวจทาง lab, x-ray, EKG ฯลฯ
• ตัวแปรสำคัญ - TIME
Table I. Common clinical presentations and noncardiovascular diseases encountered in the emergency department that require radiological investigations.

(1) Chest pain
   • Pneumothorax
   • Pneumohemothorax
   • Spontaneous pneumomediastinum
   • Esophagitis

(2) Infection (fever, signs of sepsis)
   • Pneumonia
   • Lung abscess
   • Septic pulmonary infarcts
   • Aspiration pneumonitis

(3) Dyspnea
   • Tumor
   • Asthma and its complications
   • Acute interstitial pneumonitis
   • Acute exacerbation of interstitial lung disease
   • Inhalational injury
   • Acute exacerbation of chronic obstructive pulmonary disease

(4) Hypovolaemic shock
   • Bleeding vascular malformation

(5) Haemoptysis
   • Diffuse alveolar haemorrhage
   • Bronchiectasis
   • Tuberculosis
   • Lung cancer
   • Dieulafoy’s disease of the bronchus

(6) Haematemesis
   • Boerhaave syndrome
   • Oesophagitis

(7) Foreign body
   • Tracheoesophageal foreign bodies
## American College of Radiology  
### ACR Appropriateness Criteria®

**Clinical Condition:** Blunt Chest Trauma — Suspected Aortic Injury

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTA chest with IV contrast</td>
<td>9</td>
<td>This is the diagnostic test of choice for suspected blunt aortic injury.</td>
<td>☀️ ☀️ ☀️</td>
</tr>
<tr>
<td>X-ray chest</td>
<td>9</td>
<td>Radiographs are complementary to more definitive studies.</td>
<td>☀️</td>
</tr>
<tr>
<td>MRA chest without and with IV contrast</td>
<td>7</td>
<td>This procedure should be performed on patients with contraindication to CTA.</td>
<td>O</td>
</tr>
<tr>
<td>Aortography thoracic</td>
<td>6</td>
<td></td>
<td>☀️ ☀️ ☀️</td>
</tr>
<tr>
<td>CT chest without IV contrast</td>
<td>5</td>
<td></td>
<td>☀️ ☀️ ☀️</td>
</tr>
<tr>
<td>US echocardiography transesophageal</td>
<td>5</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>MRA chest without IV contrast</td>
<td>5</td>
<td></td>
<td>O</td>
</tr>
</tbody>
</table>

**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate  

*R Relative Radiation Level
ABC

- Airway
- Breathing
- Circulation
- Soft tissue
- Extremity
ABC: airway

- Trachea

- Direct / Indirect scope
- Chest X-ray
- CT scan
ET tube, tracheostomy tube
Central line, Intra-aortic balloon pump
Tube & Line

• ET Tube
  • Neck - neutral position, its tip 5–7 cm above the carina
  • +/- 2 cm in the caudal or cephalad directions with neck flexion and extension.

• Central venous lines
  • Inserted via major veins: subclavian, internal jugular, or femoral veins into the superior vena cava.
  • Tip ending distal to the last venous valve, junction of the internal jugular and the subclavian veins.
  • First anterior intercostal space = the junction of the brachiocephalic veins to form the superior vena cava
Intra-aortic balloon pump (IABP)

- a 25 cm long-balloon temporary circulatory assist device that works on the principle of cardiac counter-pulsation.
- increase in coronary blood flow and reduction in left ventricular afterload
- avoid occlusion of the left subclavian artery and visceral and renal arteries, its tip should be slightly cephalad to the adjacent carina (2nd–3rd intercostal space)
Complication

• Malposition: Rt main intubation, esophageal intubation

http://www.learningradiology.com/archives04/COW%20129-Atelectasis-ETT/atelectasiscorrect.htm

Complication – rupture airway

Pneumomediastinum
Breathing

Non Trauma
• Infection
  • Pneumonia,
  • Lung abscess
  • Septic emboli
  • Aspiration pneumonia
• Tumor
• Atelectasis
• Cardiogenic / non cardiogenic edema
• COPD
• Pneumothorax, pleural effusion

Trauma
• Lung injury
  • Contusion
  • Laceration
  • Hematoma
• Foreign body
• Atelectasis
• Non cardiogenic edema
• Pneumothorax, Pleural hemorrhage
White stuff
Non trauma infection: Pneumonia

*Bronchopneumonia

***Lobar pneumonia

** Interstitial pneumonia

**** Round pneumonia
Pneumonia

• การวินิจฉัยโรคอาศัย
  • ประวัติการเจ็บป่วย (History)
  • การตรวจร่างกาย (Physical exam)
  • การตรวจเสมหะ และการเพาะเชื้อ (Sputum exam and culture) รวมถึงการเพาะเชื้อจากกระแสโลหิต (Hemo-culture)

• บทบาทของภาพรังสีทรวงอก
  • Detection and exclusion of disease
  • Assess severity and Determine treatment
  • Assess response & Follow up
  • Narrowing of the differential diagnosis
Septic emboli

- Hematogenous spreading of organism
- Mainly peripheral, lower lobe
- Bilateral nodular opacities with varying stages of cavitation, size up to 3 cm
- Feeding vessels sign

Small pleural effusions may be seen → suggestive of complicating pleura empyema
Aspiration pneumonia

- Depend on material aspiration
- Pathological change: Bronchiolitis, Pneumonitis, Abscess, Edema, Interstitial fibrosis
- Location depend on pt position:  
  - Supine – posterior UL & superior LL
  - Upright – posterior basal
- CT finding: “tree-in-bud” poorly defined centrilobular opacities, dependent part of lung
Contusion
Laceration
Cyst (air) vs hematoma

Trauma: Pulmonary parenchyma injuries
Pulmonary contusion

- Direct force or contre-coup injury

- Asymptomatic → mild dyspnea & fever → respiratory failure
- 14 – 40 \% Mortality rate
Radiographically pulmonary contusion

- focal or multifocal areas of confluent ground glass opacity or consolidation.
- Non segmental boundaries
- Usually in the lung periphery adjacent to site of direct trauma.
- Frequently associated injuries such as rib or spine fractures.
- Pulmonary contusions generally affect the lung bases due to increased basilar mobility.
- Develop within 6 hours of the initial injury.
- Maximum radiographic conspicuity within 24 to 72 hours and gradually.
contusion
Pulmonary laceration

- A tear of lung parenchyma secondary to shearing stress
- Findings: **pulmonary hematoma; air bubble** and frequently obscured to adjacent parenchymal contusion
- CT scans clearly demonstrate lacerations as localized air collections within areas of contusion.
- Usually spontaneously resolve over 3 weeks to a year
Laceration: RML, air-fluid cyst with adjacent GGO (contusion)

Type I: lacerations result from compression injury producing an air-filled or air-fluid-filled cyst within contused lung parenchyma
Type II: lacerations demonstrate cysts within the paravertebral lung secondary to a lateral compression shear force when lung parenchyma presses against a vertebral body.
Atelectasis

- Increased opacity in atelectatic area
- Loss of normal volume:
  - Interlobar fissure shift
  - Mediastinal shift
  - Hilium shift
  - Diaphragm shift
  - Rib space narrowing
Atelectasis
CT findings:

• Atelectatic lung also demonstrates greater enhancement than consolidative lung,

• Secondary imaging signs of volume loss:
  • shift of mediastinal and hilum structures
  • bronchovascular crowding
  • diaphragmatic elevation
atelectasis
Cardiogenic vs non cardiogenic pulmonary edema
Cardiogenic vs non cardiogenic pulmonary edema

Heart failure, MI CRF, Fluid overload

NOT CARDIAC (near-drowning, oxygen therapy, transfusion or trauma, CNS disorder, ARDS, aspiration, or altitude sickness, renal disorder or resuscitation, drugs, inhaled toxins, allergic alveolitis, contrast or contusion)
Discriminating cardiogenic pulmonary edema (CPE) from acute respiratory distress syndrome (ARDS)

Radiographic Features That May Help to Differentiate Cardiogenic from Noncardiogenic Pulmonary Edema

<table>
<thead>
<tr>
<th>Radiographic Feature</th>
<th>Cardiogenic Edema</th>
<th>Non–cardiogenic Edema</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart size</td>
<td>Normal or greater than normal</td>
<td>Usually normal</td>
</tr>
<tr>
<td>Width of the vascular pedicle†</td>
<td>Normal or greater than normal</td>
<td>Usually normal or less than normal</td>
</tr>
<tr>
<td>Vascular distribution</td>
<td>Balanced or inverted</td>
<td>Normal or balanced</td>
</tr>
<tr>
<td>Distribution of edema</td>
<td>Even or central</td>
<td>Patchy or peripheral</td>
</tr>
<tr>
<td>Pleural effusions</td>
<td>Present</td>
<td>Not usually present (left)</td>
</tr>
<tr>
<td>Peribronchial cuffing</td>
<td>Present</td>
<td>Not usually present</td>
</tr>
<tr>
<td>Septal lines</td>
<td>Present</td>
<td>Not usually present</td>
</tr>
<tr>
<td>Air bronchograms</td>
<td>Not usually present</td>
<td>Usually present</td>
</tr>
</tbody>
</table>

Pneumothorax

White margin of visceral pleura

*Absence of vascular markings beyond visceral pleura
Tension Pneumothorax
Rt. Hydropneumothorax
Pneumothorax, ICD
Subcutaneous emphysema
Subcutaneous emphysema (air)

- Air leakage into the subcutaneous layer
- Rupture airway
- Pneumothorax
- Pneumomediastinum
- Chest tube drainage improper position
- Retroperitoneal emphysema

http://cephalicvein.com/2016/07/chest-anatomy/
Airway disease

- Emphysema
  - Hyperaeration
  - Flattening of diaphragm
Opacity of the hemithorax
Pleural effusion: feature

Free-flowing | Subpulmonic | Laminar | Loculated Fissural (pseudotumor)
CT pleural effusion

Free-flowing | Subpulmonic | Laminar | Loculated Fissural (pseudotumor)
Circulation

• Shock, cardiovascular collapse
• Evaluation lines
26-yr man, accident.

- Dense contrast opacified azygos v, SVC, great cardiac v, hemiazygos v, right lumbar v, back venues, Rt atrium, Rt hepatic v, Rt kidney, splenic v, SMV,
- No CM in aorta, left heart.

Indian J Radiol Imaging, 2010; 20:150-3
Aortic injury

- High death rate – transection of aorta 99% death in 24 hrs (Costantino M.)
- Chest film: Widening mediastinum > 8 cm (Mediastinal hematoma)
Other disease: Mediastinal and diaphragmatic diseases

Non trauma
- Esophagus
  - Boerhave syndrome
  - Esophagitis
- Mediastinal mass

Trauma
- Esophageal rupture
- Mediastinal hemorrhage

Diaphragm: Rupture

Bone: Thoracic cage → Fracture
Esophageal disease (Injury)

- Early diagnosis: High morbidity and mortality
- Symptoms & signs: depend on depth of esophageal wall involvement
  - Retrosternal chest pain
  - Dysphagia & Odynophagia
  - Pleuritic chest pain
  - Dyspnea
Radiologic Findings

• All findings: depend on depth of penetration
• Difficult to demonstrate superficial penetration
• Direct finding: identify laceration, leakage of contrast
• Indirect findings:
  • Pneumomediastinum, pneumothorax
  • Pleural effusion
  • Malposition of surgical appliance
  • Foreign body in or near the course of esophagus
Identify laceration
Indirect evidence: Pneumomediastinum vs pneumothorax
Indirect evidence: Pleural effusion

- Superior two-third EI results the right pleural effusion
- Inferior one-third EI results the left pleural effusion
CT chest & abdomen: provide more informations

Direct - laceration

Indirect: mediastinal abscess

Indirect: pneumomediastinum, subcu - emphysema

Indirect: Pleural effusion, pneumothorax
CT chest & abdomen: provide more informations

Indication

- in a negative esophagram with a high clinical suspicion and critical ill patient,
- unable to performed esophagogram
- Atypical symptom at presentation
Foreign body
Chemical erosion:

- 60 yr female – Battery $\text{H}_2\text{SO}_4$ 7 hr PTA
- Oral mucosa burn gr I
- Chest Xray – neg $\rightarrow$ CT within 24 hr
Investigation

- Esophagogram – Ba: 3wk after onset (30 – 60% FN in assess early phase)

6 wk after injury
Diaphragmatic injury
Diaphragmatic rupture

• Incident ~4.5% (range 0.8-8%) of blunt abdominal or lower thoracic trauma – Motor vehicle collision
• MC organs herniation: stomach or colon
• Left >> right injury
• Common with abdominal organ trauma
Plain radiograph - diaphragm rupture

- Loss of diaphragm shadow / abnormal contour
- Intrathoracic visceral organ
- Collar sign: diaphragmatic injury site
CT

- Laceration point / Coronal vs sagittal views
- Collar sign, hourglass sign
- Dependent viscera sign
- Focal diaphragmatic thickening
- Hemothorax / hemoperitoneum
Chest wall injury

• Bone fracture
  • Rib fracture – common injury in blunt chest trauma, 50%
  • Be careful – multiple rib Fx = high energy trauma
  • First three ribs → brachial plexus or subclavian vessels injury
  • Last four ribs → intraabdominal injury
Bone Fx

• Scapular Fx – Severe

• Flail chest:
  • High motality
  • ≥ 2 Fx sites each rib and ≥ 3 ribs contiguous ribs
  • Paradoxical motion - respiration
CT - MPR
Take Home Massage

• Chest film – common use
• Systemic approach
• Positioning limitation – supine
• Common disease – increased density and decreased density
• Disease - Thinking about it

Q&A
Thank you for your attention